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African Industry & Climate Change

Project Proceedings

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Each country case study contains; a brief introduction on the country, climate change activities (bilateral, multilateral, and national), national communications, sustainable development/SD indicators, constraints (general and sector-specific), stakeholders (in-place and targeted), industrial sectors, and conclusions/recommendations.

Foreword

Director-General Mr. Carlos Magariños

Over the last two years, UNIDO has worked to enable industry in developing and transition economy countries to benefit from activities undertaken under the United Nations Framework Convention on Climate Change (UNFCCC) and its emerging Kyoto Protocol.

In 1999, UNIDO commissioned experts in six African countries and a leading energy research institute in the Netherlands to examine key issues within the Convention and the Clean Development Mechanism (CDM) as they impact upon industry. The result is this publication, prepared as a contribution to the 6th Conference of the Parties to the Climate Convention (COP6) to be held in The Hague, Netherlands.

The following chapters present:

- An overview of the technical issues that need to be examined in UNIDO's client countries when considering the transfer of technology and capacity building under the Convention with a focus on potential industrial CDM activities;
- A review of the legal implications of International Environmental Agreements (IEAs) in the context of African countries; and
- Six national case studies on industry and climate change (Ghana, Kenya, Nigeria, Senegal, Zambia and Zimbabwe).

This is a very timely publication. UNIDO member states recognize the role that the Organization can play in supporting the objectives of the Convention and its Protocol, especially those related to building capacity of industry and its support infrastructure to 'enable' the transfer of more climate-friendly and energy efficient industrial technologies. In support of the inter-governmental process, UNIDO will continue to engage business and industry in our client countries and, together with their policy makers and support institutions, foster national dialogue on means of reducing the volume of industrial greenhouse gas emissions while ensuring sustainable development of their industry.

Preface

Introduction

In October 1998, UNIDO hosted the *'Expert Group Meeting on the Clean Development Mechanism (CDM) and Sustainable Industrial Development: New Partnerships for Industry in Developing Countries'.*

The meeting, *inter alia*, concluded that *"Africa will need to build its institutional and infrastructure capacity in order to take full advantage of the opportunities under the CDM ... to attract a meaningful amount of additional investment resources..."* and requested that UNIDO *"... step up assistance to Africa in order to create the necessary conditions to attract an in-flow of investment, including CDM investment"*.

In 1999, the Organization commissioned experts from six African countries (Ghana, Kenya, Nigeria, Senegal, Zambia and Zimbabwe) and from the Netherlands to examine the implications of the Climate Convention and the CDM for industry in general as well as in the context of the six countries.

The experts completed their studies during a period of intense international debate on the Climate Convention issues of capacity building, transfer of technology and the mechanisms of the Kyoto Protocol. The national experts held discussions with all relevant stakeholder groups, including industry managers in two sub-sectors, to obtain their views on the issues.

Capacity Needs and Barriers

The results of the experts' deliberations, contained in this volume, examine both the needs to 'enable' successful industrial projects under the CDM as well as some of the barriers that currently hinder successful projects. The following groups some of the key capacity needs to support the implementation of industrial CDM projects:

- Pre-project issues
  - identification and removal of barriers to technology transfer and absorption
  - identification of national sustainable (industrial) development objectives and appropriate criteria
  - identification of technology and technology information needs
  - access to and utilization of appropriate sources of information
  - preparation of sectoral & national baselines
  - support to the processes of FDI (e.g. matchmaking services, investment events);
- Project issues
  - formulation and development of CDM projects
  - application of baselines and determination of additionality for CDM project
  - assessment of technologies to determine their appropriateness

- negotiation with project/technology sponsors;

- Post project launch issues

  - management of the process of technology transfer
  - management of the projects (technical and economic aspects)
  - management and absorption of the technologies once transferred under the CDM
  - monitoring the projects and
  - certifying emissions' reductions from the projects.

The country case studies identified three main areas of common concern: barriers; sustainable development; and vulnerability of African industry to the impacts of climate change.

Barriers

Each of the six national experts made considerable progress in identifying existing barriers to CDM implementation in their respective countries and in proposing solutions. The barriers identified generally fall into two categories: general and sector-specific. These two barrier categories can be found at country and at regional levels. Particular barriers that feature heavily in the case studies are:

- General Barriers

  - Lack of awareness in industry concerning climate change issues and the potential benefits of the CDM;
  - Poor access to the necessary skilled personnel needed for auditing, implementing and managing potential CDM activities. While there is an existing core of professionals in these African countries, they are often inaccessible to companies for a number of reasons (e.g. location and communication problems);
  - Inadequate access of companies to financial assistance. Many of the countries featured in this report are heavily indebted and therefore potential national investors face a number of problems such as high discount rates, lack of foreign currency and general difficulty in obtaining loans;
  - A number of institutional barriers have also been identified including lack of policies to promote the up-take of clean production technologies, energy subsidies on high-carbon fuels, fiscal policies that do not promote FDI and sustainable industrial development and a lack of integrated resource/energy policies;

- Sector-Specific Barriers

  - The industrial sectors that feature in the country case studies are cement, aluminium, iron and steel, pulp & paper, mining, electricity generation, electric motors, brick making and food processing. Of these industries, the ones with the most regional relevance are arguably cement and food processing.

- The main barrier stated by the companies interviewed, given the limited funds available for a large number of competing needs, was the high capital expenditure needed for implementing energy efficiency measures
- Access to 'state of the art' production equipment is also identified as a barrier to implementing cleaner production methods. The CDM is expected to assist with this problem
- Another barrier identified is the limited assess to natural gas, which could be used in fuel substitution projects. Even in gas producing/rich countries, much is wasted (by flaring etc.) because the distribution networks are not yet sufficient.

Sustainable Development (SD)

Article 12 of the Kyoto Protocol states that CDM projects must contribute to sustainable development in the host country.

While there is currently no operational or 'objective' method to determine whether and to what degree a project contributes to a country's development in a sustainable manner, most seem to agree that the criteria should be decided by the host country according to their development needs and objectives. This point is reiterated in each of the country case studies, with the clear statement that the CDM must primarily facilitate national sustainable development goals.

The SD issues identified in the country case studies are on the whole very similar and generally fall into three general categories:

- Poverty reduction through employment generation;
- Improved economic development;
- Sustainable resource utilisation and environmental protection to safeguard the future resource base and human health and safety.

These categories are clearly interconnected and fall into UNIDO's core development objectives of competitive Economy, productive Employment and sound Environment (the 3 E's) placing the Organization, with it's knowledge and experience, in a good position to facilitate the implementation of industrial CDM projects as well as to contribute to Sustainable Industrial Development (SID).

Vulnerability of African Industry to Climate Change Impacts

An issue raised in a number of the case studies is the vulnerability of African industry to the impacts of climate change. Risks range from decreased industrial output in some countries (less hydro-generation capacity due to increasing drought severity and frequency) to reduced agricultural production. The latter affects the production of raw material for the food processing industries, reduces the potential for biomass utilization as fuel and threatens the health of the population and employment opportunities of the labour force.

Programme Framework

The experts subsequently developed a programme framework to address the central issue of barrier identification and removal to assist in preparing national 'enabling environments' for industrial projects. This framework will be piloted in the Africa region as a continuation of the previous activities and will include:

- Mobilizing the stakeholders and fostering public-private sector dialogue;
- Training of national experts from government, industry, financial and technology support services;
- 'Learning-by-doing' industrial CDM projects covering the whole project cycle;
- Information dissemination and networking of partners to industrial development.

Based upon the results of the Africa studies, UNIDO has prepared a regionally focused industrial climate change capacity building programme for client countries in each geographical region. An ASEAN sub-regional project is ready to start; a Central America project is under preparation; and a project for transition economy countries will be prepared next year.

Acknowledgements

This publication would not have been possible without the hard work of the experts who produced their papers within a tight project schedule. Thanks are also due to James New for reviewing the text and the format of all papers to ready the publication for printing.

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Kyoto Protocol Branch

Chapter One

Industry And The Clean Development Mechanism

Capacity Building Options To Enable Industrial Technology Transfer To Africa

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1.0 INTRODUCTION

1.1 Clean Development Mechanism (CDM)

Foreign investment, by the public and private sector, is generally expected to be the driving force behind projects under the Clean Development Mechanism (CDM) of the Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC).

The Clean Development Mechanism (CDM) is defined and elaborated in Article 12 of the Kyoto Protocol as a mechanism between Annex I and Non-Annex I parties. With this mechanism Annex I countries (practically speaking the industrialised and Eastern European economies) are able to use emission reductions from project activities in Non-Annex I countries (practically speaking the developing countries) for their own compliance with their greenhouse gas reduction targets. On the other hand, the projects must help developing countries in achieving sustainable development, providing material, equipment and technology. What the institutional structure of CDM will look like has yet to be decided. Article 12 defines how emission reduction activities can take place under CDM, but is unclear about its facilitating role. Will it be a verification and registration facility or will it merely supervise CDM as a whole?

CDM projects are to be validated by both Annex I countries and the host countries. The reductions achieved must be additional to those that would have happened anyway. The obtained emission reductions will be certified and are termed *certified emission reduction units* (CERUs). Private and public funds shall be channelled through the CDM to finance projects in developing countries. An 'Executive Board' and 'Operational Entities' will be established to administer the CDM and supervise the process. The emission reduction achieved from 2000 until 2008 can be banked and credited towards industrialised countries' obligations in the first budget period. Part of the proceeds from the project activities will be used to cover administrative expenses of the CDM, while an adaptation fee will be added to assist developing countries in meeting the costs of adaptation to a changing climate.

According to Article 12.5 of the Protocol, the role of the 'Operational Entities' would be to certify the level of emission reduction (CERUs). Additionally, they should levy administration and adaptation costs. The number of such 'entities' may be limited in order for the Executive Board to be able to effectively supervise them. Private consultancy firms or regional development banks might qualify for such a role.

The responsibility for CDM validation lies with a national CDM authority or a designated (public or private) agency of the host country and the investor country. With the possible support of 'validation consultants' from the investing or the host country the CDM project developer would submit a 'validation assessment' to such a 'Validation Agency'.

At the end of the project, the project owner/operator should draft a monitoring report to be submitted for auditing and verification by CDM authorities and potential buyers. This is similar to the accounting books of a firm that are open for inspection by a public accountant or a potential corporate buyer or to a product open to inspection and testing prior to payment by a client. The actual verification process can be undertaken by independent ERU 'Verification Agents' that are certified by the national CDM authority, in accordance with the guidelines provided by the CDM Executive Board.

1.2 The Need for National Support Systems for CDM Projects

Many countries in Africa do not have the infrastructure and institutional practices needed to encourage and support foreign investment or sufficient capacity to deal with the economic, technical and environmental issues that must be addressed in order to effectively participate in CDM projects. This will require urgent attention to a range of capacity building measures that will identify and eventually remove barriers to the transfer of climate-relevant, environmentally sustainable, technologies. The international community is already providing assistance to African countries that are signatories to the UNFCCC. Most of this assistance has been related to awareness raising (workshops), development of tools and methodologies (to determine emissions and sinks) and information provisions (preparation of the first National Communications[1]). However, such preliminary assistance has been directed to the National Focal Points of the Convention and has not included support to the industrial companies or services. Clearly, industry and other stakeholders need to become involved in order to be in a position to benefit from technology transfer that will occur through CDM projects.

These countries need national support systems that will encourage the inflow of industrial CDM projects. This will require the creation of an 'enabling environment', i.e., a system of national support of capacity building activities and policy measures, aimed at the removal of barriers to technology transfer and the enhancement of capacity to manage a range of methodological, technical, economic, financial and legal processes that will surround these projects.

2.0 CAPACITY BUILDING AND TECHNOLOGY TRANSFER, A CONCEPTUAL FRAMEWORK

2.1 Introduction

Climate-relevant technologies are a specific category of 'environmentally sound technologies'. 'Technology transfer' is a process, which results in the acquisition, introduction and operation of such technologies available in one country, to other countries and to facilitate the receiving country's development. Transfer of technology involves various steps:

- Awareness creation, i.e., to inform stakeholders on the need for climate relevant technologies;
- Obtaining information and assessment of options, i.e., obtaining information on the cost and performance of technologies and to assess their technological, environmental, economic, financial and social impacts;
- Development of the capacity for effective transfer, implementation and dissemination of the technology; and
- Optimising the structures and processes that are related to the implementation and operation of the technology.

An attempt to group the various actors involved in technology transfer through CDM projects is presented in Figure 1. Implementation of CDM projects by industry results in the acquisition, introduction and operation of 'hard' and 'soft' technologies conducive to the mitigation of

[1] Zimbabwe and Senegal have prepared their National Communications that can be downloaded from UNFCCC Secretariat's web page.

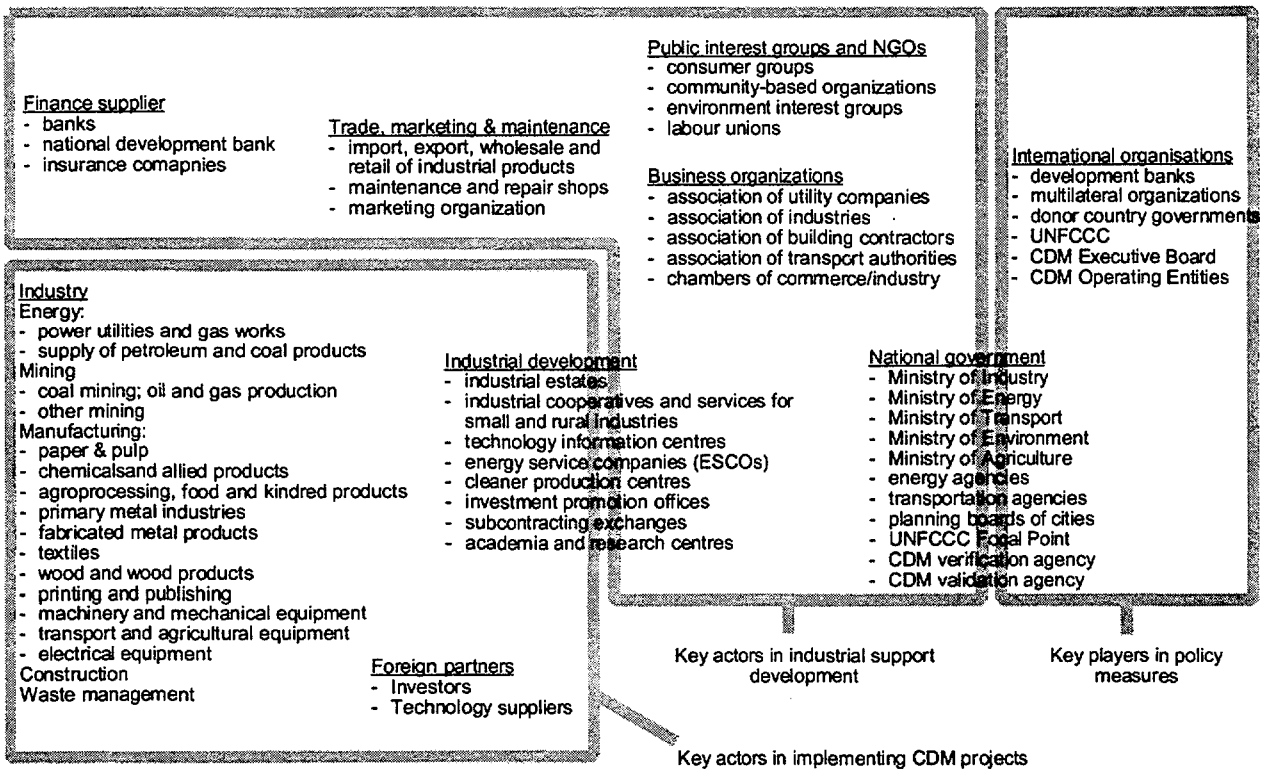
industrial emissions of gases. Here the creation of an 'enabling environment' is paramount to the successful transfer of climate-relevant technologies, i.e., a system of national support of capacity building activities and policy measures:

- *Capacity building activities*, undertaken to create the technological, institutional and managerial capacities in industry, industrial support services and the government to create an 'enabling environment' for CDM projects;
- *Policy measures,* taken by the national or local government and governmental agencies to prepare, implement and enforce regulations (e.g., product standards, environmental legislation or financial incentives) conducive to dissemination of climate-relevant technologies and behavioural change;

The boundaries of Figure 1 between groups of actors are not sharp, actors may take various actions at various levels. The government, for example, takes policy measures (e.g., tax incentives) but can also implement a CDM project (e.g., a pilot project on cleaner fuels in public transportation) or provide extension services to small industries (e.g., industrial estates).

Capacity building and technology transfer projects (such as CDM) are most likely to be successful if these are based on a solid assessment of the needs of the host country and if this needs assessment is endorsed by the most important actors (stakeholders).

Figure 1: Participation of different actors in industrial CDM Projects



Several of such 'national needs assessments' have been carried out in various sectors. The evaluation of such studies has been used by IVAM Environmental Research, based in Amsterdam, The Netherlands to develop a framework for the application of needs assessment

for the preparation of climate-relevant capacity building actions and technology transfer projects[2] This methodology has been modified and adapted to technology transfer through CDM projects with industries (in Africa).

For most developing countries, climate change is not a priority, so the effective transfer of climate-relevant technologies may require the implementation of measures that are primarily designed to achieve other development goals. This involves a series of relevant ministries, agencies, local government, non-governmental organisations, the private sector and the public, as mentioned in Figure 1, in the planning process. Their active involvement will be necessary to secure the support and resources needed for CDM projects. The various stakeholders have to be engaged into a participatory capacity building process for CDM technology transfer.

The planning and implementation of CDM initiatives is a continuous, iterative process, based on four components (see Figure 2):

1. *Mobilisation of Stakeholder's participation,*

   Gathering information on the basis of initial surveys of the present situation (sources of emissions, carbon sinks), projections of trends and developments and the perception of main actors (stakeholders) regarding climate change issues, and on the basis of identification of the stakeholders and creating favourable conditions amongst those through communications and awareness creation.

2. *Identifying and prioritising CDM mitigation options*

   Carrying out a needs and opportunities assessment through data analysis and consultation with the stakeholders, resulting in a portfolio of prioritised mitigation options, including CDM technologies and project opportunities, capacity building activities and policy measures.

3. *Creation of a national support system*

   This consists of the prioritised CDM capacity building activities and prioritised policy measures, organised in 'programmes'.

4. *Implementation of CDM projects*

   Starting with the implementation of CDM projects. Review and evaluation of the results of the projects and the support programme and dissemination thereof in a national dialogue with the stakeholders in order sustain the continuous process of assessing needs and implementing options.

Figure 2 shows the inter-relatedness between the four components in the above-sketched participatory approach to technology transfer through CDM projects. The desired outcome of the whole process is the improved utilisation of climate-relevant technologies and the creation and strengthening of climate-change-related capacities and policies.

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[2] *A Primer on Climate Relevant Technology Transfer,* by René van Berkel, IVAM Environmental Research (1997, Amsterdam)

The Framework Convention calls on Parties to prepare a National Communication on the Parties' national policy regarding climate change. Such Communications contain typically:

- A national inventory of anthropogenic emissions by sources and removals by sinks;
- A description of steps taken to implement the Convention;
- A detailed description of the policies and measures taken for mitigation of greenhouse gases and adaptation to climate change
- A specific estimate of the effects of these policies and measures on emissions.

Annex-I Parties are obliged to draft such National Communications to prove that their policies adopted are sufficient to meet the emission reduction targets set in the Convention. Non-Annex-1 Parties are not obliged, but encouraged to draft National Communications. To meet the information requirements under the Convention, various 'enabling studies' may be undertaken (see Figure 2):

- *Emission inventory,* an estimate of the anthropogenic emissions by sources and removals by sinks of all greenhouse gases, using a comparable methodology as agreed upon by the Conference of Parties (CoP)[3];
- *Mitigation assessment,* an inventory of available strategies and measures to reduce emissions by sources and increase removal by sinks of all greenhouse gases and a quantification of the effects of these measures.
- *Vulnerability and adaptation assessment,* an estimate of the physical and economic impacts of predicted changes in the climate system and an inventory and socio-economic evaluation of the available measures and strategies to adapt to these impacts (not shown in Figure 2, as this paper only deals with mitigation options).

These studies can be integrated into a 'national action plan', a portfolio of mitigation and adaptation measures accepted for implementation under the Convention. The preparation and implementation of CDM initiatives coincides with the development of policies and strategies as laid down in the 'enabling studies' in an interactive way. CDM initiatives should be included in the assessment studies and the action plan, while these studies will support the planning of CDM projects.

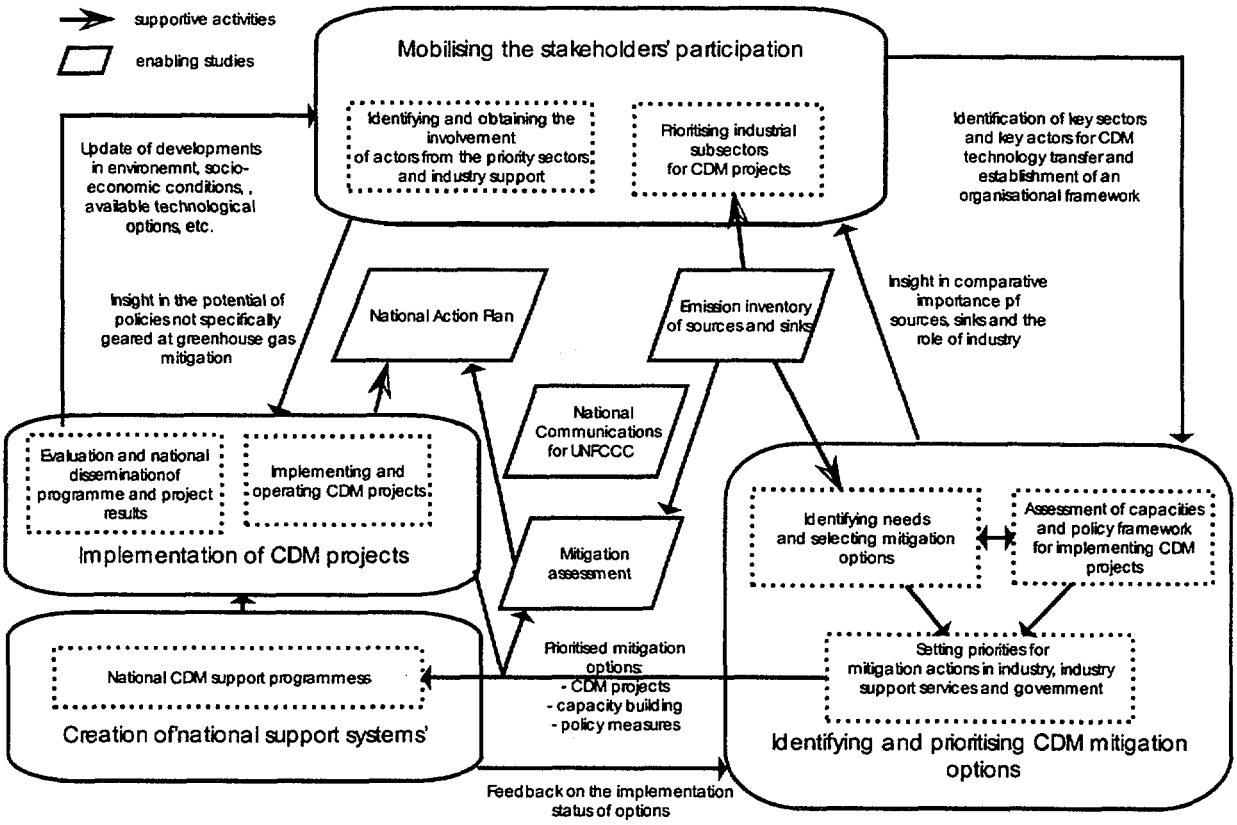
2.2 Mobilising the Stakeholders' Participation

The key tasks in creating an enabling for the active participation of the actors (stakeholders) involved are:

- Selection of priority areas within industry for climate relevant technology transfer through CDM projects, by means of assessment of the present and future levels of greenhouse gas emissions, of the energy use and supply, and of the status of technology use in the industrial sub-sectors.
- Identification and obtaining the involvement of the stakeholders in industry, industrial support services and the government.

[3] *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories,* IPCC/OECD/IEA (1996). See IPCC website.

Figure 2: Framework for the participatory approsch to capacity building for technology transfer through CDM projects



Adapted from "A Primer on Climate Change Relevant Technology Transfer", Rv. Berkel, IVAM (1997, Netherlands)

The outputs of these two tasks are:

- Improved insight in the priority of sub-sectors for mitigation options and potential benefits and in the capacity network for implementing such options;
- Enhanced dialogue with the main actors in an operational structure on the need for mitigation options.

Most often, the energy, transportation and industry sectors are recognised as the most important sectors for technology transfer. However, in African countries, with a comparatively low level of industrialisation, the contribution of 'land-use' related emissions, involving agriculture, forestry and fuel wood collecting will be relatively important. In this context, implementing measures such as dissemination of efficient wood and charcoal stoves can be regarded as an effective mitigation option, in which 'industry' is involved as the producer of such stoves. Such analysis has the emphasis in the first task, starting with a review of climate change country studies, national economic and fiscal policies, infrastructure plans, demographic surveys, forestry programmes, industrial (sub-sectoral) development plans, waste management strategies and agricultural plans.

This goes alongside the next task, the identification of stakeholders in the prioritised sub-sectors, creating awareness and building alliances with these stakeholders. Actors are not necessarily formal institutions, but can be found in the 'informal' sector as well. An overview of

possible stakeholders in industry and the industrial support system is given in Figure 1. Apart from just knowing 'who is who', it is important to get an overview of:

- The perception of each organisation regarding climate change issues, its involvement in capacity building actions and past experiences with technology transfer projects.
- The structure and functioning of the whole network of stakeholders, i.e., an analysis of the relationships amongst these groups, an indication of their comparative importance, the regulatory and legislative framework, a quick analysis of natural, human and financial resources available in a sub-sector, a sense of how strategic functions are carried out (decision making, co-ordination, networking), and a sense of the organisational structure within sub-sectors.
- Realistic funding possibilities for CDM initiatives available in national and international, public and private sectors.

A certain degree of general awareness regarding climate change is conditional for CDM projects to take place. In Africa, knowledge on the need for greenhouse gas mitigation is probably limited to a small group of individuals in the national government (e.g., the UNFCCC Focal Point), in research institutes and in environmental NGOs. It will be necessary for these organisations to create general awareness amongst the general public, industrial entrepreneurs, agencies, industrial support services, local communities, etc. Although tailor-made to the interests and knowledge of each interest group the following general sequence could be adopted:

- Attract attention by explaining the threat posed by climate change impacts (e.g., droughts);

- Suggest solutions by explaining how mitigation options have other benefits, such as cost reduction, increased fuel independence, reduced contamination, job creation and improved trade balance;

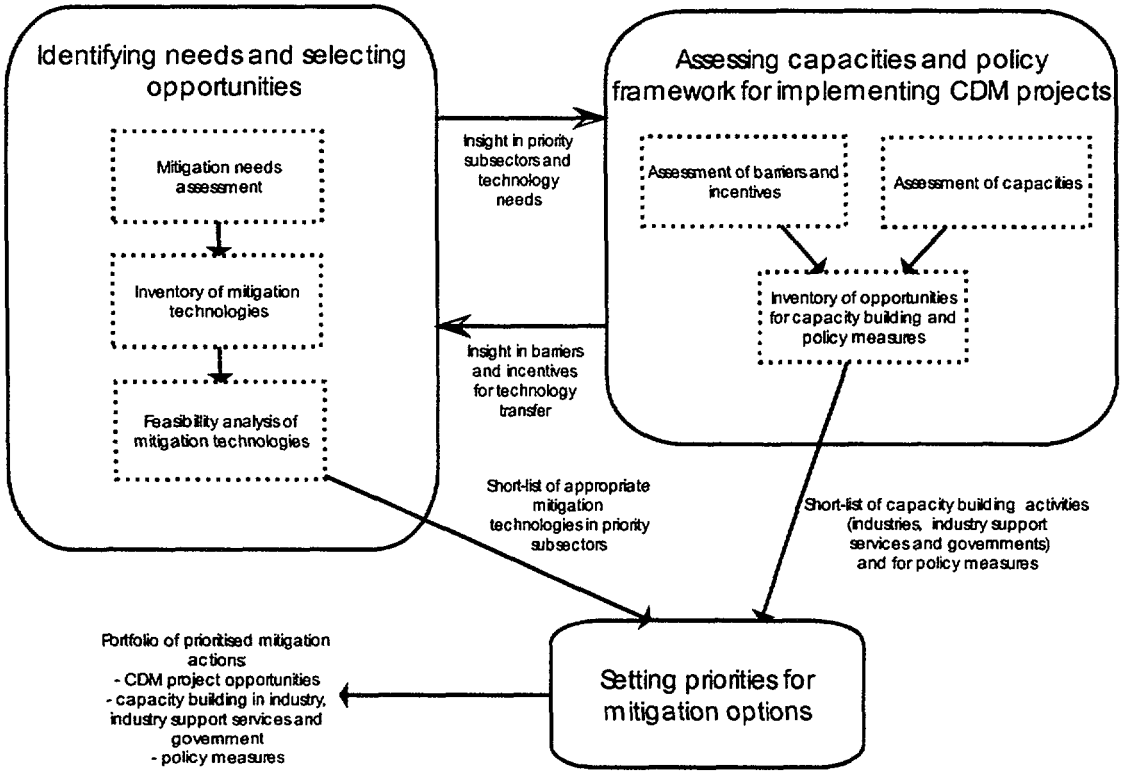
- Provide a framework for continuing dialogue with the main sub-sectors and their stakeholders, e.g., by means of workshops, seminars, steering committees, roundtables or taskforces.

2.3 Identifying and Prioritising CDM Mitigation Actions

Figure 3 gives a summary of the key tasks for assessing the needs and opportunities for CDM projects are:

- *Identifying needs and selecting opportunities for technologies in prioritised industrial sub-sectors,* i.e. an inventory of technological needs and a comparative evaluation of those options on economic, financial, technological, social and environmental impacts.
- *Assessing the capacities and policy framework for the implementation of such technologies,* i.e., an assessment of the barriers and incentives regarding the implementation of climate-relevant technologies and the formulation of opportunities for capacity building and policy formulation to overcome these barriers.
- *Setting priorities for options,* a comparative evaluation of appropriate climate relevant technologies and short-list of mitigation *options,* regarding potential CDM technology transfer projects and opportunities regarding capacity building and policy measures.

Figure 3: Identifying and Prioritising CDM mitigation actions



These, inter-related, tasks are in principle the consecutive stages of a traditional project or programme planning cycle. The output of the three tasks is consolidated portfolio of prioritised mitigation actions; including CDM project opportunities, capacity-building opportunities and policy measures. The first task merges the analysis of mitigation needs in the prioritised sectors with the selection of those technologies most relevant and consists of the following steps:

- *Mitigation needs assessment,* an analysis of mitigation needs in terms of CO_2 reduction and cost-effectiveness, but also regarding their contribution to technological and socio-economic development objectives;
- *Inventory of mitigation technologies,* an identification of climate-relevant technological options to address the identified needs in the prioritised sectors (see Annex 1 for an overview);
- *Feasibility analysis of mitigation technologies,* preliminary evaluation of the available options on technological relevance[4], economic feasibility, environmental impacts and socio-economic consequences.

In order to facilitate the effective transfer of the prioritised mitigation technologies, it is necessary to assess the national capacities for the uptake of new technologies on the basis of which capacity building activities and policy measures can be developed. This second task consists of the following steps:

- *Assessment of barriers and incentives,* for implementation of climate-relevant technologies, from the point-of-view of technology users (and suppliers);
- *Assessment of capacities,* i.e., an evaluation of the current functioning of the capacities needed for the acquisition, adaptation and implementation of new technologies;

[4] Complexity of the technology, ease of operation and maintenance, spare parts supply, potential for local assembly and use of local resources and cost of the technology.

- *Inventory of opportunities for capacity building and policy measures,* resulting in a priority list of opportunities for capacity building and policy options.

Barriers to implementation and transfer of energy-efficient practices and clean technologies can be found in the literature. An overview of barriers regarding the implementation of these technologies in industry is given in the Annexes 2 and 3. It depends on the type of technology and end user, which barriers are of importance.

Many technology transfer projects have failed, because the capacity for implementing the technology was lacking. A capacity assessment, with the participation or active consultation of the stakeholders, is important therefore and should concentrate on:

- The technology capacity of the industries, i.e., their ability to adapt, test, manufacture, implement, operate and/or evaluate new technologies;
- The capacity of the industry support services, to provide consultancy, financial and training services to relevant target groups and the ability to network and co-operate among different stakeholders;
- The capacity of the government and dependent bodies to prepare and implement policies and to enforce those.

Combining the results of the barriers analysis and the capacities assessment allows the formulation of opportunities for capacity building and policy measures. Formulating those should actively involve the stakeholders. While doing so, the possible partner organisations for capacity building should be indicated.

The task aims to prioritise mitigation 'options', that can be CDM technology transfer opportunities, capacity building activities and policy measures. A practical solution would be to invite stakeholders to submit specific project outlines both for technology transfer and capacity building. This has the advantage that it raises the stakeholders' interest and commitment. Once such a list of project concepts has been compiled, a comparative evaluation will result in a portfolio of prioritised CDM mitigation options. Criteria for such an evaluation are:

- *Mitigation potential,* the contribution to greenhouse gas emission reduction, in terms of the amount of carbon reduced and cost per tonne of CO_2 saved;
- *Sustainable development potential,* i.e., to what extent does the project contribute to socio-economic and environmental development objectives;
- *Commitment of the actors involved,* to what extent are parties' that benefit from implementing the project willing to co-finance projects and what will they earn from the project.

2.4 Creation of a National Support System for CDM

2.41 National Support System for Projects

CDM projects may only take off in the right 'enabling environment', provided by a 'national support system. This starts with organising capacity building activities and policy measures in technology or sub-sectoral programmes that support and promote the successful implementation of individual projects. Such programmes are to be designed to address the major barrier groups (information, financial, regulatory, institutional and technological) in an integrated way. Examples of elements of such programmes are given in Table 1. Here the sense of 'ownership'

is important for the programme's success, so from the onset the most important stakeholders should be involved, such as the industrial partners (foreign technology vendor or investor and the national technology user), the industrial support services (retailers and wholesalers, banks and non-governmental organisations) and government.

Table 1: National support system of technology and sub-sectoral programmes

	Information Programme	**Financial incentives**	**Institution building**	**Technical assistance**	**Regulatory programme**
Industrial partners	On-the-job training	Loan assistance	Creating joint-ventures	Audits; on-the-job training	Voluntary norms
Industry support	Outreach by industrial association	Product leasing; customer finance	Strengthening or creating NGOs	Service and maintenance; R&D support; training and education	Subsectoral strategies
Government and agencies	Equipment labelling; commercial building codes	Tax incentives; Subsidies;	Strengthening or creating government agencies	Demonstration projects	Standards and norms; environmental regulations

Obtaining finance is often the stumbling block. Unfortunately, a number of Africa counties are heavily indebted and thus cannot easily access private and multilateral foreign loans. The matter of finance will be discussed in more detail in Section 3.

2.42 Opportunities for International Co-Operation

International co-operation has an important and beneficial role to play in favour of supportive actions by way of official development assistance. Both bilateral and multilateral donor agencies can fruitfully assist in capacity building, institutional strengthening and formulation of programmes to promote climate-relevant technology transfer. In addition, these channels can help to establish dedicated credit lines (e.g., revolving funds). Apart from CDM-related credit lines, the Global Environmental Facility (GEF) is another important element under UNFCCC, besides CDM. The GEF is operated by the World Bank, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). GEF provides incremental financing to developing countries, focusing in four areas: biological diversity, international waters, ozone-layer depletion and climate change. Most GEF projects average 5 to 6 million USD and take several years to implement. In 1996, the GEF Council approved the processing of smaller projects (below 1 million USD) with simplified and faster procedures. Its priority area is enabling activities focused on capacity building, to finance programme of adaptation to climate change and support high-risk barriers.

In the end, the prime mover to introduce climate-relevant technologies through CDM projects will be industry itself, given a competitive business environment and adequate 'stick & carrots' wielded by the governments in a non-discretionary way. It has to be stressed that while bilateral and donor agencies may partly finance the implementation of actual projects, such funds should be additional to the official development assistance of the donor agency. The roles of GEF and CDM must not become blurred, with GEF supporting the creation of an enabling environment for CDM projects, which could then be implemented by industrial partners through CDM.

Table 2: Strengthening CDM-specific capacities

	Information programme	Financial incentives	Institution building	Technical assistance	Regulatory programme
Industrial partners	Data acquisition; Development of baselines; Involvement and consultation	Foreign capital (equity, loans, grants) Local capital (equity, loans, grants)	Networking; Creation of internal environment units; Identification of potential partners	Project negotiation skills; Energy and emission audits; CDM project identification and formulation	
Industry support	Data sharing and dissemination; Exchange programmes; Involvement and consultation; Info on project finance	Leasing Consumer finance for efficient products; CDM investment funds	Strengthening key academic, R&D institutions and NGOs; Networking; Investment promotion	Pooling expertise and skills; Integration climate change issues in curriculae; Training on methodological issues (baseline, additionality)	Analysis of constraints to CDM technology transfer
Government and agencies	Development of emission factors and guidelines; Promoting a national dialogue (workshops, roundtable); Public awareness campaigns; information on national and international investment laws	Tax incentives; CDM investment fund	Strengthening the UNFCCC Focal Point; Validation, verification and certification agencies; Networking and co-ordination at national, regional and international level	CDM demonstration projects; Development of criteria for baseline and emission reduction assesments;	Integration of CDM into national development plans and strategies; Structure for the CDM programme

Table 3: Opportunities for international co-operation

Strengthening the capabilities of agencies involved in environmental, sustainable energy or clean technologies (e.g. through training of local staff, trainee ships abroad, North-South co-operation between institutions).
Adapting national regulations (e.g. on demand-side management, co-generation and independent power production, environmental regulations, norms and standards, etc.).
Strengthening other relevant actors, such as research institutes, energy service companies (ESCOs), energy management units within companies (E-cells), CDM validation and verification agencies. Co-operation could take place through participation in national or regional raining programmes and encouraging national networking.
Facilitating the access to information on climate-relevant technology (e.g., through the Internet, a multilaterally or regionally managed database on climate-relevant technologies and investment opportunities).
Assistance to design and fund credit lines to foster industrial energy (i.e. identification of viable projects, design of effective stimuli and innovative funding schemes)
Facilitating transfer of climate-relevant technology (turn-key investment, build-operate-transfer, build-own-operate-transfer, joint venture)
International networking (regional information centres and clearinghouses, seminars, fostering partnerships between national and foreign firms, e.g., by twinning of companies or branch associations).

2.5 Implementation of CDM projects

2.51 Implementation and Operation of CDM Projects

The next step is to really implement the portfolio of CDM project concepts. At this stage, the project concept is further developed into a detailed project set-up with regard to:

- Target groups (a market survey may need to be undertaken);
- Objectives
- Organisation
- Sales objective; market potential; definition of outputs
- Technology choice (a more detailed technology assessment may be required)
- Estimation of baseline greenhouse gas emissions and emission reduction (by desk study or real emission measurements)
- Work plan of activities
- Budgets and finance
- Technical and economic feasibility
- Environmental benefits and other impacts.

A CDM project needs to be validated by a national CDM validation agency, in the host country or in the investor country or by both. In agreement with UNFCCC guidelines, the validation agency approves baseline emission estimates and projected emission reduction as a consequence of project implementation.

2.52 Evaluation and National Dissemination

The review of the implementation of prioritised mitigation actions is essential to evaluate their success. At the project level, monitoring and evaluation of the project by a recognised 'CDM verification agency' is necessary to get UNFCCC certification for the emission reduction units of the project. This implies that the role of national institutions or agencies, acting as CDM validation and verification agencies is clearly defines, and that their methodology is well-developed. Also, at the programme level, a mechanism should be established for the periodic review of the implementation status, results and experiences of capacity building and policy measures. Such reviews provide the inputs for the country's National Communications to UNFCCC and National Action Plans. Apart from emission reduction and cost-effectiveness criteria (price of emission reduction units), other criteria include environmental (e.g., local pollution, deforestation), macro-economic (international trade balance, job creation, foreign exchange reserves), micro-economic (return on investment, net present value) and social (wealth distribution, gender).

It is likely that those stakeholders, involved in the definition, selection and implementation of mitigation actions will remain interested in the actual achievements. However, stakeholder may 'drop out' if project ideas were not selected as priorities, project fail to get implemented due to the barriers mentioned earlier, etc. This asks for a sustained dissemination of information between the key actors and a concerted action amongst them to start a national dialogue, by means of information clearinghouses, websites, workshops, and conferences of Roundtables. After all, it has to be stressed that the phases mentioned in Figure 1 form an *iterative* process of assessing needs and options and actually carrying the options out.

3.0 FINANCING CDM PROJECTS

3.1 Introduction

One requirement of CDM projects is 'additionality', i.e., the project has to yield emission reduction that is additional to what would have been achieved in the 'baseline', a business-as-usual scenario. Although not specifically mentioned as such in the Kyoto Protocol, the

additionality requirement of CDM projects will generally translate to additional cost for CDM projects in comparison with baseline options.
Absence the additional cost, these projects would generally be included in the baseline and implemented as a normal business or governmental activity. Reaching financial closure for CDM projects is thus very similar to reaching financial closure in general, with one exception: the potential financial value of the resulting 'Certified Emission Reduction' (CER) must also be secured. Recovery of the 'additional' cost through the acquisition of CERs will be critical for the financial closure of the whole CDM project.

A number of conditions have to be met before an agreement on purchase of the CER can be made between the parties involved, one of them the investing party (investing country Government, a company, broker and/or investment fund) and the other the recipient party (host country government and/or a company):

- Protocols for measurement, auditing, reporting and verification of the resulting CER. Both parties have an interest in over-stating the amount of realised emission reduction, hence the importance of independent auditors and UNFCCC certification. The protocols should settle quantity, quality, price and delivery date of the CER, as well as the implication of future changes in the project's baseline reference
- The participants need to define contractually the allocation of performance rewards, responsibilities, risks and non-compliance.
- Required approval from the host Government, investing Government and CDM operating entity as applicable.

3.2 Financial Models for CDM Projects Involving Industrial Companies

In terms of financing, the lesser the number of actors involved, the simpler the financing mechanism. In the 'government-to-government' case, the host country Government prepares, implements and finances the project itself. It also implements the emission reduction audit, which it offers for certification to the CDM Operational Entity. Based on this, the investing country transfers an amount to the host Party, directly or through a multilateral CDM Fund, in return for which it acquires the CER.

Figure 4 illustrates the structure for a CDM project, in many ways similar to many Activities Implemented Jointly (AIJ) project that are currently being implemented, actively involving the private sector[5]. The investing country Government sets up an incentive scheme for CDM projects, which is managed by the Government directly, by an agency or in the form of a CDM fund. Industrial companies (from the investing and the host country) contemplate setting up a technology transfer project, financed by debt and equity from 'normal' sources. However, the project cannot be made financially viable. To displace the baseline option, additional funding is sought from the CDM scheme in the investing country. This adds an 'additional' revenue stream in the form of additional equity, debt or a combination thereof. This helps to reduce the financial risks and helps to increase the capacity of the project partners to secure other debt and equity financing. This helps to make the CDM project financially viable. On completion of the project cycle of implementation, emission auditing, verification and certification, the investing country Government uses the resulting CER for compliance purposes.

[5] Of course, under AIJ emission reduction cannot be credited yet.

Figure 4: CER Government financing, involving the private sector

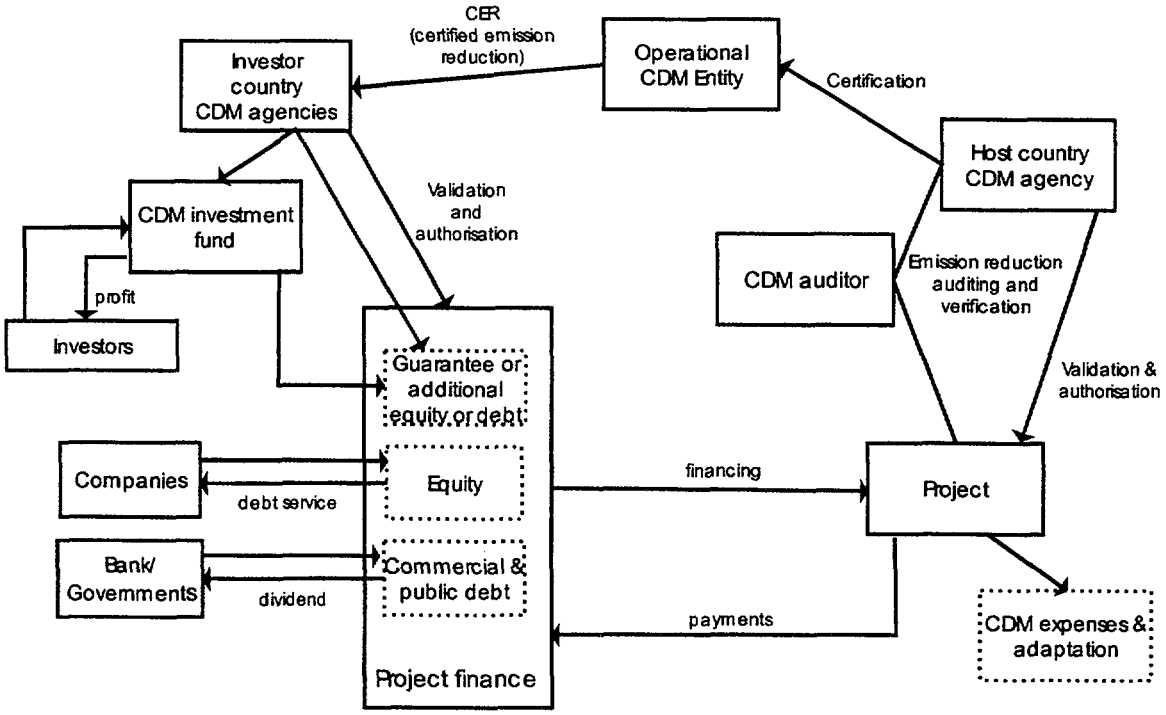


Figure 5: Loan and equity financing of certified emission reductions

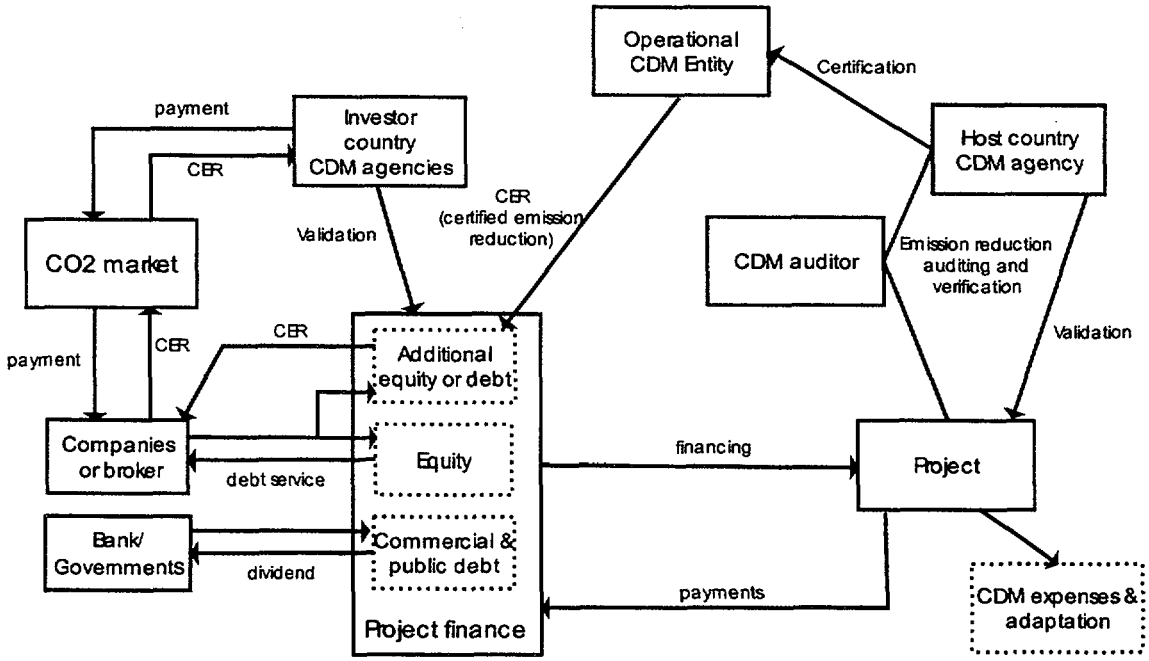


Figure 5 shows an even more market-based model. In this case, the private investors themselves or brokers provide the additional equity (investor) or debt (broker) to help making the CDM project viable, compared to the otherwise occurring baseline investment and/or loan. At the end of the project, the investor or broker can use the CER (associated with the additional equity or debt) for:

- Its own compliance purposes (assuming that company-level reduction targets exist),
- Selling the rights of the CER to the investing country government (e.g., in return for tax reduction or exemption),
- Selling the rights of the CER in a CO_2 emission credits spot market.

Independent power producers, international energy companies, clean technology vendors, energy efficiency service companies are examples of CER buyers, that in addition to buying the CER, want a strong involvement in the project, e.g., by participating with additional equity. Risk-avoiding companies or CER brokers are not interested in getting actually involved in project implementation, providing additional loans.

Figure 6 details the financial model for investments made a CDM investment fund (CIF). Typically, the CIF would not invest in one project, but in a portfolio to reduce the risk of non-performance of some of the investments. Again, the project transactions would be based on 'normal' project financing arrangements, to which the CIF's investment would be added in return for the CER rights. Apart from adding investment, the CIF could act as a guarantee fund, thus increasing the project partners' capacity to secure debt and equity financing from 'normal' sources, lifting the project towards financial viability.

Such CIF's could be operated by a number of entities, such as private investors, government agencies (representing the investing country and the host country), multilateral organisations or an international entity established for such a purpose. Investors would buy shares in the fund (in exchange for profit when the CER is sold or cashed) or a share of the CER (in case investors seek compliance, such as the investing country Government itself).

3.3 Financial Instruments

Many CDM projects will need financial support to overcome the financial, information, institutional and other barriers, mentioned in paragraph 2.4, such as:

- High 'transaction' cost associated with small-size projects using new and clean technologies;
- Lack of information and experience associated with proposed technologies;
- High risks and costs associated with project development in developing markets;
- Price and regulatory uncertainties;
- Weak commercial guarantees for new and innovative technologies.

A number of financial options are available to remove above-mentioned barriers and thus catalyse the implementation of projects that would otherwise not have reached financial closure:

- General assistance for market development;
- Assistance for technical-economic feasibility study and business plan;
- Partial guarantees to reduce the risk of investment (political instability, exchange rates, economic conditions, bottom price CER);

- Revolving funds to support project development cost that are replenished after financial closure;
- Investment subvention and tax incentives;
- Commercial loans (at market or subsidised interest rates).

Figure 6: CDM Investment Fund Financing

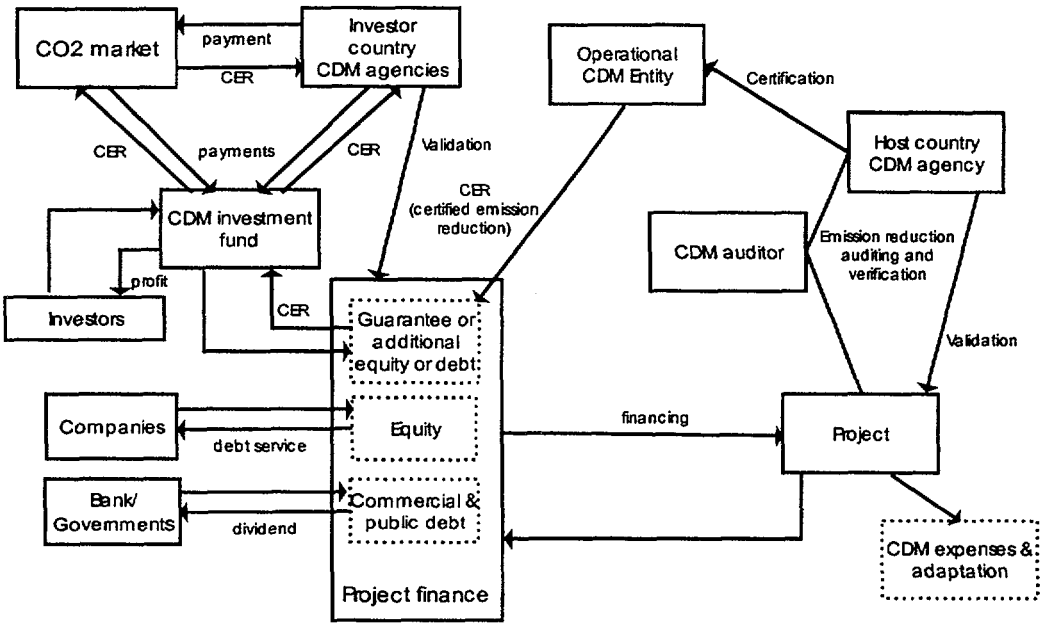


Table 4: Example of Forms of Finance and Providers

Finance provider	Examples
Multilateral (grants)	• Global Environmental Facility (GEF) • United Nations Industrial Development Organisation (UNIDO) • United Nations Development Programme (UNDP) • World Bank • African Development Bank (AfDB) • United Nations (UN)] • European Union (EU)
Bilateral (grants)	• USA • European countries (Denmark, France, Germany, Italy, Netherlands, Norway, Sweden, etc.) • Japan
National funds (grants and subsidies)	• National environmental agencies
Multilateral Development Bank (offering loans below market interest rates)	• World Bank • African Development Bank
National funds (loans below market interest rates)	• National innovation or environmental funds • National development banks
Commercial loans	• State and private banks • Chambers of Commerce
Joint ventures	
Fiscal benefits (tax exemption; tariff differentiation	
Export subsidies / vendor financing	• European Union and its member states • USA • Import-export banks

Annexes

Annex 1: Climate relevant technology options in industrial processes and products.

Industrial processes	Industrial products	Examples of technology transfer options in CDM
• Efficiency improvements in present production processes, including advanced process control measures (such as quality control, 'just-in-time' inventory control, regular energy audits) or the application of proven, new, high-efficiency industrial processes • Material recovery (such as flared gas, organics in waste streams, water) • Recycling (in particular of energy-intensive materials and/or complex composite materials), • Feedstock, using high-performance, materials instead of high energy-intensive materials • Improved electromechanical drives (variable speed drives), motors, pumps, fans, etc. • Optimisation of thermal processes in boilers and process heaters, including waste heat recovery (heat exchangers and vapour recompression systems), improved insulation, steam traps, improved combustion control, plugging leaks • Cogeneration of electricity and steam, using high-pressure steam turbines, gas turbines and steam-injected gas turbines • Improved operation and maintenance (e.g., lubricating, adjusting belts and gears, • Adequate equipment and process testing procedures and standards • Adaptation of 'turn-key' and package systems and equipment to developing-country operating conditions. • 'End-of-pipe' emission control techniques • Switching from high-carbon fuels (i.e., coal, fuel oil) to low-carbon sources (such as natural gas) • Switch from carbon-based fuels to (sustainably produced) biomass fuels or non-carbon based fuels (hydro, wind, geothermal, solar)	• Improved wood, charcoal and other cooking stoves • Efficient technology for charcoal production • Improved operation and maintenance of appliances • Improved efficiency of electric home and office appliances • Improved lighting efficiency (use of CFLs, task lighting, reflectors, etc.) • Improved refrigerators (not using CFCs) • Use of energy-efficient air conditioners • Improved fuel efficiency of cars (using newer more efficienct vehicles instead of older ones) Fuel conversion kits for vehicles (e.g., LPG) **Construction** **Construction** • Improved building systems, i.e., better design (e.g., orientation of windows, white roofs, use of trees), low energy-intensive building materials • Avoiding the use of CFCs and halons in insulating and air-conditioning; substitution of cement with other materials (glass, steel) **Rural industries** • Substitution of diesel generators with alternative fuels (hydro, solar, wind) • Introduce newer technologies	**Cement** • Information and training on increasing share of additives • Conversion from wet to dry process • Use of precalciners • Efficient grinding equipment **Iron and steel** • Switching from 'open hearth' to the 'basic oxygen furnace' • Dry coke quenching, instead of stopping the coking with water • Using natural gas or coal-derived gas, instead of cokes • To increasingly switch to steel production from scarp and metling it in electric arc furnaces • Continuous casting, elimating 'ingot' casting and subsequent reheating **Pulp and paper** • Recovery of the pulp residues as on-site source of process heat • Combined heat and power • Recovery of chemicals in pulping • Improved pressing techniques, to squeeze the water before drying • Better insulation of pipes & ducts **Fertilizer manufacturing** • Recovery of chemicals from waste for re-use; re-use water • Control of leaks and spills • Recirculation of cooling water • Change plant layout and processes to improve energy efficiency **Landfills** • Top and bottom sealing and recovery and burning of methane **Food and agro-industries** • Waste water treatment (oxydization, recoveryof methane and pollutants) • Efficient use of energy & water • Recovery of biomass residues to burn or gasify in cogeneration **Tanneries and leather** • Waste management; waste segregation

Annex 2: Inventory of barriers to the implementation of clean technologies, capacity building opportunities and policy measures

	BARRIERS	CAPACITY NEEDS	CAPACITY BUILDING AND POLICY MEASURES
INDUSTRY	- Lack of awareness among consumers on efficient devices and wasting behaviour - Lack of information on cost-effective opportunities and savings - High initial cost of equipment and risk averseness - Secondary interest of users in energy efficiency that must compete with other cost types (labour, raw materials, etc.) or other factors (quality, reliability) - Multiple roles and needs served by an existing technology that may not be met with a new one - Too small-scale markets and low-quality infrastructure for efficient, but more expensive appliances - Split responsibility between technology purchaser and user or operator	- Ability to develop, produce and maintain energy efficient devices - Ability to conduct energy audits in different industrial sectors - Ability to conduct and review technology assessments and implement new energy-efficient and clean manufacturing processes and devices - Ability to review management systems and process monitoring and to implement optimised practices	- Information exchange , extension and education (through conferences, workshops, clearinghouses and awareness campaigns, demonstration programmes) - Innovative finance arrangements (including loans, grants, tax credits, accelerated depreciation) - Energy and environmental audit programme, performed by trained in-house employees or outside consultancy (e.g., ESCOs)
FINANCIAL SERVICES	- Lack of adequate financial services, especially for small enterprises	- Ability to provide financial services	- Innovative finance arrangements (including loans, grants, tax credits, accelerated depreciation) - Investment funds
INDUSTRY SUPPORT SERVICES	- Lack of consultancy services - Lack of diagnostic and measuring technologies for energy audits - Shortage of skilled technical and managerial personnel - Split responsibilities between energy utility and user - Inadequate spare parts and energy infrastructure to adequately support high efficiency technology (e.g. voltage jumps, dirty fuels, lack of spare parts)	- Ability to develop and market training products on energy conservation and clean technology to different target groups - Ability to provide non-technical support services (environmental, investment promotion, export marketing, R&D, subcontracting)	- Establishment of research programmes - Training of skilled personnel at 'centres of excellence' - Vocational training programmes - Application of demand-side management measures by utilities - Permission to generate private power and incentives for cogeneration - Establishment of industry support services (technology clearinhgouses, customer information centres, extension services for small and rural industries, industrial estates, marketing services)
GOVERN-MENT	- Energy subsidies (reducing the user's willingness to invest in energy conservation or clean technology) - Inappropriately designed duties and taxes (biasing purchasing decisions towards less efficient or polluting technology) - Bias of energy and industry planners towards a small number of large projects - Uncertainty and instability in international prices of energy raw materials and commodities - Fluctuations in currency exchange rates - Intellectual property rights - Political and economic instability	- Ability to develop, implement and evaluate policies conducive to Clean Development Mechanism, energy conservation (energy, environment, industry, science and technology), and environmental technologies.	- Environmentally sound energy and material pricing policies - Tax incentives to stimulate investment in clean technology - Adjustment of import restrictions on clean and energy-efficient technology - Standards and testing protocols for new and second-hand equipment; energy and green labelling of products and devices - Improved data collection through surveys on equipment and end user preferences, manufacturers and distributors - Establishment of (inter-ministerial) sustainable energy and climate change co-ordinating bodies - Integrated resource planning, that includes energy efficiency and environmental considerations

Box 3.0: Barriers to the implementation of clean and energy-efficient technologies

Lack of information
Many investors and most of the consumers have insufficient information on the rapidly evolving technologies that are available. Furthermore, they are uncertain regarding energy savings and the cost-effectiveness of employing more efficient designs.

Technology transfer and technical barriers
The energy-efficient equipment developed in the industrialised countries may not be suited to the conditions in Africa. Considerable adaptation may be needed. Yet, funds for the necessary research and development may not be. Markets in Africa are small in general, thus making the penetration of large-scale technologies less viable. Also, spare parts supply, needed for installing, operating and maintaining high-efficiency equipment, may be lacking or inadequate. Industries often lack the specialised skills and equipment needed to carry out energy audits. Low-efficiency equipment often circulates widely in second-hand markets in Africa, sometimes as "gifts" from industrialised countries. Penetration of high-efficiency technologies is often hampered by patents, as their royalties add to the initial cost of the equipment. Foreign exchange shortages, that many indebted African countries face, often exacerbate these problems in handling imported high-efficiency equipment.

Institutional barrier
The industry support services of skilled personnel, finance, investment promotion, etc., may not be developed enough to absorb new technologies.

Policy and regulations barriers
Many African countries have had some implicit or explicit energy subsidisation. Policies to keep energy prices low in general bias the choice of technology against efficiency and will not encourage consumers to adopt an energy-efficient behaviour. Also, when revenues cannot cover the cost of energy supply, declining quality and shortages may result. Although designed to help the poor, subsidies often have had the opposite effect, benefiting the more affluent, being those that are connected to the electricity grid and the heaviest users of fuels.

High import tariffs and non-fiscal barriers can bias purchase decisions away from efficient products and appliance, or may stop energy efficient products from entering a country altogether.

The 'initial cost' barrier
An important barrier is formed by the initial prevailing preference for less-capital intensive (but often not the most energy-efficient) technologies, equipment and products, without adequately taking into account, or without being able to, the true lifecycle cost, let alone the long-term economic and environmental implications of wasting energy. In Africa were capital is usually scarce (and effective discount rates are high), the requirements are for rapid payback. Also, users may not find a level of energy cost saving attractive to justify investment in technical and managerial personnel to realise such savings. Energy efficiency is often of secondary concern to industrial firms. Energy is just one input in the production process, and must compete with other cost/benefit concerns, including profitability, competitiveness, product quality and quantity, reliability etc. Especially in African countries capital costs are relatively high as compared with energy costs and labour costs. In general, smaller manufacturing firms are less energy-efficient but require greater capital investment per unit output to realise energy savings than can be achieved in large plants.

The 'split responsibility' barrier
Within a firm, accounts for operating costs (such as paying the energy bill) are separated from accounts for capital investments (as in more efficient equipment). Other examples can be found in the residential sector. The owner will buy an air conditioner based on the lowest first cost, while the tenant must pay the operating cost. In rural households, the buyer of stoves (the man) is not the same as the user (housewife).

A similar disconnection-of-responsibility barrier can be observed in the electricity sector. Here, capital can be saved because the higher initial cost of efficient end use equipment is usually outweighed by the savings realized from building fewer power plants. The perception that energy efficient equipment has high capital cost, results from consumers facing the increase in capital cost of more efficient appliances, but not 'cashing' the decrease in the capital cost of building fewer power plants.

Institutional barrier
Traditionally, both the public and private sector, often encouraged by development banks or bilateral donor agencies, have concentrated on large-scale projects in big industries, ignoring the needs and potential of many small-scale enterprises that find themselves pushed into the 'informal' sector.

Chapter Two

The Legal Implementations Of The Clean Development Mechanism (CDM) For Industry And Industrial Support Organizations

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1.0 Introduction

1.1 Historical Review-Emergence of International Environmental Agreements

Since the beginning of the century, a number of bilateral, regional and multilateral environmental treaties have been signed. These agreements have either overtaken existing customary international rules, or complemented them by expanding their traditional scope. In fact there is now well over 200 international treaties concerning the environment.

Apart from treaties and conventions, in the environmental field, there are numerous declarations, resolutions, recommendations, guidelines and statements of principle emanating from international organizations and conferences. These are the so-called "soft law" instruments, which have grown significantly in the last twenty years. While soft law instruments do not carry any binding force, their provisions may crystallize into norms of international customs by their being accepted as obligatory through state practice.

The preoccupation with "soft law" started as early as 1972 with the United Nations Conference on Human Environment, more commonly known as the Stockholm Conference. The principles of this Conference acknowledged the concept of sustainable development and encompassed concerns such as social inequality, disparity of opportunity and economic and political relationships between developed and developing countries.

Of significance, at Stockholm, in 1972 the developing states clearly put development high on the agenda and made it clear that they will not countenance further environmental controls without such financial assistance and transfer of technology as is necessary to offset the economic restrictions involved.

Principle 23 of the 1972 Stockholm Declaration-

"Without prejudice to such criteria as may be agreed upon by the international community, or to standards which will have to be determined nationally, it will be essential in all cases to consider the system of values prevailing in each country, and the extent of the applicability of standards which are valid for the most advanced countries but which may be inappropriate and of unwarranted social cost for developing countries"

In the 1980's strategies aimed at environmental protection were adopted, notably the international Union for Nature and Natural Resources' World Conservation Strategy which were again premised on sustainable utilization of species and ecosystems. Similarly the World Charter for Nature adopted by the General Assembly in 1982 had the objective of optimal sustainable productivity of all resources coupled with conservation and protection.

The World Commission on Environment and Development synthesized these developments in 1987 by underscoring the principle of inter-generational equity, (which is defined as development that meets today's needs without compromising the ability of future generations to meet their own needs.) Finally, the United Nations Conference on Environment and Development (UNCED) held at Rio in 1992 culminated in a Declaration on Environment and Development.

It was also not fortuitous that the United Nations Framework Convention on Climate Change, 1992, was opened for signature at the Rio conference.

From the forgoing brief historical introduction, it is easy to perceive that the international community was initially concerned with what may be termed "first generation" environmental issues, such as pollution of water, air and land from human causes. In recent years, "second generation" environmental issues such as climate change, acid rain, destruction of the tropical rainforest and depletion of the ozone layer, have risen to prominence.

Moreover, due to the complexities of many environmental issues, one can see that the techniques of treaty formulation have undergone considerable change. There has been a growing use of framework treaties confined to a statement of general principles, with flesh being added by subsequent protocols- as is the case with the Framework Convention on Climate Change, 1992 as read with the Buenos Aires Plan of Action and Kyoto Protocol, respectively. From a Framework Convention with a soft inadequate target, Kyoto has metamorphasized the Framework Convention on Climate Change into a treaty with hard, yet potentially, uncertain targets.

However, consistently permeating such changes in treaty formulation are the twin concepts of "sustainable development" and "common but differentiated responsibility".

Principle 7 of the Rio Declaration expressly recognizes that states have common but differentiated responsibilities toward the environment generally.

The principle of common but differentiated responsibility is further developed in Article 3 of the Framework Convention on Climate Change, and to a certain extent in the Kyoto flexibility mechanisms (contrast CDM under Article 12 with Articles 3 dealing with Quantified Emission Reduction and Limitation Commitment of Annex I countries, Article 4 dealing with Joint action "bubbling", Article 6 on Joint Implementation and Article 17 on Emissions Trading, respectively).

It is argued that the legal implications involved in implementing the CDM will necessarily reflect the above mentioned underlying principles and objectives.

Another observation which must be drawn is the fact that whilst in the past many environmental treaties had little spill over into other non-environmental areas, the nature of environmental laws has changed in recent years. For example the Climate Change Convention and related Protocols can significantly affect a signatory country's primary energy production, transport policy, taxation policy, and to a certain extent it's industrialization strategy. Legal norms have a variety of purposes, depending upon the

context within which they are designed to operate. In the environmental field the primary purpose of law is to regulate conduct and activity so as to minimize environmental harm on the one hand, and, on the other, to maximize environmental protection and the preservation of resources.

2.0 DOMESTIC INCORPORATION OF CDM INTO NATIONAL LEGAL SYSTEM

It is axiomatic that laws cannot be devised in the abstract. The formulation of laws depends on the dictates of policy, which in turn must be informed by accurate empirical and technical data. By the same token, laws cannot operate in a vacuum. No matter how carefully they may be devised, their application may be rendered futile in practice. For example, if the administering authority is unwilling or unable, due to institutional inadequacies, to enforce law, or conversely if legal subjects choose to disregard their duty to comply with the law. These dangers are inherent in both the national and international law. At the national level, the legal policy and principles adopted may be so inflexible or so divorced from reality as to be impossible to execute on the ground. Or it may not infrequently be the case that the existing institutional infrastructure is inadequate and inept for the purpose of effectively implementing the law.

At the international level, the less regimented the nature of the normative order coupled with the absence of a truly "supra-national" authority may combine to induce a somewhat cavalier attitude in the practice of states.

These difficulties are particularly acute in the circumstances prevailing in non industrialized countries where the need for economic advancement is particularly acute. The law is called upon to reconcile the seemingly conflicting needs of rapid industrialization on the one hand, and environmental preservation on the other. Given these ever-present tensions, the concept of sustainable development is not always susceptible to clear exposition in legal terms.

The applicability of international law within the domestic sphere is generally subject to two divergent doctrines. The doctrine of incorporation asserts that the rules of international law are automatically incorporated into and form part of the domestic law. The doctrine of transformation, on the other hand, restricts the internal applicability of international law to those rules, which have been clearly transformed into rules of the domestic legal system. The position in most Commonwealth countries is that customary international law is regarded as having been internally incorporated insofar as it is not inconsistent with statute law and judicial precedent. In contrast, the internal reception of treaty law (with which we are here concerned) is perceived as standing on an entirely different footing. Under the arrangements prevailing in most Commonwealth countries, the constitutional separation of powers requires that the executive's treaty making powers should not override parliament's law-making functions. Accordingly, it is constitutionally necessary to subject the domestic application of treaties to the doctrine of transformation. It follows therefore, that a treaty does not form part of the domestic law, except by virtue of enabling legislation. Thus the mere ratification of a treaty does not serve to incorporate its provisions into domestic law. What is required for the purpose is parliamentary

intervention in the shape of legislation clearly designed to transform the relevant treaty provision into rules of national law.

Quite apart from the incorporation of particular international instruments, it may be appropriate, in certain areas of statute law to *enact general policy guidelines relative* to the State's international obligations. With particular reference to the CDM, it is suggested that policy guidelines would be particularly useful in designing the adaptation component of the CDM as well as conceptualizing the facilitatory role of the CDM, in particular methodological issues such as baselines and additionality, monitoring, reporting, verification and certification procedures, as will assist industry and industrial associations to implement and operationalize the mechanisms.

3.0 POTENTIAL LEGAL BARRIERS TO IMPLEMENTATION OF CDM PROJECTS IN AFRICA

The Clean Development Mechanism (CDM) is principally (although not exclusively) envisaged to operate through the BOT medium, which requires a defined and stable legal and regulatory environment, as well as a freely convertible currency. *Ergo*, Most of the legal barriers to implementation would logically fall under three main categories, for ease of reference, roughly corresponding to the different phases of a BOT project, viz.:

- Project identification
- Law and Policy instruments
- Project Agreement

3.1 Project Identification Phase

The potential legal barriers to CDM projects which might arise include those arising at the project identification phase which constitutes the lynch pin of any CDM project's success. As recognized in the UNIDO BOT Guidelines "At the outset, the need for a particular project must be identified and the possibility and advantage of having it carried out on a BOT basis must be recognized. Usually this is done by the host government in its planning process...."[1]

This assumes the existence of a coordinated planning process within each of the countries selected for the Project, which recognizes the need for clean development in the face of the competing need for industrial development. The potential barrier lies in the fact that clean development is seen as a subsidiary objective to industrial development, a perception borne out by the manner in which domestic resources are allocated in the national economy.[2] For example, one indicator might be to ask what is the frequency of project financing through BOT arrangements as depicted in the national budgets of the

[1] Unido BOT Guidelines, at page 21

[2] See page 8 of the Paper *Industry and the Clean Development Mechanism*, ETC Energy, by J. Van Den Akker, UNIDO, October,1999 where the author makes the point that for most developing countries climate change is not a priority, so the effective transfer of climate related technology may require the implementation of measures that are primarily designed to achieve other developmental goals.

countries selected for the project? The answer would most likely be very little at present. In this regard, planning authorities must see the need, or be assisted to see the need for clean development. This calls for a total paradigm shift in the planning process regarding the need for clean development projects. Fortunately, in most if not all the countries selected for the CDM Project, environmental awareness is high. A factor which also has a bearing on the "appeal" of a CDM project would be the extent of autonomy/devolution of administrative authority to local government structures. Put differently, the authority empowered to negotiate a potential CDM project may be difficult to determine especially where the host counterpart has overlapping responsibilities with other organs of central government, which may make the identification of project partners difficult.

Another barrier might be the lack of a separate and clearly defined procurement process for BOT projects. Many procurement processes in the sub-Sahara region are undergoing substantial transformation, principally in order to accord with WTO obligations. Typically though, many of them were designed for command economies and have not yet adapted to globalization. The procurement processes might be inflexible and inappropriate for BOT type projects.

Another significant barrier, which could arise at the planning stage, is that concerning reserved sectors of the domestic economy.[3] For example, section 34 (2) of the Procurement Act of Zimbabwe, [Chapter 22:14] provides that a procuring entity may restrict participation in procurement proceedings to persons who are citizens of, or ordinarily resident in Zimbabwe. Such a provision could provide a potential impediment to CDM projects where the policy is indiscriminately applied.

Most of the countries in the Project have investment approval and facilitation agencies which handle Foreign Direct Investment (FDI) issues and a number of them constitute the implementing agency for government's investment related policies and legislation. The legislation under the control of these agencies should be reviewed with a view to identifying potential constraints to implementation, as would constitute reserved sectors.

There is also a need to examine whether these institutions are adequate to implement the specific requirements of the CDM, and to establish linkages between these agencies and Framework Convention on Climate Change (FCCC) national focal points.

In this regard, an intergovernmental authority with co-coordinating responsibility for CDM-such as the Climate Change National Focal Points in each country would be apposite. Such an authority should have representation from the Ministries of Industry and Commerce, Environment, and Industrial associations primarily for the expeditious identification of possible CDM projects.

[3] For example, section 23 (1)(c) of the Constitution of Zimbabwe permits the discriminatory treatment of persons who are neither permanent residents nor citizens of Zimbabwe with respect to entry and employment.

3.2 Law and Policy Instruments-Domestic Legislative & Regulatory Environment for CDM Projects

3.21 Barriers-lack of Capacity to Effectively Negotiate Technology Transfer (TT) Arrangements

It would not be a sweeping generalization to state that at present the countries involved in the Project lack capacity to effectively negotiate the legal aspects of technology transfer arrangements, whether they are BOO, BOOT, or BOT.

In the countries selected for the Project, technology transfer agreements occur predominantly on a bilateral basis, independent of the procurement processes and investment regulatory framework, which raises the issue of the potential for disputes when the technology transfer agreements are negotiated in a CDM project without due diligence.

For example, a CDM project is approved in the energy sector in country Y with an investor from country X. Experience with the laws in country Y is that only national power utilities may sell power generated by Independent Power Producers (IPP's) in country Y. If the negotiators in country Y due to lack of TT negotiating skills agree to purchase the power produced by the IPP at a predetermined formula over a long period of time-then they have effectively negotiated themselves out of the possibility of cheaper sources of power which may arise during the contract period. Should country Y wish to avoid the contract, they would be enjoined to use the savings from cheaper sourced electricity to subsidize the electricity sourced from country X, or risk being sued for breach of contract, a choice best avoided. The legal issue which arises for CDM type projects from the above scenario is who between X and Y should bear the differential in price between the price offered by X (p1) and that represented by the new offer (p2).

There is therefore a perceived need for negotiation skills training on contract negotiation, preparation and signing skills, at a multi-stakeholder level, involving lawyers, government negotiators, industrial associations and other players.

In this regard the initiative by the Center for Sustainable Development (CSD), in conjunction with the Foundation for International Environmental Law and Development provides an option for capacity building with respect to contract negotiation skills. They have already organized the first phase of a multi-stakeholder process related to the CDM consisting of informal meetings of developing country negotiators (See Doc-FCCC/SB/1999/6 at p.12).

3.22 Barrier-Regulatory Framework for Technology Transfer:

Article 4.5 FCCC-commits to the transfer of environmentally sound technologies among parties. There is thus a need to enact or to consolidate the regulatory framework to govern such arrangements. It is self-evident that environmental norms relating to the CDM are all pervasive and straddle the entire spectrum of industrial and social activity. Very often there are already in existence at the domestic level, pre-existing institutional

structures designed to handle only certain aspects of technology transfer, and only from a foreign direct investment oriented/industrial development and competitiveness approach. There is thus a need to ensure that the full ranges of legislative options are considered when implementing the CDM, viz.:

- Where the existing provisions on transfer of technology are adequate, no change in the law may be called for.

- Where the existing legislation is adaptable to specific international requirements, the law is to be modified accordingly, either by amending the relevant statute and/or through new and subsidiary legislation made under that statute.

- Where there are no existing laws in place, entirely new legislation ought to be enacted in order to meet specific international requirements under the CDM.

In each of the countries selected for this Project, it may be necessary to deploy all or any of the above options, depending on the nature of the existing provisions with respect to access to, and transfer of technology.

3.24 Issues Relating to Access to Appropriate Technologies

- ***Intellectual property protection legislation***

Closely linked to the issue of the regulatory framework for technology transfer is the adequacy of the intellectual property protection regime of the host state.

It is axiomatic that technology transfer occurs optimally where protection regimes for innovation are best rewarded, i.e. through exclusionary rights for defined time periods. In this regard there has been a measurable amount of synergy derived from implementation of the Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, which has sought to enhance protection for the covered forms of intellectual enterprise, including technology.

Most, if not all of the countries selected for the CDM project are parties to the WTO, and are consequently enjoined to apply provisions of the TRIPS Agreement and therefore have enacted appropriate intellectual property legislation, where one can find provisions containing elements of technology access and conditions for transfer.

3.24 Investment Regulation-National & International Investment Law in Relation to the CDM

Most of the countries in the Project also have investment approval and facilitation agencies which handle Foreign Direct Investment (FDI) issues and a number of them constitute the implementing agency for government's investment related policies and legislation. There would be a need to examine whether these institutions are adequate to implement the specific requirements of the CDM, and to establish linkages between these agencies and Framework Convention on Climate Change (FCCC) national focal points.

- Bilateral Investment Promotion Protection Agreements (BIPPA's) also have a bearing on the conditions of technology transfer, to the extent that they constitute government to government agreements on investment which could, conceivably be modified to highlight investment in cleaner industrial production methods.

The legislation would need to provide for protection against expropriation/nationalization and would need to be supported by appropriate corporate legislation.

3.3 Project Agreement

The Project Agreement/concession agreement is at the heart of any BOT project. It defines the rights and obligations of the project company and the host government for the development and operation of the project.[4] The potential barrier in legal terms lies in the length of time it would take to have the agreement approved in accordance with constitutional requirements. This makes it imperative that in the capacity building programme for CDM projects, provision be made to include lawyers with drafting skills who are familiar with the national legal system in the particular country, to be able to be involved in the project development so as to maximize chances of approval of the Project Agreement, once it has been negotiated and drafted.

In particular, care ought to be taken when drafting protection clauses required of the host government by the Project sponsor, including price escalation clauses, (e.g. in off-take agreements such as that found in power projects), as well as the inclusion in an agreement of a commitment by the host government as to availability of foreign currency at a future date to enable transfer of dividends and capital, since this can be a sticking point.

In this regard, the legal framework options available for BOT project agreements (narrow/wide/hybrid)[5] in each country should be explored before proceeding to agree a Project Agreement.

In the case of Zimbabwe, the Procurement Act [Chapter 22:14] also doubles as the legislation governing BOOT and BOT contracts [6] and to this extent does not, as is the position in most countries in the sub-region, have an effective *sui generis* legal framework for implementing CDM projects using a BOT approach.

Dispute settlement mechanisms would also need to be put in place in order to provide for a mechanism for settlement of disputes arising from the interpretation or application of CDM modalities with specific reference to issues such as verification, monitoring and certification procedures.

4.0 BIBLIOGRAPHY

1. UNIDO BOT Guidelines, General Studies Series, Vienna 1996.

[4] Page 12 UNIDO BOT Guidelines
[5] see page 50 UNIDO BOT Guidelines
[6] This Act provides *"This Act shall apply mutatis mutandis, in respect of BOOT or BOT contracts as if they were procurement contracts.."*

2. Industry and the CDM, J. Van Den Akker, ETC Energy, prepared for UNIDO CDM Workshop, October 1999.
3. UNFCC Doc FCCC/SB/1999/6
4. Constitution of Zimbabwe
5. Procurement Act, Zimbabwe [Chapter 22:14].

Chapter Three

Concept For Developing National Capacity To Implement Industrial Clean Development Mechanism Project In Africa

Ghana Case Study

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1.0 INTRODUCTION

Article 12, Paragraph 2 of the KYOTO Protocol to the UNFCCC declares the main purpose of the Clean Development Mechanism (CDM). This is principally to assist the Parties not included in Annex I in achieving sustainable development while facilitating the compliance to quantified emission limitation and reduction commitment (QELRC) of Annex 1 Parties under Article 3 of the Protocol.

African Country Parties as Non–Annex I Parties to the UNFCCC have to take advantage of and explore opportunities being offered by the emerging financial mechanism, the CDM under Article 12 of the KYOTO Protocol to the UNFCCC. African expert group meetings on CDM have in principle accepted this challenge. This position has been born out of the lessons learnt from the near exclusion of Africa from AIJ/J1 projects under of the UNFCCC, in which only one Country in Africa, Burkina Faso initiated one AIJ project.

The prospects of the management of the GHG emissions stabilisation plan under the emerging CDM appears to be acceptable to Non-Annex I Parties including Ghana as it seeks to address sustainable development, and also to the interests of Annex I Parties as it moves in to the whole process of technology transfer and private sector investment. Indeed, the Africa Regional expert meetings conducted in Africa have so far gone a long way in addressing some potential perception problems because of the relatively good communication and awareness creation of the CDM.

The extension of the AIJ phase at COP/MOP 5 in Bonn emphasises the concern of the global community in the non-involvement of Africa in the first phase of AIJs, and the need to use AIJs to develop capacity for the implementation of future CDM projects. The anticipation of CDM take off by the year 2001 demands proactive approaches in identifying and documenting potential CDM projects that would make Africa globally competitive in attracting Foreign Direct Investment (FDI) compared to the economies-in-transition.

The economies-in-transition have a competitive advantage over African countries because of the very low energy efficiency of the indigenous technologies compared to relatively good efficiencies of technology transferred to Africa. Further, these economics also have the advantage of economies of scale relative to individual African countries. This therefore demands a sub-regional or regional approaches for host African countries to ensure competitiveness or equity in attracting CDM projects.

It is in the light of these, that the UNIDO pilot project, "Developing National Capacity to implement industrial CDM projects in Africa" is very laudable. The project is consistent with Article 12.4 that encourages Developing Country Parties to propose projects for financing including specific technologies, materials and equipment, techniques and practices that would be needed for such projects.

The project also fulfils the provisions of the convention under Article 12.7 that enjoins the COP to arrange for the provision of technical and financial support in identifying the technical and financial needs associated with proposed projects and response measures. Moreover, that such support may be provided by competent international organisation e.g. UNIDO.

The project would further enhance reporting and the update of Ghana's subsequent national communication regarding the country's technology needs for the industrial sector in accordance with Decision 4/COP4 on "development and transfer of technologies to reduce greenhouse gases emissions while supporting sustainable development."

The collaboration with National Experts from the participating Countries is seen as very appropriate as it would help in developing and enhancing endogenous capacities of the selected African Countries consistent with Decision 4/COP4. This would also facilitate replication in other Countries of the Region. The regional/sub-regional approach, which has emerged at the second Vienna meeting, is also commendable since it addresses the problem of economies of scale in many African countries.

1.1 Project Objective:

The Africa CDM project initiative aims, inter alia, to achieve the following set objectives:

- To build national endogenous capacity to take full advantage of the opportunities under CDM.
- To assist African Countries to create necessary conditions to be competitive in attracting an inflow of Foreign Direct Investment (FDI) for CDM projects.
- To assist in proactively creating an enabling environment for the operation of CDM.

2.0 CLIMATE CHANGE AND CDM ACTIVITIES

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted by 57 Sates on 9 May 1992, and subsequently signed in June 1992 at UNCED by 158 Countries including Ghana. Ghana has since then participated actively in COP/MOP. Ghana was in fact the Chief Negotiator for G77 and China in COP 3 at Kyoto, Japan. The multilateral, Bilateral, and national activities carried out in Ghana are outlined as follows:

2.1 Multilateral Activities

2.11 GEF/UNDP Project RAF/GA/93

The multilateral activities in Country have principally been the implementation of GEF/UNDP Project RAF/GA/93 on "Building capacity in sub-Saharan Africa to respond to the UNFCCC. The project is co-ordinated by the Environmental Protection Agency (EPA). The Ministry of Environmental, Science and Technology (MEST), the GEF National Focal Point of CC has also initiated and formed the National Climate Change Committee (NCCC), which has a CDM subcommittee to ensure the integration of CDM issues into national policy.

Phase I of the capacity building programmes under the GEF/UNDP project included:

- Preparation of Greenhouse Gas Inventories.

- Vulnerability and adaptation studies in agriculture.
- Mitigation in the Energy, and Land Use Change and Forestry sectors

The output of the Phase I of the capacity building project is currently being compiled in writing Ghana's Initial National Communication in the Phase II of the GEF/UNDP Project. The multilateral project involved three other African Countries namely: Senegal, Kenya and Zimbabwe.

2.12 GOG/UCCEE CDM Project

The UNEP Collaborating Centre on Energy and Environment (UCCEE), Denmark has recently initiated a CDM project in Ghana as part of a larger programme on sustainable development and Climate Change Finance. The project is aimed at generating awareness in the Africa Region on opportunities, problems, and requirements associated with the possible use of CDM for sustainable development in accordance with Article 12 of the KYOTO Protocol. The Ghana project is an extension of a similar project implemented in Zimbabwe. The indicated activities of the project include:

- Developing a set of sustainable development indicators and criteria for selecting GHG mitigation projects
- Identification of 2-4 potential GHG mitigation projects that could be implemented under CDM and other alternative financing mechanisms.
- Building capacity of relevant government entities, NGOs and private sector to participate in CDM.

2.2 *Bilateral Activities in Climate Change (CC)*

2.21 GOG/Netherlands CC Assistance programme

The EPA has co-ordinated one bilateral CC project with the Netherlands Government under the Netherlands CC Assistance programme. The programme provided financial and technical support for Country Studies on Vulnerability of the Ghana's water resources, agriculture (cereal production) and coastal resources to climate change, and also adaptation options to respond to CC. The studies output would be included in Ghana's Initial National Communication.

2.12 Hosting of Africa Regional Workshop on CDM in Ghana

Ghana, in collaboration with UNEP and UCCEE organised African Regional workshop on "New Partnerships for Sustainable Development: The Clean Development Mechanism and Africa". The workshop emphasised, that irrespective of Africa's very low contribution of 3.2% of CO_2 and 7.7% of non-CO_2 to the global emissions, there are very good reasons why African Countries should pursue mitigation measures by limiting future GHG Emissions. This concept of mitigation of future emissions is seen as the equity basis of making Africa competitive in technology transfer for sustainable development under CDM while the economies-in-transition can depend on present levels of "HOT AIR" to attract mitigation investment. The workshop, therefore, extended the scope of mitigation to include future reduction by choice of alternative development paths using clean technologies

in addition to the reduction of existing/historical levels by transfer of more efficient and low-emitting technologies to slow down Africa's energy consumption growth rate.

2.23 Hosting of Africa Regional Workshop on GHG Inventories on Energy and Land Use Change and Forestry

The country has also hosted an International conference on GHG Inventories in Energy and Land-Use Change and Forestry sectors. The workshop was aimed at improving methodologies of GHG inventories in the two sectors, and also to identify potential projects for estimation of GHG emission factors to the Africa.

2.3 National Activities

2.31 Zonal CC Policy Dialogues

Under the GEF/UNDP capacity building project, the country has organised in three Zonal Policy Dialogues in the southern, middle and the upper zones of the country. The essential objectives were principally for awareness raising on Climate change and the vulnerability of the country to Climate change. The target groups were the Municipal and Local authorities, government departments NGOs, CBOs and other relevant stakeholders. A national conference on the greenhouse gas inventories has also been held.

2.32 Periodic NCCC Meetings

The NCCC also meets periodically to discuss the emerging issues under the Convention and the Kyoto Protocol to the Convention, and accordingly advises the Government through the Minister of Environment, Science and Technology (MEST).

3.0 NATIONAL COMMUNICATION

National experts are currently preparing the Initial National Communication of Ghana. The content of the Initial National Communication includes:

- The National Circumstances.
- Greenhouse Gas Inventories
- Vulnerability and adaptation strategies for Water Resources, Coastal Areas Resources, and Cereal production in Agriculture.
- Mitigation options in the Land use Change and Forestry sectors.
- Mitigation options in Energy sector development.
- Policy Guidelines for integration of Climate Change issues in National Development Planning.
- Climate Change awareness creation and dissemination strategies for the Initial National Communication (i.e. Policy dialogues to move the CC issues from science-to policy strategies).
- Projects for improving country activity data base and estimation of relevant emission factors

3.1 The National Circumstances

The basic National Development Profile is summarised in Table 1.

3.11 The Ghanaian Industry

The industrial sector of the economy consists essentially of mining, manufacturing, utilities (electricity and water) and construction sectors. The real GDP has been reported in the first decade of implementation. The industrial sector favourably and strongly responded to Economic Recovery Programme (ERP) and the Structural Adjustment Programme (SAP) initiated by the Government since 1983 based on market-oriented policies. The sector showed an initial growth rate of 12% (1984 - 1988) but declined to an average of 4.7% from 1989 to 1993.

Nevertheless, the overall sector contribution to real GDP growth was maintained at 14% over the last decade as a result of continued growth rates in the precious and industrial mining sectors, and the energy sub-sector (Ref. Figures 1 & 2). Notwithstanding the general decline in the manufacturing sub-sector, the beverage industries, saw milling and wood products, iron and steel products and non-ferrous metal mining and mineral process industries showed marked growth.

3.12 Industrial Activity

The manufacturing industry sector is relatively diversified, producing consumer, intermediate and capital goods. Average capacity utilisation rates are (1995) estimated to be under 40% and remains highly raw material import dependent. In total, it is estimated that Micro and Small Scale Enterprises (MSEs) constitute about 85% of the manufacturing industries sector. A survey conducted by the World Bank for the Ministry of Trade and Industries in 1995 identified 500 medium and large enterprises (MLEs). The total employment generation was 77,926 with a gross output of approximately 890 billion Cedis, equivalent to 1.371 billion US dollars at an exchange rate of ¢649.06 to US$1.00.

3.13 Projected Sectoral Economic Indicators – (Ghana Vision 2020).

The economic development objective of the people of Ghana by the year 2020 is to achieve a lower upper-middle income status (i.e. a country with GNP per capita above $1700 from the current level of about $375. The projected population and corresponding sectoral economic indicators necessary to attain the desired objectives are articulated in Ghana's Vision 2020. Table 2 summarises the essential projected economic indicators.

The determination of the people of Ghana to achieve the projected industry contribution of 36% to the country's GDP of which manufacturing is to be 25% by 2020, is demonstrated by the Governments on-going drive to make the private sector the engine of growth of the economy. The programmes include: Free Zone and Gateway Project, which are developing infrastructures currently in the two port/harbour cities of the country into a Free Zone enclave to attract Foreign Direct

Investment essentially for job creation and an export led economy. The strategy is to be a springboard for the sub-regional market and generate the much-needed employment as a poverty reduction strategy.

Table 1: National Development Profile

	INDICATORS	1993	1994	1995	1996	1997
1	Population	16.200	16.639	17.075	17.521	17.979
2	Population, urban (000)	5.686	5.906	6.129	6.377	
3	Population, urban as % of total, interpolated (%)	35.1	35.5	35.9	36.4	na
4	Per Capita GDP at Current Prices	439	320	370	375	na
5	Real Gross Domestic Product Growth rates (%)	5.00	3.70	4.50	5.20	5.10
6	**Sectoral GDP Growth rates (%):**					
6.1	Real Agriculture GDP	2.5	2.9	4.2	4.0	3.3
6.2	Real Industry GDP	4.3	4.3	3.3	4.2	5.7
6.3	Real Services GDP	7.7	4.4	4.9	6.3	6.3
7	**Sectoral Contribution to GDP (%)**					
7.1	Agriculture	41.6	41.1	41.0	40.6	40.1
7.2	Industry	14.7	14.5	14.5	14.2	14.2
7.3	Services	46.2	46.7	46.9	48.4	47.8
8	**Bank Rates (Interest Rates) %**	35.0	33.0	45.0	45.0	45.0
9	Average Exchange Rate (Cedis/US$)-	648.98	986.73	1.200.40	1,637.24	2,050.28
10	**Energy Consumption(TOEx1000)**					
10.1	Petroleum Products	893	973			
10.2	Hydroelectricity	459	436			
10.3	Wood fuel	3181	3283			
11	Per capita Commercial Energy Consumption(koe/capita)	83.46	84.68			
12	Commercial Energy Growth rate	5.2	-3.3			

Source: The State of the Ghanaiain Economy (ISSER, 1998)

Figure. 1: GDP Growth Rates & Contribution of Industry Sector

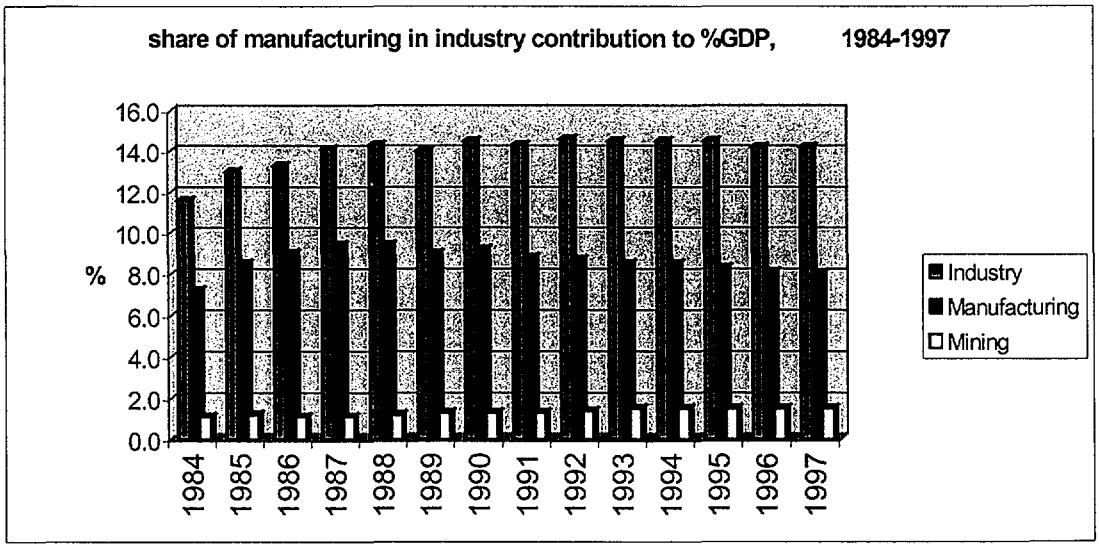
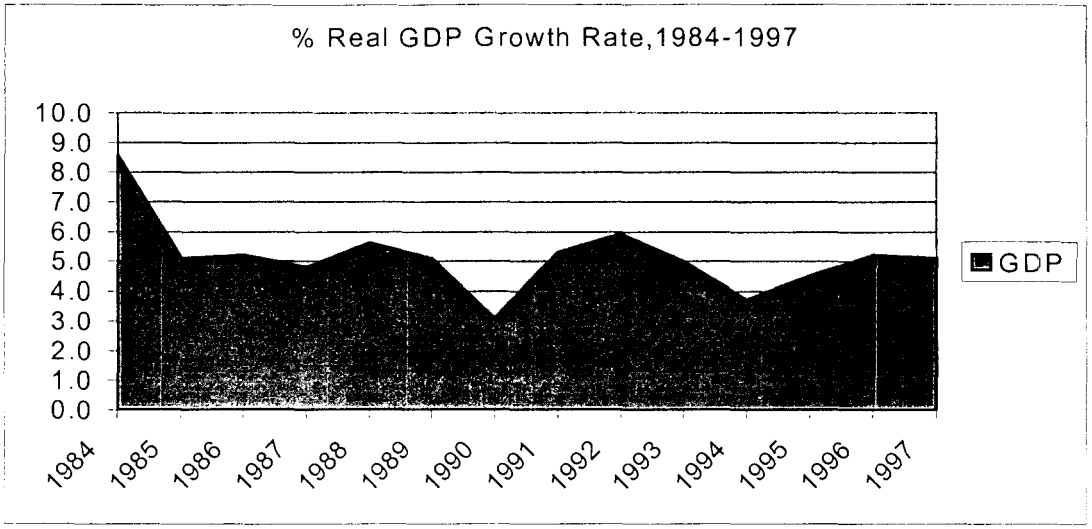


Figure. 2: Real GDP Growth Rates, 1984-1997



Source: The state of Ghanaian Economy, (ISSER 1998)

Table 2: Projected Sectoral Economic/indicators, Vision 2020

Indicator	**Unit**	**Actual/ Base Year**	**Targets**	
		1993	2000	2020
Population	Million	15.7	19.4	30.1
Population Growth Rate (%)		3.1	2.9	1.7
Urban population as % of Total		35	39	49
GNP per capita PPP estimate	US $	430	487	>1700
Real GDP Growth Rate (%)		3.5	5.9	8.3
SECTORAL COMPOSITION % GDP				
Agriculture	% GDP	42	38	18
Industry		14.7	14.8	36
of which manufacturing is % GDP		9	8	25
Services	% GDP	46	50	49
Energy	koe/capita	68	200	1500

Source: National Development Planning Commission, Ghana's Vision 2020

3.14 Commercial Energy Implications of Projected Growth –Vision 2020

Based on the commercial energy consumption and corresponding GNPs of economies that Ghana is aspiring to become, the projected per capita commercial energy consumption based on economic indicators of Vision 2020, indicate that CO_2 emissions will increase to about 140,000Gg by 2020 if thermal plants of conventional efficiencies of 34% are installed. However, by introducing combined cycle plants of

efficiencies of about 60%, the cumulative CO_2 emissions will decrease from 1,143Gt to 648Gt representing a 43% reduction. A further reduction of 159Gt can also be attained by introduction of natural gas combustion system, which is equivalent to 14%, see Figures 3 and 4.

Figure 3: Future CO_2 Emissions Mitigation from Thermal Power Plants by Technology and Fuel Type

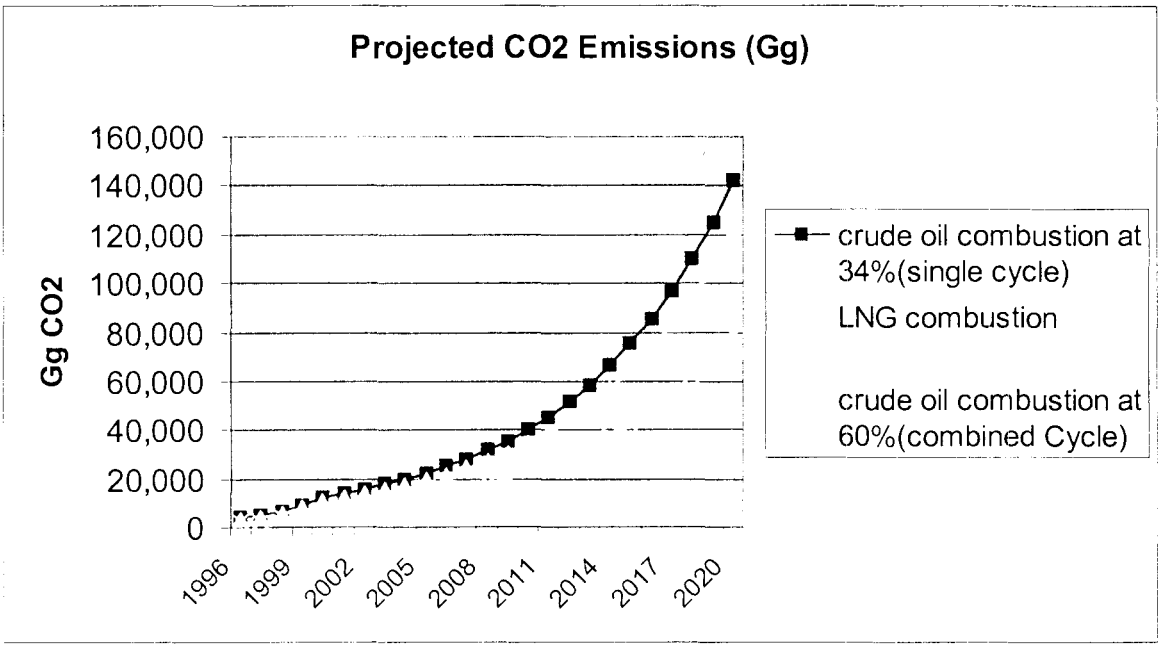
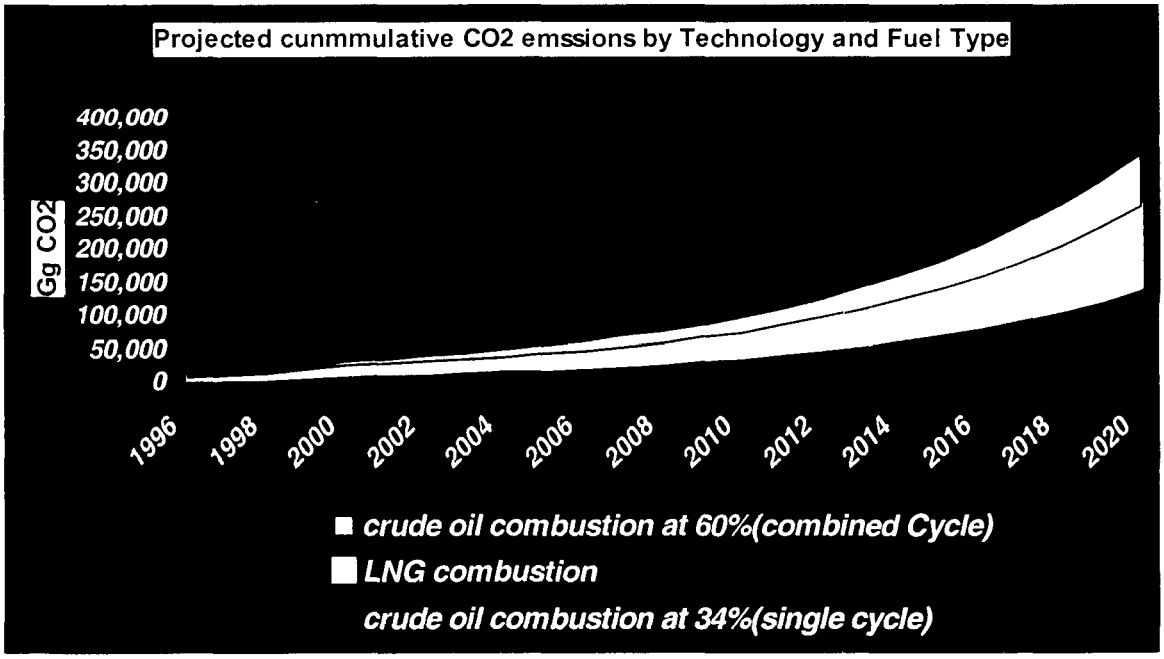


Figure 4: Future Cumulative CO_2 Emissions from Thermal Power Plants by Technology and Fuel Type



The emissions scenario shows that CO_2 would definitely increase. However, technology selection and transfer as well as choice of low carbon content fuels would provide an alternative energy development path that slows down the energy consumption growth rate with a potential to prevent over 57% of emissions of CO_2. This offers Ghana a great opportunity to meet her legitimate development needs under CDM for sustainable energy, while contributing to the global mitigation of climate change.

Additionally, as more efficient energy use and conservation practises are adopted in industry, transport, residential, commercial and public sectors, less energy will be used for the same amount of work. Consequently this reduces further the amount of GHG emissions from energy demand and consumption.

3.2 National Greenhouse Gas (GHG) Inventories and the Industry Sector

3.21 National GHG Inventories

The National GHG Inventories were conducted for five economic sectors in accordance with the Revised 1996 IPCC Guidelines. The economic sectors GHG source categories considered are Energy, Industrial Processes (Non-energy), Agriculture, Land Use Change and Forestry, and Waste. The summary of Ghana's GHG Emissions by sources and removal by sinks is given in Table 3.

The Total Net CO_2 Equivalent emissions by sources and Removal by sinks indicate that Ghana is a Net sink of all reported greenhouse gases (i.e. CO_2, CH_4, and N_2O). The Net CO_2 removal by the Country's forest resources offsets the total CO_2 and Non-CO_2 equivalent emissions. However, the rate of deforestation without any significant afforestation programmes has continually decreased Net CO_2 removal by sinks. The Total Net CO_2 equivalent emissions by sources and removal by sinks of all the reported GHG are depicted in Figure5.

Table 3: Summary of Ghana's GHG Emissions by Sources and Removals by Sinks, 1990-1996 (Gg).

Greenhouse Gas	1990	1991	1992	1993	1994	1995	1996	%change
1.1 CO_2-Emissions by Sources								
All energy (Fuel Consumption)	2831	2320	2418	2974	3048	3240	3533	7.7
Industrial Processes:	293	295.6	298.3	311	281.8	277.6	268	-3.8
Total $C0_2$ Emissions by sources	***3124***	***2615***	***2717***	***3285***	***3330***	***3517***	***3801***	6.6
CO_2 Emissions and Removal by Sinks Categories								
Land use Change and Forestry								
Changes in Forest and Woody Biomass Stocks	-35719	-36372	-31117	-26724	-22324	-23150	-21874	-37.5
Forest and Grassland Conversion	5738	5738	5738	5738	5738	5738	5738	0.0
Abandonment of Managed Land (Total CO_2 Uptake)	-3292	-3292	-3292	-3292	-3292	-3292	-3292	0.0
Net of CO_2 Removals (-) /Emissions(+)	**-33273**	**-33926**	**-30872**	**-24278**	**-19878**	**-20704**	**-19428**	**-40.3**
Total Net CO_2 Emissions								

2.0 Methane Emissions (CH_4)								
Biomass Burned for Energy	102.9	113.7	131.3	144.9	155.8	156.2	156.2	51.4
Agriculture	223.6	227.2	217.7	230.7	220.6	222.2	234.9	-1.3
Land Use Change & Forestry	17.53	17.53	17.53	17.53	17.53	17.53	17.53	0.0
Waste:	17.37	18.75	21.05	20.65	20.55	21.65	22.3	18.3
Total CH_4 Emissions	**361.4**	**377.2**	**387.6**	**413.8**	**414.5**	**417.6**	**430.9**	**14.7**
Total $C0_2$ Equivalent CH_4 Emissions	*8,854*	*9,241*	*9,496*	*10,138*	*10,155*	*10,231*	*10,558*	*14.7*
3.0 Nitrous Oxide Emissions(N_20)								
Biomass Burned for Energy	0.50	0.50	0.60	0.70	0.80	0.80	0.80	60.0
Agriculture	2.00	2.03	2.02	2.02	2.01	2.01	2.01	0.5
Land Use Change and Forestry (Grassland Conversion)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.0
Human Waste	0.12	0.13	0.13	0.13	0.14	0.14	0.15	13.0
Total N20 Emissions	**2.74**	**2.78**	**2.87**	**2.97**	**3.07**	**3.07**	**3.08**	**11.9**
Total CO_2 Equivalent of N_20 Emissions	877.76	888.64	918.4	951.68	982.08	983.36	984.64	11.9
4. TOTAL. (NET) CO_2 EQUIVALENT EMISSIONS BY SOURCES AND REMOVAL BY SINKS	**-20,417**	**-21,181**	**-295,59**	**-9,904**	**-5,411**	**-5,973**	**-4,085**	**-73.5**

Figure. 5: Total Net CO_2 equivalent emissions by sources and removal by sinks

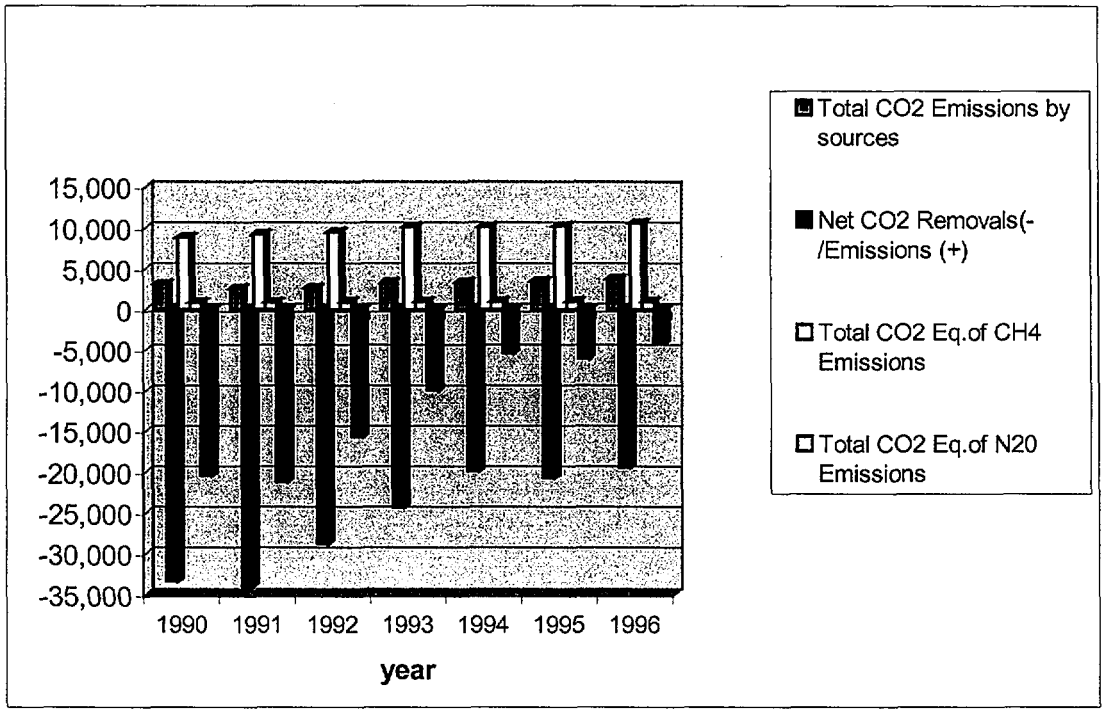
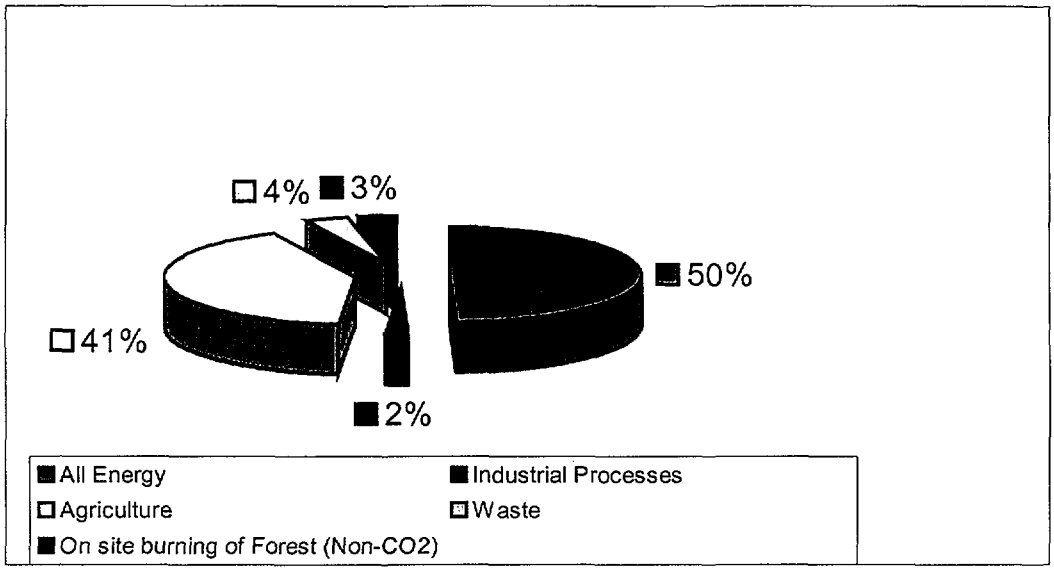


Figure.6: % Share of CO_2 equivalent emissions by sources, 1994



3.22 Industry Contribution to GHG Emissions

Industry's contribution to total National GHG emissions appears low, about 3% because the CO_2 emissions indicated are solely that from non-energy industrial processes, see Figure 6. The CO_2 and non-CO_2 emissions from energy consumption have been credited to energy sector inventories. The contribution of industry to energy sector emissions has not been quantified. In addition, the non-CO_2 emissions from industrial processes have not been estimated.

3.23 Industry Share of Fuel Consumption

The simplified IPCC methodology (Tier I) for fuel combustion was adopted for estimation of GHG from the Energy sector due to lack of data on technology and operations. The energy sector inventories, therefore, did not consider contributions of the significant national sub-sectors/subcategories namely: Industry, Agriculture, Residential/Commercial, and Transport. That notwithstanding, the distribution of energy consumption by combustion for these economic sub-sectors for the period 1985-1994 were estimated and illustrated in Figure 7. Figure 8 shows the petroleum consumption of these same sub-sectors over the period 1990-1994. It indicates that the industrial sub-sectors above consumed 17% of the total national consumption of petroleum in 1990, and this increased to 25% by 1994.

3.24 Industrial Processes (Non-Energy) Sector Inventories.

The relevant non-energy industrial processes sector that contribute significantly to GHG emissions are:

- Limestone use and lime production in the minerals sub-category.
- The limestone use in industry became very significant in 1996 as a result of the following:

a) The application of local oyster shells as a substitute of imported fluxing agents, and the substantial increase in iron and steel production level from about 60 MT/year to 120,000MT/year.
b) The use of the local oyster shells as calcium carbonate for neutralisation of acidic effluents in the mining sector.

The respective CO_2 emissions from the industrial sub-sectors; aluminum production, lime/limestone use and iron and steel production for 1994 are given in Figure 9. The GHG emissions from limestone-use/lime production increased significantly to 28Gg in 1996 representing 11% of CO_2 emissions from the industrial process sector.

Figure 7: Share of Industrial Sector Energy Consumption by Type 1985-1999

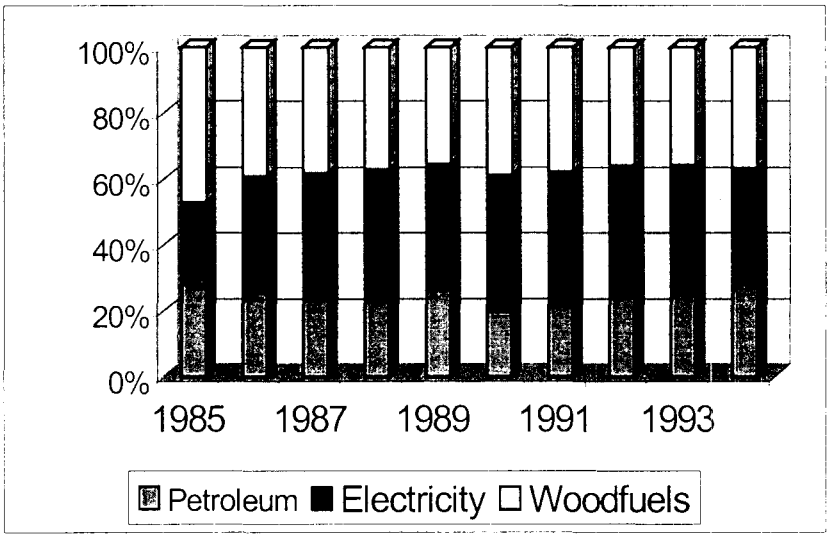


Figure8: Petroleum Products Consumption by Sub-Sector, 1990-1994

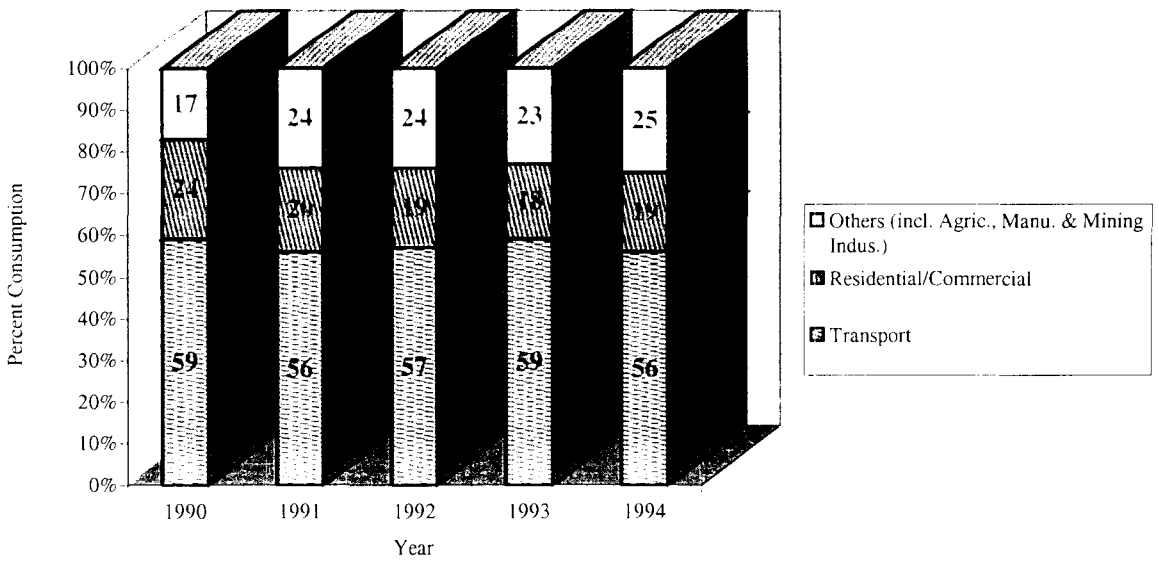
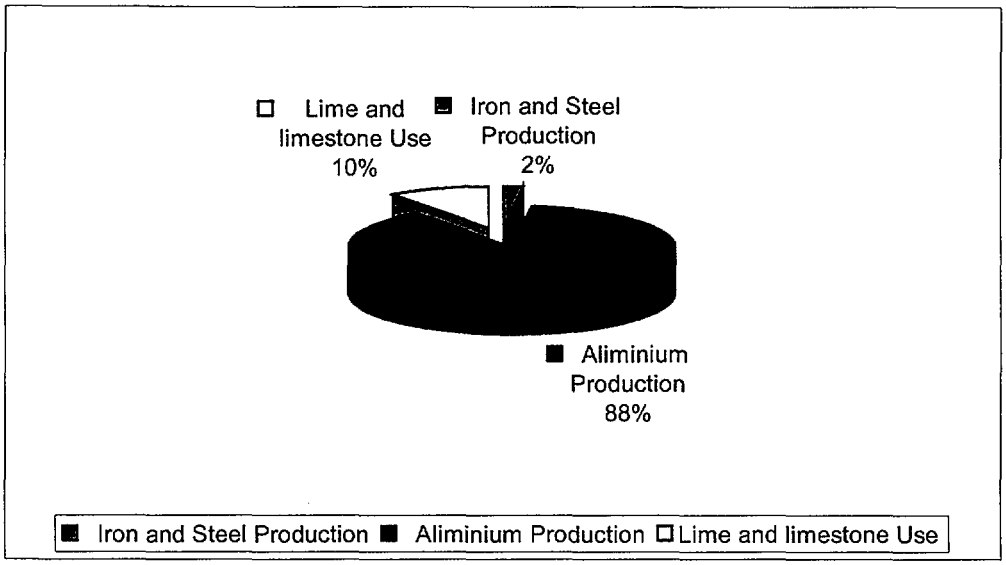


Figure 9: Share of CO_2 Emissions by Industrial Sub-Sectors 1994



3.25 Aluminium Production

The aluminium-smelting sub-sector contributed 81% of emissions in 1996 from 99% in 1993, equivalent to 230Gg and 311Gg respectively. The sharp drop in the emissions from the aluminium-smelting sub-sector was due to low hydro-dam operating levels and corresponding low energy generation and supply to the aluminium smelter that depends entirely on the hydropower. The levels of the hydro-dam depict the vulnerability of hydropower to drought in Ghana. Initial GCM models of climate change impacts substantiates the vulnerability Ghana's water resources to climate change.

3.26 Iron and Steel Sub-Category

Electric Arc Furnace scrap melting emissions due to EAF carbon electrode consumption also grew sharply from 1990 to 1996 as a result of substantial growth in the sector. Steel production rose from 550 MT (1990) to 110, 000 MT (1996). The increase was due to the divestiture of the state steel plant, the commissioning of one new plant and the rehabilitation of one old plant. The three plants operated at a high capacity utilisation of 90% equivalent to 110,000 Mt/year.

3.27 Cement Production

Cement production, which constitutes the largest source of CO_2 emissions in the mineral source categories of the industrial processes sector *presently, does not* contribute to GHG emissions in Ghana. This is because cement production in the country is basically by clinker processing only. However, the situation is projected to change with the consistent economic growth of the economy. For instance, the Country's large deposit of limestone, and indeed a national clinker production plant abandoned in the 1960s, (i.e. Buipe Lime) is likely to be re-activated by potential investors by the year 2003. The feasibility study has been completed, and the Environmental Impact Assessment is in progress currently.

TABLE 4: CONSUMPTION OF ENERGY BY SECTOR, 1985 - 1994

(TOE X 1000)

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	TOTAL
Residential and Commercial											
Petroleum	177.07	172.09	168.9559	188.2	205.4	197.48	131.88	158.34	161.66	186.88	1747.95
Electricity	46.33	52.33	.82	61.87	69.11	77.87	88.31	105.69	117.56	127.082784.7	805.97
Woodpiles	2123.37	2187.32	2253.44	2321.81	2392.53	2465.69	2541.38	2619.70	2700.77	**1098.66**	24390.71
Total	**2346.77**	**2411.74**	**2482,21**	**2571,89**	**2667.04**	**2741.03**	**2761.57**	**2883.73**	**2979.99**		**26944.63**
Industrial											
Petroleum	157.15	167.33	161.62	166.84	206.88	145,56	167.78	206.5	215.96	242.59	1838.21
Electricity	124.53	236.09	270.72	297.44	303.28	305.97	319.4	332.4	341.25	308.79	2839.87
Woodpiles	251.37	257.91	264.72	271.49	278.55	285.79	293.22	300.85	308.67	316.69	2829.15
Total	**533,05**	**661.33**	**696.95**	**735.78**	**788.71**	**737.33**	**780.41**	**839.75**	**865.87**	**868.07**	**7507.25**
Transportation											
Petroleum	339.65	386.87	383.63	450.69	516.52	493.06	376.02	487.42	537.23	557.25	4528.34
Electricity											
Woodfuels											
Total	**339.65**	**386.87**	**383.63**	**450.69**	**516.52**	**493.06**	**376.02**	**487.42**	**537.23**	**557.25**	4528.34
Grand Total	**2879.82**	**3073.07**	**3179.16**	**3307.67**	**3455.75**	**3478.36**	**3541.98**	**3723.48**	**3845.87**	**3966.73**	34451.89

4.0 CLIMATE CHALLENGE AND INDUSTRY

4.1 Vulnerability of Industry to CC

Climate Change, is a global phenomena associated with global warming and is the result of increases in the concentrations of anthropogenic greenhouse gases in the atmosphere. The major gases include CO_2, CH_4 and N_2O. Carbon dioxide (CO_2) is the most common greenhouse gas produced by anthropogenic activities. Global CO_2 accounts for about 60% of the increase in radiative forcing since pre-industrial times (IPCC, 1992). Statistical evidence also indicates that about 90% of CO_2 emissions are from the energy sector, particularly fossil fuel combustion and biomass burning for energy.

Ghana has predominantly been dependent on hydropower generation for electrical energy supply. The CO_2 emissions result namely from petroleum product combustion for thermal energy generation in industry and non-energy industrial processes sources. Thus, CO_2 emissions per capita are very low compared to per capita energy consumption. The over dependence on hydro-power plunged the country in energy supply crisis as a result of low operating water levels due to considerable increase in ambient temperatures in the 1980s and 1990s and consequent reduction in precipitation and drought. As a result of the power crisis experienced in 1981 and 1998, there has been national policy shift from hydro sources (i.e. CO_2–free) to diversifying the country's energy base into solar and thermal generation.

Presently, a combined cycle thermal power plant to supply 400 MW is under construction. The phase 1 of a 200 MW system has been completed. In addition, independent power producers are generating about 60 MW from Diesel-fired generating engines for the industries in Tema.

The shift to thermal energy and the considerable change of national energy mix, coupled with the sustained policy of removal of subsidies have substantially has raised the aggregate price of energy in the Country. Further, the removal of subsidies and realistic pricing of energy as well as introduction of penalty/surcharge on efficiency utilisation lower than 90% Power Factor Correction (PFC) have all contributed to the energy consumption cost, and thus affecting energy-intensive industries, as well industries operating at low energy efficiency levels.

Indeed, the energy price rise has already caused the shutdown of some electric arc furnace (EAF) operation in the iron and steel scrap melting plants. These companies have resorted to importation of steel billets for processing. The low water level in Akosombo Dam also led to the shutdown of some of the potlines in the aluminium smelting plant. The effect has therefore led to a lay off of some workers in the aluminium, and the iron and steel sectors.

The climate change challenge to the Ghanaian industry, under the increasing cost of energy generation due to diversification, is the adoption of most cost-effective energy efficiency enhancement options for thermal and electrical energy use in industry. It is generally observed that while major efficiency increases are being designed for energy generation (e.g. combined cycles), energy utilisation efficiency in industry is still only 8-10% relative to generation and overall plant utilisation factor from 20-35% most African industries (UNEP Report on CC and Industry). This implies that one unit saved at the industry level is equivalent to 20-25 units savings at the generation level and thus provide high sources of reduction in CO_2 emissions.

4.2 Recommended Energy Intensive Industries for the CDM Case Studies.

The recommended energy intensive industries, which are also significant national sources of non-energy industrial process CO_2 emissions, are:

- Three Iron and steel scrap melting plants with combined capacity of 120,000 MT/year,
- 200,000ton/year Aluminium smelter, which, at optimum capacity utilisation, consumes a greater percentage of the total hydropower generation in Ghana.

5.0 Sustainable Development (S.D.) And Sustainable Development Indicators (SDI)

5.1 National Sustainable Development Plan.

The Ghana Government has endorsed Agenda 21 and the concept of sustainable development as a blueprint of integrating environmental issues into the country's development. The country has subsequently developed the National Environmental Policy (NEP) and National Environmental Action Plan (NEAP). The policy actions outlines interventions deemed necessary to safeguard the environment. Though the plan, at the time of development did not directly consider CC issues, or the strategy for an energy security policy that addresses relevant climate change mitigation. These sustainable development issues include:

- Improving productivity and efficiency in the procurement, transformation, distribution and use of all energy sources.
- Ensuring the availability and equitable distribution of energy through increasing integrated efficiency measures from generation to end-use.
- Promoting the development of potential renewable energy technologies.
- Decreasing the consumption of firewood and charcoal by using more efficient cooking stoves to reduce deforestation.
- Conserving the country's forest resources through improved methods for charcoal and firewood production.
- Planning for the future security of biomass supplies through sustained agro-forestry.
- Substituting firewood and charcoal with LP Gas in accessible areas.

Others are:

- Create higher levels of awareness of the opportunities and benefits of energy efficiency improvement among all energy users (residential, commercial, industry, transportation)
- Achieve savings in per capita energy consumption in all areas of energy use through the application of appropriate technologies of higher energy efficiency and thereby slow down the growth of commercial energy consumption.
- Develop endogenous capacities for identification and implementation of energy efficiency measures.
- Develop institutional capabilities for implementation of strategies to realise the potential efficiency improvements in all the sectors of the national economy.

It is envisaged that the achievement of these policy actions would not only slow the growth of energy generation but would indirectly address environmental degradation that arises from energy projects.

5.2 Sustainable Development Indicators

Based on the National Environmental Action plan and Ghana's Vision 2020, National sustainable development indicators (SDI) of projects will include among others, factors that would contribute to the attainment of the national development objectives. These are to transform the country from the current status of severely indebted, exporter of non-fuel primary products, and low income to at least a lower middle income, moderately indebted, diversified exporter by the year 2020. These SDIs are:

- Effective integration of environmental considerations into projects so as to ensure minimisation of environmental impacts and thus break the vicious cycle of environmental cost that erode socio-economic gains.
- Poverty reduction
- Increased employment generation and average incomes to raise the current GNP of about ¢400 to a minimum of $1700 by 2020.
- Improvement of general health, welfare and well being of the majority of the population
- Positive contribution to GDP growth rate targeted at 8.3% to sustain the high rate of population growth of about 3.0% per annum.
- Contribution to real industry growth rate and raise the current GDP share of 14% to 36% of which manufacturing is 25%.
- Increase literacy level and the proportion of the population with secondary, technical, and tertiary education.
- Contribution to improving the balance of the trade position of the country through competitive import substitution and foreign exchange savings, as well as export oriented and foreign exchange earning potential.

The aluminium smelter offers a potential sub-regional project since Ghana, Nigeria and Cameroon are all presently operating aluminium smelters.

Energy efficiency improvement plants for individual industries may not be substantial for case studies. However, the industry cluster concept, which is currently being used in UNIDO's Country programme can be adopted for a number of industries at the regional level.

6.0 BARRIERS AND CAPACITY NEEDS TO ENSURE ADOPTION OF ENERGY AND PROCESS EFFICIENT TECHNOLOGIES AS GHG MITIGATION OPTION

The Ministry of Mines & Energy carried out an Energy Efficiency and Conservation Programme in the mid-1980s, with the primary aim of demonstrating the potential for energy conservation in Ghanaian industrial and commercial enterprises. As a result, a few Ghanaian companies, especially the larger multinational companies, have demonstrated some appreciable level of energy management capacities and have put in place energy management schemes on their own. However, the bulk of Ghanaian industrial firms, especially the MSEs,

lack basic energy management capabilities due to the existence of some major constraints that limit the implementation of energy efficiency measures.

6.1 Barriers

The UNIDO integrated capacity building project for Ghana identified specific barriers including:

- Lack of awareness on the part of plant owners, managers and technical personnel of the options available to improve their energy efficiency and also of the need to conserve natural resources and protect the environment;
- Lack of awareness of and access to energy-efficient equipment on the part of local equipment suppliers:
- Difficulty of access, especially by MSEs, to bank loans and other types of commercial financing for energy efficiency measures;
- Lack of codes, standards and guides on energy efficiency.
- Lack of adequate physical infrastructure for energy distribution.

The above barriers were also emphasised at the Africa CDM stakeholders' forum organised in Accra (ref.: Summary of Stakeholders Response to ETC questionnaire)

However, regarding local expertise and consultancy services for diagnostic and measuring technologies. The Government of Ghana has initiated and implemented a policy to mobilise local expertise to undertake energy efficiency programmes in industry. The energy Foundation of Ghana has been established and is working effectively with local consultancy services.

The constraint to effectiveness at this programme is principally availability of adequate equipment. Other barriers identified include; inadequacy of the existing framework of fiscal and financial incentives and services to encourage the adoption of energy efficiency schemes.

6.2 Barrier Removal Recommendations

Under the UNIDO Integrated country programme, a preparatory assistance project would be implemented to:

- Review the current situation and the problems related to MSE's;
- Raise awareness among MSE's;
- Analyse the existing barriers to energy conservation;
- Identify the options for barrier removal;
- Prepare a large–scale project with pilot and demonstration projects at selected MSE's.

Further, the Government counterpart will be strengthened through the training overseas of three local engineers in energy management to conduct energy audits. This support, together with the monitoring equipment to be provided will enable the counterpart to carry out energy audits and provide advice on how to reduce the specific energy consumption in selected industrial processes in MSMEs.

At the UNIDO Africa CDM workshop, the industry partners and the ESCOs identified the following as major barriers needing removal for the implementation of CDM. These are:

- Provision for Data development, financial incentives, and internal energy audits capabilities while the ESCO's (energy services companies),
- Data sharing and dissemination, information on project financing, CDM project identification, formulation, and methodologies on quantification of baseline and emission reduction assessment.

7.0 STAKEHOLDERS

7.1 Stakeholders Forum

At the national forum on Africa CDM organised on November 29, 1999, the potential core stakeholder identification was based on the project's targeted National Support Systems namely: Technology, Support services for technology assessment, Investment support services for CDM investment promotion, and Legislative support system.

The stakeholders of the forum were drawn from industry, financial services, industry support services, and Government. The Donor community, including the Royal Danish Embassy, (DANIDA) The World Bank, USAID, CIDA, JICA, UK/DIFD, EU and Caisse Francaise have all being notified of the UNIDO Africa CDM Initiative. All the letters were signed by the UNIDO country Director.

7.2 Stakeholders-In-Place

The initial stakeholders enlisted at the Forum have been classified as follows:

Industry Partners/Private Sector Host

The two high-energy intensive sectors of the metal industry identified earlier were endorsed at the Forum. They are:

- Volta Aluminium Company Limited (VALCO) – an aluminium smelting industry
- Iron and steel scrap melting plants namely:
  - Ferro Fabric Limited, Tema
  - Wahome steel Limited, Tema
  - Tema Steel Company Limited, Tema

Policy / Government Support System

- Ministry of Environment, Science and Technology (GEF Focal point for CC activities)
- Ministry of Mines and Energy
- Ministry of Trade and Industry

Legislative Regulatory Support

- Energy Foundation.
- Energy Commission
- Public Utilities Regulatory Commission
- Environmental Protection Agency

Technology Support System

- Energy Foundation
- Dekon Engineering Services
- Centre for Innovation and enterprise Development and Kumasi Institute of Technology and Environment (KITE) in University of Science and Technology, (Centre of Excellence)

Investment Support

- Ghana Investment Promotion Centre (GIPC)
- National Development Planing Commission
- Ghana News Agency (Media)
- UNDP/GEF-Small Grants Program.

7.3 Additional Targeted Stakeholders

In addition to the initial core stakeholders the following have also been targeted:

- National Development Banks:
  - National Investment Bank
  - Metropolitan Allied Bank.
- Electricity Company of Ghana. (End-use Energy Distributor)
- Volta River Authority (VRA) (thermal & hydropower generation company)
- Institute of Industrial Research (IIR) of the CSIR.
- Parliamentary sub-committee on Environment and Finance.

7.4 Results/Outcome of National Stakeholders Forum.

The national stakeholders' forum was organised in close collaboration with the UNIDO Country Director. The UNIDO Country Director signed all the letters to identified stakeholders, including the Donor Community.

The Forum essentially discussed the UNIDO Africa CDM project initiative, raised awareness of the climate change, the UNFCCC, the Kyoto Protocol and the emerging Financial mechanisms, particularly AIJ & CDM which are of relevance to Developing Country Parties to the Climate convention.

The outcome of the Forum is summarised as follows:

- Eighteen (18) Institutions and organisation participated. They comprised, industry, consultants, government Departments, Regulatory bodies, the media and centres of excellence.
- The UNIDO Country office performed the opening. Two Technical papers were presented namely:

  a) The UNIDO Africa CDM Project: Objectives and Expected Output.
  b) Meeting Climate Challenge: Role of Industry in Energy Efficiency Improvement.

- Participants completed Africa CDM Questionnaire

- The plenary discussions centered on:

    a) UNFCCC, Kyoto protocol and Financial Mechanisms (AIJ & CDM)
    b) Opportunities under the Financial mechanisms for FDI flow to sustainable development projects of potential GHG emissions reduction in existing operations
    c) Linkage between energy and process efficiency enhancement and GHG emission reduction potentials, a pre-requisite for attracting AIJ/CDM investor parties.

- Sustainable development indicators as also a pre-requisite for meeting developing country's criteria for hosting CDM/AIJ projects.
- Need of Core group and networking with international institutions to develop and strengthen national capacity to identify and implement AIJ/CDM projects.
- Awareness of the reality of financing opportunities under AIJ's using the US-JI case studies in Costa Rica.

The forum strongly endorsed the UNIDO initiative and the project implementation approach based on the integrated stakeholders core group concept. The observations made by participants during the plenary session include the following:

- That there is the need of effective dissemination of the obligations and provisions of the convention and the Kyoto Protocol to Policy and Decision makers to facilitate development of AIJ/CDM projects, and suggested that the parliamentary sub-committee on Environment, and Finance should be major stakeholders as well metropolitan/District Authorities.
- That the process of awareness raising, involvement and consultation of the private and public sectors, is commendable and should be sustained.
- That GHG mitigation projects, under CDM are welcome as long as they lead to Foreign Direct Investment (FDI) on the basis of the transfer of clean technologies, which are energy and process efficient, as well as cost effective, and would increase industry competitiveness in the global market.

8.0 SELECTED INDUSTRIAL SECTORS

The CO_2 emissions averages for the high-energy intensity industrial sectors selected, namely: Aluminium production, and Iron and Steel Scrap Processing Plants are summarised below. The estimations include non-energy CO_2 emissions and oil equivalent energy consumption.

8.1 Primary Aluminium Production

8.11 Brief Process Description

The primary aluminium smelting process in Volta Aluminium Company Ltd. (VALCO) employs pre-baked technology. The alumina reduction is carried out in large steel shells/pots lined with carbon and silicon carbide. The electrolyte or bath is made up of cryolite, alumina, "spar", and aluminium fluoride. The pre-baked carbon anodes are produced in the plant at the "Green Carbon" section. The baked anodes are attached to copper rods. The cathode is made of pre-baked carbon lining.

8.12 Energy CO_2 Emissions Estimate, 1986-1996

During the aluminium smelting process, molten aluminium is formed at the cathode while the anode is consumed in the reaction with alumina, thereby emitting CO_2. The reaction equation is $Al_2O_3 + 3/2C \Rightarrow 2Al + CO_2$. Most CO_2 is evolved from the reaction of the anode carbon with alumina, but some is formed as the anode reacts with other sources of oxygen during the cell operation and as well as during the production of pre-baked anodes. The plant-installed capacity is 200,000 MT of aluminium. The raw material consumption and energy efficiency averages for 1986-96 is summarised in the Table 5.

8.13 Trend of Non-Energy CO2 Emissions Factor and Activity Data, 1986-1996 (MT)

The trend of non-energy CO_2 specific emissions and Activity Data for aluminium production is depicted in Figure 10 and summarised in Table 6.

8.14 Potential Savings

The energy consumption and non-energy emissions factors for the industrial processes for production technology options for the Aluminium industry are summarised in Table 7.

Table 5: Aluminium Production and Energy Consumption Efficiency Data

PRODUCTION & ENERGY CONSUMPTION ACTIVITY DATA		
PARAMETER	unit	1986-1996
Production	MT	1,714,330
gross carbon	MT	1,103,112
butts returned	MT	332,622
net carbon	MT	774,054
POWER		
VOLTS/POT		4.673
DC Mwh		26,106,412
EFFICIENCY DATA		
KPD	kg/pot day	1,046.2
Current Efficiency		91.43
Gross Carbon/kg Al	kg/kg. Al	0.64
Butts returned/kg	kg/kg. Al	0.19
Net Carbon/Kg al	kg/kg. Al	0.45
DC. KWh/kg.Al	kwh/kg.Al	15.23

Based on the best available technology option, a potential reduction of specific energy consumption from the best operating average of 14.92 MWH to 13.70 MHW would potentially save 8.0% of the average total energy consumption representing 1.22 MWH/ton aluminum. At peak production, capacity utilisation of 90%, this would be equivalent to 219,600 MWH savings a year at the plant level. Assuming the estimated leverage of downstream efficiencies, the equivalent savings at thermal power plant level would be about 1,756,000 MHW per year. Based on a single cycle thermal plant operating at an efficiency of

34%, this savings would represent a thermal plant CO_2 emissions reduction of 464Gg per year.

Table 6: Aggregate Non-Energy CO_2 Emissions Estimation, 1986-1996

Activity Data		Emission Factor	Aggregate CO_2 Emissions	Plant CO_2 Emission Factor
Average Annual Aluminium Production Tonne Al	Average Annual Specific Net-Carbon Consumption Tonne C/tonne Al	Tonne CO_2/tonne Al	Gg CO_2/year	Kg CO_2/tonne Al
155848.2	0.452	3.6	253.596	1625

Figure 10: Activity Data and Specific CO_2 Emissions per Tonne Aluminum, 1986-1997

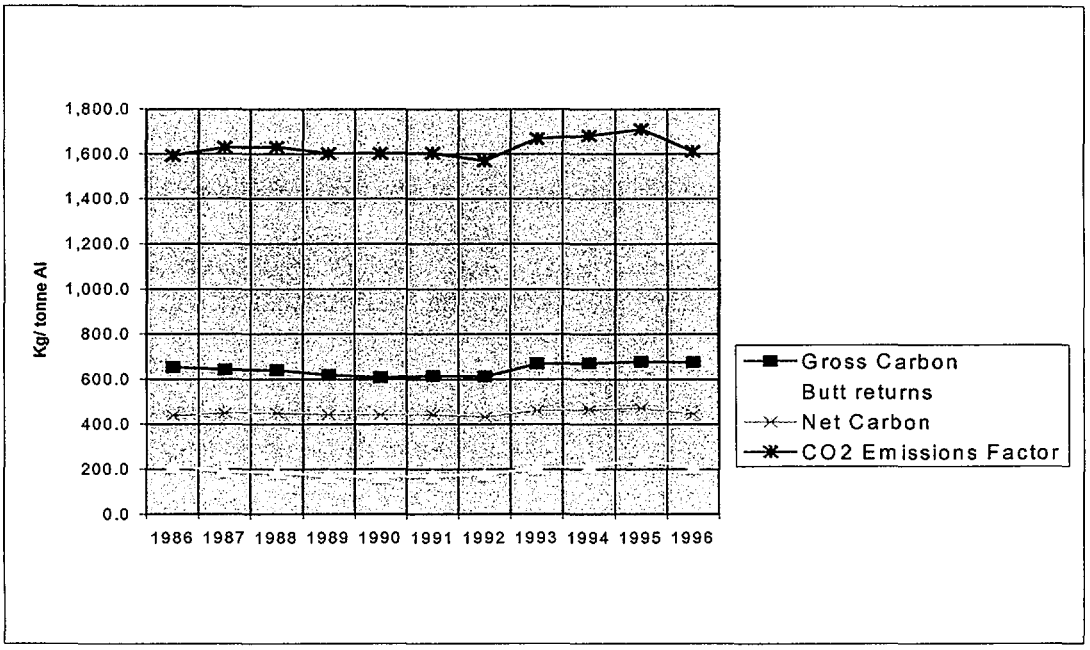


Table 7: Production Technology Options for Aluminium Smelting

		Technology Options			
Parameter		**Pre-baked Existing**	**Improved Prebaked**	**New Pre-Baked**	**Best Available Technology**
Electricity Consumption	**MWH/tonne**	16.20	17.00	14.50	13.70
CO2 Emissions Factor	**kg/tonne**	1020	1570	1140	1010

Source. Indutrial Processes Mitigation Options, IPCC

8.2 Iron and Steel Scrap Processing

8.21 Process Description

The production processes common to all the three steel plants comprise of:

- Scrap charging and melting in electric arc furnaces (EAF)
- Continuous batch casting of billets
- Oil-fired preheating of billets
- Hot rolling mills for the production of iron rods.
- Oxygen production plants for generation of oxygen for lancing EAF melt as well for cutting scrap.

Additionally, Wahome steel has an acetylene production plant, and Tema Steel Company Ltd. operates two induction furnaces. Both Wahome Steel and Tema Steel produce angle iron in addition to iron rods.

8.22 CO_2 Emission Estimations

The CO_2 emissions sources in the steel plants result from the following non-energy industrial processes.

a) Graphite electrode consumption in the electric arc furnace during melting operations. ($C+O_2$ CO_2)
b) Local limestone charges used as fluxing agent, which undergoes dissociation giving off carbon dioxide and calcium oxide during slag formation and reduction of iron oxide.
c) (Ca/CO_3 $CaO + CO_2$)
d) Carbon alloy burnt off as a result of the part of the carbon addition in the form of cathode carbon scraps obtained from aluminium electrolytic cells (pots) at VALCO.

The CO_2 emission estimation indicates that the oxidation rate of carbon added for alloying is about 8-10 kg per ton steel while limestone consumption is 49-50 kg/tonne. The CO_2 emissions estimated is 5.9Gg at combined capacity utilisation of 92%. This represents an over all specific emissions of 0.053 ton CO_2 per ton steel production, and 2% of the total industrial processes emissions of 268Gg CO_2.

8.23 Energy Demand and Consumption Profile

A Preliminary study has been carried out, by a local consulting firm in collaboration with Energy Foundation, on the energy load management in the three steel mills. This was to identify the energy demand at peak load and also at off peak in order to recommend the most appropriate load management that potentially could result in peak demand savings. The study also assessed the energy efficiency of the various load centers.
Further, an initial assessment of improving the furnace preheating firing efficiency in addition to introduction of hot rolling has shown that it is possible to reduce fuel consumption from the current high level of about 65L/ton down to about 33 L/ton. This represents over 49% fuel savings equivalent to a further CO_2 emissions reduction of 9.2Gg. The steel sector in Ghana therefore offers a very good opportunity for technology transfer and a CDM project.

9.0 CONCLUSIONS & RECOMMENDATIONS

The emerging global commitment to stabilise greenhouse gases to levels that would not dangerously interfere with the world climate system, particularly through CO_2-emissions reduction to mitigate Climate Change, would become a major driving force in technology innovation and initiatives by developed country Parties to the FCCC to improve global energy efficiency. This is also because, the energy sector offers potential areas of minimum regret options in the short and long term, particularly for developing countries that have the opportunity to choose an alternative sustainable development path with minimised greenhouse gas emissions.

Financing has potentially been a barrier to adoption of technology innovations and modification. This is the very reason why the emerging multilateral financial mechanism, the clean development mechanism (CDM), under the Kyoto Protocol, must be seen by governments and private sector of developing country Parties as an opportunity for international co-operation and a chance to drive technology transfer as well as flow of FDI for sustainable development.

In the light of this, the decision to initiate the UNIDO Africa CDM project is seen as very laudable as it seeks to enhance capacities in Africa to ensure effective participation in the emerging financial mechanism. The response and the level of participation in the Stakeholders forum organised in Accra on the 29th of November indicates that giving the required awareness raising in Ghana by the project, we would be able to achieve the set target to develop a bankable project by 2001.

It has been emphasised that one major barrier removal strategy should be effectively making climate issues relevant to the policy and decision-makers to facilitate integration of CC issues into national policies. It would indeed take the co-operative effort of Government, and Private Sector in the development and implementation of acceptable policies and strategies in developing countries to attract foreign direct investment under the emerging financial mechanisms of the Climate Convention and the Protocol, and to open the doors for industry's adoption and improvement of energy and process efficiency.

Ghana has coincidentally developed Capacity building project with UNIDO for implementation. The project has Component 5 addressing energy efficiency improvement in industry, which is aimed at making particularly the high-energy intensive industries competitive in view of the rising cost of energy production and use. The selected industry sectors, namely: Scrap Steel Melting Plants and Aluminium Production are strategic in any energy conservation programme. For instance 1.22MWH per ton aluminium saving would be equivalent to 244,000MWH energy saving per year at 90 % capacity utilisation (180,000 ton/year production) and represents an approximate 463Gg CO_2 emissions reduction. Similarly, the specific energy consumption of the steel sector can potentially be reduced by about 334 KWH per ton, which would be equivalent to a saving of 34,068MWH per year for 85% capacity utilisation. This could achieved by modernisation of the two old steel melting plants, and improvement of energy efficiency in all the three plants by appropriate technology transfer. The metal sector therefore holds enormous potential for CDM projects being developed.

The sectors development also meets most of the government's criteria for sustainable development, which is a prerequisite for an investor country under the Kyoto Protocol. This

is because the project benefits would include; direct employment and income generation, indirect employment generation and poverty reduction for, especially, the urban and peri-urban poor. In addition it would address sustainable energy use to effectively slow down the growth of the country's energy consumption, and also contribute to the country's GDP, foreign exchange earning and foreign exchange savings in the provision of steel required to support the economic growth of the country.

Further, the projects are likely to be highly competitive regarding CO_2 abatement at the thermal power generation level, as well as reduction of non-energy CO_2 emissions that can potentially result from more efficient EAF operation.

Finally the extension of the pilot phase of the Activities Implemented jointly (AIJs) at COP/MOP 6 in Bonn further emphasises the urgency the global community places on Africa's participation in the clean development business. Thus, the UNIDO project should be seen more under the principles of co-operation in the promotion of effective modalities for the development, application, and diffusion of, or access to, environmentally sound technologies, know-how, practices, and processes pertinent to climate change. Therefore, the process should be moved forward to attain the goals we set ourselves in April 1995, at the Parties to the FCCC where the authorisation of the international pilot phase of AIJ was given.

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Chapter Four

Concept For Developing National Capacity To Implement Industrial Clean Development Mechanism Project In Africa

Kenya Case Study

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1.0 INTRODUCTION

1.1 Background

Kenya ratified the United Nations Framework Convention on Climate Change (UNFCCC) on the 30th August 1994. Kenya has yet to put in place laws and measures that specifically address climate change but relies on existing sectoral laws and policies.

Parties to the UNFCCC agreed to submit "national communications" that would include inventories of emission sources and sinks. However, Kenya has not yet made a country communication. Several workshops and meetings have been held in Kenya but no significant achievements have been made due to limited financial resources and lack of sufficient human capacity to implement commitments under the Kyoto protocol.

In 1996 the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) approved funding for a Capacity Building project for four sub-Saharan countries (Ghana, Kenya, Mali and Zimbabwe) to enable them respond to the UNFCCC. Kenya is implementing this project through four Working Groups which have been assigned tasks of creating public awareness on climate change, assessing the impacts of and adaptation options to climate change, compiling the national inventories of greenhouse gases and formulating mitigation options.

The working group on mitigation options was mandated to formulate steps to be taken by the Kenyan Government to implement the UNFCCC. The report is to include circumstances that influence CDM in industry. The work on mitigation options started by reviewing existing sectoral policies and measures that directly or indirectly mitigate climate change or control emissions of anthropogenic gases. The review covers energy, transport, industry, agriculture, forestry and waste management sectors. The mitigation option study concentrates on carbon dioxide emissions and opportunities for addressing them.

The National Climate Change Activities Co-ordination Committee (NCCACC) under the Ministry of Environment & Natural Resources has prepared guidelines to guide government ministries in evaluating project proposals initiated from within or outside the country on Joint Implementation (JI) and Activities Implemented Jointly (AIJ).

1.2 National Circumstances

This section covers those aspects relating to national efforts to address climate change convention.

1.21 CDM AND KENYA'S VULNERABILITY TO CLIMATE CHANGE

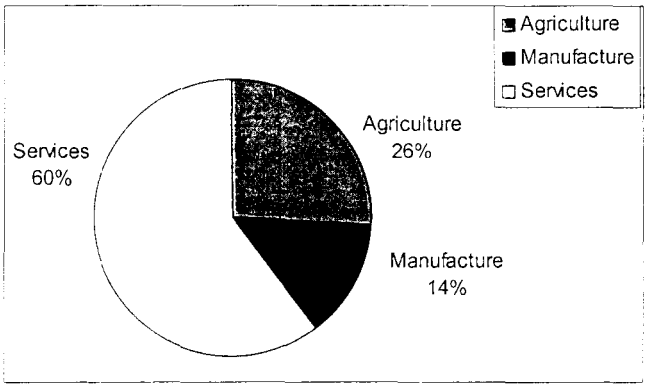
Kenya is an East African country bordered to the west by Uganda, to the south by Tanzania, to the east by Somalia, to the north by Ethiopia and Sudan and to the southeast by the Indian Ocean with a coastline of 400 km. It covers an area of 587,000 km^2 and is extremely vulnerable to the effects of climate change because of its dependence on agriculture. Of this area, 80% is classified as Arid and Semi-Arid Lands (ASAL). The country is highly prone to drought and desertification, both of which will be exacerbated

by climate change. There are serious indications in Kenya that dry lands are becoming even drier. There is also and increased frequency of extreme climatic events such as El-Nino.

1.22 ECONOMIC SITUATION

Agriculture has been the main stay of the Kenyan economy. This sector also supports agro-based industries. The contribution of agriculture to GDP has shown a decline from 37% in 1964 to 26% in 1995, indicating a gradual shift from agricultural reliance to manufacturing (Figure 1 and Table 1).

Figure. 1 Sectoral shares in real gross domestic product 1995 (%)



Source: Government of Kenya, 8th National Development Plan 1997-2001 (Modified)

Table 1: Key Economic Indicators

Criteria	1994	1995	1996
Population (million)	27	28	32
Relevant area (KM^2) whole country arid/semi arid	587,900	587,900	587,900
Estimated share of informal sector in GDP (%)	5.6	5.7	6.1*
Share of manufacturing industry GDP %	13.6	13.8	14*
Share of services in GDP %	15.8	15.35	15.05
Share of agriculture in GDP %	25.01	25.00	25.00
Arable land (KM^2)	52047	52047	52047
Urban population as % total of total population	20*	21.5*	22.0*
Livestock population	9175*	9616e	10170e
Forest area (km^2)	20310	20310	20310
Population in absolute poverty	47.8	48.0	48.02
Literacy	72.8*	73.0*	73.4*

Source: Government of Kenya central Bureau of statistics, 1994, 1995, 1996, and 1997
e= estimate *= projection

Manufacturing production is concentrated in urban areas around the high potential areas. This sector recorded an increase from 10% in 1964 to an average of 13.6% in 1995. This implicitly means higher energy consumption and increased emissions of green house gases (GHG).

The service sector contributes over half of Kenya's GDP and provides over two thirds of the total employment. The potential contribution of the service sector to GHGs is through

transportation, dumping of wastes generated and deforestation. Currently, there is limited awareness of the impacts of the sector's activities on the environment.

1.23 Energy

The current energy scenario in Kenya shows heavy dependence on fossil fuels in support of modern economic sector and a continued reliance on dwindling biomass-based fuels. Table 2 shows the national energy consumption outlook for 1995 by percentage.

Table 2. National energy consumption by percentage

Source	Proportion (%)
Wood fuel	68
Petroleum fuels	21
Electricity	10
Others	1

Source: Ministry of Energy 1/1/95

The fossil fuels account for a large share of the national import bill and are also the major source of greenhouse gas emissions, see Table 3

Table 3. National fossil energy

Sector	Proportion of the total (%)
Transport	67
Industry	24
Agriculture	4
Power generation	3
Government	2

Source: Economic Review 1996

It is important to note that fossil fuel consumption by the domestic sub-sector, mainly in the form of Kerosene, shows that it is an insignificant proportion in comparison with the overall national aggregate.

1.24 KENYA'S NATIONAL PRIORITY

The crucial challenges facing Kenya is reduction of poverty, unemployment, fulfillment of basic needs and economic growth (Table 1). The Kenyan Government has embarked on programmes aimed at enhancing the industrial sector development geared towards transforming Kenya into a newly industrialized country (NIC) by the year 2020. The current National Development plan, (1997–2001) articulates deliberate policies and promotional initiatives for industrialization. The plan further seeks to establish harmony between environmental conservation and industrialization for sustainable development.

Industrial growth will pose a great environmental threat and challenge to Kenya in the future, especially in its contribution to international efforts to mitigate climate change.

Climate change will have a significant impact upon the very resources humans and other species rely on for survival in Kenya. Hence, Kenya must find finances and resources to aggressively mitigate climate change by addressing emissions and removals by sinks of GHGs.

2.0 CLIMATE CHANGE ACTIVITIES

2.1 Bilateral Activities

In 1994, the United States of America funded a country study programme on climate change impacts, vulnerability and adaptation analysis. The study culminated in the documentation of climate change and vulnerability trends in Kenya.

Most of the climate change issues are tackled somehow indirectly at sectoral levels. This approach is too restrictive and is found to duplicate efforts. Therefore developing capacity to undertake research on costs of reducing negative impacts of climate change and to enable policy options to be devised for the integration of climate change information into the general planning process including inter-sectoral coordination should be encouraged.

2.2 Multi-Lateral Activities

UNDP/GEF (1996) funded a capacity building project in four Sub-Saharan countries (Ghana, Kenya, Mali, and Zimbabwe) to enable them respond to the UNFCCC. Kenya is implementing this project through 4 working groups:

- Public awareness on climate change
- National Inventories of GHGs
- Mitigation options.
- Impacts and adaptations to climate change.

Under the above project, NCCACC has held workshops and seminars on awareness creation, climate change impacts and mitigation at the national level but it has not penetrated the district and grass root communities due to financial constraints. Only one workshop was held at national level. Both the print and the electronic media are limited both in outreach and language communications. Climate Network Africa, a local NGO, has a quarterly publication "IMPACT" which disseminates information and raises awareness on climate change issues.

Another attempt has been through providing support to the promotion of environmental issues in schools, training institutions and public universities.

Mitigation options have been developed at sectoral level. Impacts and adaptations to climate change have been documented.

Other multi-lateral activities include:

- The UNEP/GEF study of IPCC GHGs inventory methodology applied to land use change in Kenya identified serious gaps in Research and Data Management.

- The UNEP study on the implications of climate change, sea level rise and vulnerability assessment of selected coastlines, which has provided some data relevant for studies on the vulnerability of the coastal zones, potential climate change effects and adaptation measures.
- The UNIDO/WORLD BANK project on Energy Efficiency and Environmental Conservation in Industries.

2.3 National Activities

In order to fulfill the commitments under the Kyoto Protocol, the Kenya government, with financial support from donors, initiated activities aimed at establishing an inventory of GHGs in the following sectors of the economy: Energy, Industry, Agriculture, Land use, Forestry, and Urban wastes. Gases that were considered during the survey include: Carbon dioxide (CO_2), Methane (CH_4), Carbon monoxide (CO), Nitrogen Oxide (N_2O) and other oxides of nitrogen (NO_x). To date, only three activities in the core areas of the convention have been undertaken, namely:

- National inventories of Green House Gas sources and sinks;
- Climate Change mitigation options;
- Climate Change Impacts, Vulnerability and Adaptation

The reports of these studies have accordingly been presented in three volumes with their respective titles. Although the findings of the study may not be very conclusive due to the many GHG sources and sinks that were not accounted for, it concluded that:

- Kenya is a net GHG emitter
- Forests act as sinks of carbon dioxide

The aspects not accounted for in the study include: CO_2 sources and sinks in the agricultural sector, CH_4 and other GHGs from industrial waste and CH_4 from wildlife other than the African buffalo, lakes and other open water surfaces which can act as sinks, emissions of CH_4 from wetlands and SO_x emissions. This scenario has partly delayed submission of the country communication.

3.0 NATIONAL COMMUNICATIONS

In accordance with article 4.1 of UNFCCC, all parties to the convention are required to periodically update and report on the national inventory of anthropogenic emissions and sinks of Green House Gases (GHGs). Although Kenya ratified the treaty on 30th August 1994, to date, the country is yet to finalize her first national communication to the UNFCCC. A few workshops have so far been held towards the preparation of the first draft. The progress has, however been hampered by lack of funds. In July 1999, funds for this were received from GEF to help put up these communications. It is expected that the four working groups will have generated adequate information/data to put up the first draft of the communications.

4.0 CLIMATE CHANGE AND INDUSTRY

Activities already undertaken in 2.0 & 3.0 above and are relevant to industry include:

- **National activities:** National inventories of GHGs sources and sinks in the energy sector, industry (cement) and urban waste.
- **Bilateral activities:** None of those carried out is relevant to industry
- **Multilateral:** The UNIDO/WORLD BANK project on Energy Efficiency and Environmental Conservation in industry.

In Kenya, the manufacturing sector is dominated by inefficient, uncompetitive, traditional, and low technology industries. The sector also relies heavily on imported intermediate inputs and machinery - a combination of factors that make the sector a significant emitter of GHGs.

4.1 Mitigating Emission of Carbon Dioxide and Other GHGs

Many small industries especially in rural towns rely on biomass (wood fuel) and/or fossil fuel. These numerous point sources collectively make significant GHGs contribution into the atmosphere. A good example of the level of demand is wood fuel, which in 1995 was at 20,107,000 m^3. It is projected that in 2002, the demand would be 25,662,000 m^3, which will be sourced from forests, and woody vegetation stands.

To reduce the pressure on forests, vast quantities of available agricultural waste with high calorific value must be harnessed. Such waste include rice husk, bagasse from sugar manufacture, saw dust from sawmills, and coconut shells. These may be used as substitute fuel for firing small-scale kilns in the manufacture of building materials (i.e. bricks and tiles and lime). Used engine oils can also be a significant source of energy for firing kilns in cement industries).

The Kenya Association of Manufacturers (KAM) has an on-going programme to study (through energy Audits) and sensitize industrialists on energy efficiency and conservation. When the project commenced in 1989 it was found that industries in Kenya wasted 10-45% of fuel oil. This situation has since improved and manufacturers are becoming more aware of the benefits of saving their energy resources. Kenya Industrial Research and Development Institute (KIRDI) is directly involved in conducting energy audits for industries and development of renewable energy technologies. KIRDI is in the process of setting up a National Clean Production Center for Kenya, which will contribute significantly to the reduction of emissions and contribute to sustainable industrial development.

5.0 DEVELOPMENT OF SUSTAINABLE DEVELOPMENT (SD) AND SUSTAINABLE INDUSTRIAL DEVELOPMENT (SID) OBJECTIVES

SD and SID indicators are necessary for the evaluation of projects to determine their sustainability in terms of:

- Poverty eradication;
- Employment creation;
- Improved nutrition levels;

- Sustainable Urban population densities;
- Quality of development with respect to socio-economic dimensions;
- Sustainable resource utilisation; and
- Qualities of industrial development with respect to adoption of environmentally sound technologies

5.1 Criteria for Developing Indicators

Criterion that may be adopted to arrive at setting limits may be the "Steady State Criterion" in which changes tend to cancel each other out in a dynamic sense i.e. there must be always a balance between the amounts of resources or effluent used and those produced. Maintaining such a state is one of the operable definitions of SD.

5.2 Proposed Indicators for SD And SID

The main objective of SID is to ensure efficient utilisation of energy and raw materials. However the following indicators may be used to evaluate performance of industries towards SID.

- Export concentration ratio of 1:1;
- Ratio of consumption of renewable resources to non renewable resources should be 1:1;
- Efficient Industrial consumption of water per-capita;
- Efficient fuel wood consumption per-capita;
- Implementation of policies aimed at the promotion of industrial ecology and cleaner production technologies;
- Efficient industrial production processes;
- Increased material recycling in industry;
- Substitution with lower energy-intensity raw materials;
- Thermal process optimisation;
- Improved operation and maintenance;
- Recovery and re-use of leaked or released methane, CO_2, and GHGs;
- Implementation of industrial ecology policies; and
- Adoption of cleaner production technologies/techniques.

There are no sustainable development indicators already developed in Kenya. However two workshops have already been organized with a view to developing criteria for establishing sector specific indicators for SID and SD.

6.0 CONSTRAINTS

6.1 General Barriers Applicable to Industry

In order to identify industry specific barriers currently hindering acquisition of cleaner technologies to local industries in Kenya, a survey was carried out by KIRDI in November 1999 to ascertain the situation. The study addressed the following:

- Barriers to technology acquisition by industry.

- Existing and missing capacity in institutions supporting industry in technology acquisition and Climate Change activities.
- Case study of two energy intensive industries.

The criteria for selection were based on the top 50 energy intensive industries in Kenya and their potential generation of GHGs. A total of 25 industries were selected covering 7 sectors: pulp and paper, iron and steel, cement, textiles, mining, petrochemicals and food processing. The following tables show the findings of the survey and recommendations from the stakeholders' workshop:

Barriers	Proposed intervention measures
Poor access to efficient production technologies.	• Information exchange and education through workshops, seminars, etc. • Training on process and technology management.
Poor access to markets and low quality products	• Expansion of local market base • Enhancing demand for quality products through lowering production costs.
Lack of suitable/appropriate raw materials	• Provision of cost-effective measures for procuring and/or manufacturing of high quality raw materials locally or overseas.
Lack of enabling legal and regulatory framework	• Capacity building on policy formulation; • Provision of tax incentives to stimulate investments in ESTs; • Strict adherence to customs regulations on imported goods.
Inadequate financial systems	• Provision of innovative financial arrangements such as low interest loans, grants, tax credits and accelerated depreciation • Provision of soft loans for CDM related projects.
WeakTechnologyManagementsupportservices	• Improve capacity of local consultants; • Capacity development in support institutions.
Poor physical infrastructure and utilities	• Provision of incentives for private companies to co-generate power for own use; • Lowering of tariffs for internet, e-mail and other electronic communication; • Encourage private sector to invest in infrastructure.
Lack of priority on environmental management in production processes	• Training in environmental engineering and awareness creation; • Regular environmental audits.
Inadequate energy efficiency practices	• Building institutional capacity to respond to industry's energy optimization needs

6.2 Sector Specific Barriers

The barriers listed above are applicable to all the sectors surveyed. The study established that the large industries that have foreign partners through whom information on the CDM and available technologies have in general have obtained such information to differing degrees. In addition these large industries have access to cheaper offshore funds. However all the barriers within the country are applicable to them.

Indigenous small and medium enterprises are not so privileged unlike their large counter parts in terms of accessing foreign funding and information. They also have weak internal capacities to utilize available information and manage CDM related technologies. They are most vulnerable to poor and expensive infrastructure since they do not have co-generation or other alternative sources of utilities.

6.3 Institutional and Policy Gaps

The following are some of the policy and institutional gaps currently being experience in Kenya.

Institutional Gaps:

- Weak linkages and co-ordination of matters of cleaner technology acquisition;
- Poor networking;
- Inability to identify potential partners;
- Lack of effective R&D;
- Weak analytical procedure on terms and conditions of technology acquisition;
- Lack of skilled man power to carry out specialized duties
- Lack of adequate resource center for effective information dissemination

Policy Gaps:

- Lack of policies geared towards promotion of cleaner technology acquisition
- Poor policies on environmentally sound energy and material pricing;
- Policies on tax incentives;
- Policies aimed at establishing standards and testing protocols;
- Policies on eco-labeling and green consumerism;
- Integrated policies on resources planning including energy efficiency and environmental management system.

7.0 STAKEHOLDERS

7.1 In Place (Existing)

The existing institutions involved in industry and climate change activities are

summarized in the tables below:

7.11 Government Departments and Parastatals

Institution	Function
National Environment Secretariat (NES)-Ministry of Environment and Natural Resources	• Focal point (UNFCCC) • Coordinates Inter-ministerial committee on Environment (IMCE) • Policies and strategies on climate change. • Natural Resources conservation
Kenya Industrial Research and Development Institute (KIRDI)	• Co-ordination • Implementation of CDM activities • Technology vetting, acquisition & transfer • Policy advice
Kenya Meteorological Department	• Monitoring of weather patterns in Kenya.
Department of Resource Surveys and Remote Sensing (DRSRS)	• Monitoring of Kenya's Natural Resources
Ministry of Energy	• Coordination of energy development & conservation activities countrywide.
Ministry of Trade, Tourism & Industry	• Industrial Policy
Ministry of planning and national development	• Plans for sustainable development in Kenya.
Survey of Kenya	• Development of photogrammetric maps of climate.
Kenya Wildlife Services (KWS)	• Research on impact of Climate Change on Flora and Fauna.
Kenya Forests Research Institute (KEFRI)	• R & D in forestry • Conservation of forests
National Museums of Kenya	• Research on biodiversity
Kenya Electricity Generation Company (KEN-GEN)	• Electric power generation
Moi University (School of Environmental Studies)	• Capacity building in Environmental Science including Climate change
University of Nairobi (Department of Meteorology)	• Capacity building in meteorology)
Kenyatta University Faculty of Environmental Science)	• Capacity building in Environmental Management.

7.12 Private Support Institutions and NGOs

Institution	Function
Climate Network Africa (CAN)	Awareness Creation on Climate Change
Kenya Association of Manufacturers	Lobbies for industry interests
Bamburi Portland Cement Company	Cement manufacturing Company
PanAfrican Paper Mills (EA) Ltd.	Paper manufacturing company
Unga Ltd.	Millers of cereals
Galsheet Kenya Ltd.	Steel rolling mills
Kenya Pipeline Co. Ltd.	Petroleum / gas pipeline
Kenya Breweries Ltd.	Brewery
KAPA oil refineries	Cooking fats/detergents manufacturer
East African Portland Cement	Cement manufacturer

7.2 Targeted (Additional) Stakeholders

7.21 Public Institutions Indirectly Involved in Climate Change

Institution	Function
Lake Basin Development Authority (LDA)	Rehabilitation of the lake basin for sustainable Economic Development
Investment Promotion Center (IPC)	Information on investment opportunities and provides guidelines on technology transfer and acquisition.
Kenya Marine and Fisheries Research institute (KEMFRI)	Undertakes marine research- oceans are important Carbon dioxide sinks.
Kenya Industrial Estates (KIE)	Provision of loans to small scale enterprises
Industrial and Commercial Development Co-operation (ICDC)	Financial assistance to SMEs
The Permanent Presidential Commission on Soil Conservation and Afforestation	Promotes Environmental Conservation in Kenya
Kenya Agricultural Research Institute (KARI)	Conducts Agricultural research in Kenya
Kenya Tea Development Authority (KTDA)	Research on Tea Development

7.22 Targeted (Additional) Stake Holders (Private And NGOs)

Institution	Function
African Academy of Sciences (AAS)	Coordinates Scientific Research in Africa.
African Center for Technology Studies (ACTS)	Policy Research on Biodiversity and related areas.
Kenya Energy NGO (KENGO)	Executes Research in the Energy Sector.
Other manufacturing companies	

7.3 Results of the National Stakeholder's Meeting

A meeting of stakeholders (from industry, Government, and NGOs) was held in Nairobi to brainstorm on CDM and Industry. A total of 20 stakeholders from industry, Government Ministries, Research Institutions, Universities and Non-governmental Organizations attended. The main aim of the meeting was to seek the stakeholders' view on ways and means of creating an enabling environment for the effective implementation of CDM projects in the country as well as identification and removal of constraints/barriers to CDM.

7.31 Issues Discussed

❑ *Information Dissemination*

- The meeting noted that there is need to collect, synthesize and package information to sensitize the local industries to adopt cleaner production mechanisms with a view to enable them benefit from CDM projects.
- Form a network of stakeholders in industry and support institutions to enhance rapid information exchange

❑ *Capacity Building*

- There is need to build capacity of those already working in the industry and other support organizations to be able to formulate, appraise and implement bankable projects.

❑ *Technology Transfer*

The meeting noted that, the existing industry related policies are in adequate in addressing environment and industry related problems, hence, pro-active policies that will encourage the effective implementation of CDM projects should be put in place so to:

- Avoid GHG emissions
- Substitute GHG emitting technologies
- Shift to higher productivity but low lower-emission of GHG technologies
- Increase the efficiency of energy conservation and use
- Introduce GHG removal technologies

❑ *Identification of CDM Projects*

It was resolved during the meeting that, CDM projects should satisfy both sustainable development and emission reduction objectives concurrently. This is on the understanding that, for Kenya, the development challenge is to increase the provision of the basic needs for adequate food, shelter, health and literacy. Therefore, CDM projects should facilitate industrialization by targeting the following key sectoral areas:

- Increased food production
- Appropriate Shelter
- Transportation

- Employment creation

7.32 Barriers Agreed on at the Meeting

The participants identified the following as major barriers to CDM implementation in Kenya:

- Lack of awareness of CDM in industry;
- Lack of finances, poor infrastructure and in adequate human capacity both in industry and support institutions to implement CDM projects;
- Lack of umbrella administrative and environmental law;
- Lack of co-ordination among the stakeholders;
- Lack of technological capacity to support industry in identification and vetting of technologies and establishment of their impacts on national development;
- Lack of government policy to compel multi-nationals to conduct their R&D locally. The industrial property act should be revised to cater for this;
- Lack of flow of information from top management to operators in industry; which hampers information flow;
- A lack of mechanisms to ensure that middle management staff are involved in CDM;
- Political and social instability;
- Poor macro and micro economic stability;
- Electric power rationing and high unit costs;
- Lack of baseline studies;
- Poor state of roads and communication networks;
- Poor co-ordination of data acquisition, sharing and dissemination
- Lack of free dialogue between government and private sector;
- Lack of emission guidelines.

7.33 Meeting Recommendations

The following recommendations were made:

- There is need for awareness creation of CDM and climate change in industry;
- There is urgent need to build local capacity to facilitate faster establishment of baseline information as well as eventual removal of barriers to allow for faster CDM implementation;
- Sustainable industrial development indicators have not been properly identified. There is need to define and formulate SID indicators in Kenya;
- Need for development, packaging of information and modes of passing information to industry in order to make the required impact;
- There is need to put up a data base inventory in environment, climate change and CDM;
- Activities under CDM e.g. certification/verification be done by local parties. Kenya should be pro-active so that our own experts go out as verification officers;
- Need for formulation of policy to allow disclosing of information or undertake certain measures which provide information on individual industries, on the

state of the environment, and non-confidentiality of environmental information;

- Emissions are accounted for at National level, hence the government should have policies to guide such emissions;
- Technology transfer into Kenya needs vetting for sustainability so as to promote those that utilize local raw materials;
- KIRDI to source for funds to enable stakeholders from industry to be trained to observe CDM as well as facilitate technology transfer;
- KIRDI and industry to participate in global and international negotiations on climate change;
- Establishment and maintenance of free dialogue between the government and the private sector;
- Government to enhance further integration of policies and regulation systems. Government need to adopt integrated environmental policies in industry;
- There is need for establishment of baseline data for CDM and Climate Change related issues. However, care needs to be taken as political interests may interfere in setting up of such data;
- Kenya does not necessarily require emission reduction, but rather its priority is sustainable development geared towards poverty alleviation and creation of employment;
- Environmentally sound energy sources to supplement hydro-electric power needed;
- Investment to rehabilitate and expand physical infrastructure; and
- Trade investment reforms on the part to government, with reduced tariffs and barriers to domestic and foreign investment.

8.0 INDUSTRIAL SECTORS

A review of the operating processes was done in the two energy-intensive sectors in Kenya: the cement and pulp and paper industries. The findings of this study are given below:

8.1 Technologies in Use and Emission Levels

8.11 Cement Manufacturing

The cement sector in Kenya uses the dry process that is modern, efficient and easily controlled. In the dry process the raw materials are crushed and transported to stock-piles. Reclaimed raw materials in the right proportions are then passed through a grinding mill, and the resulting raw mix with the desired chemical composition is passed through a pre-heating tower (cyclone) to the cement kiln. The kilns are fired using fuel oil or alternatively coal to a temperature of ~1450 °C. The resulting clinker is cooled and finely ground into cement. The sector emitted a gross total of 2936 Gg of carbon dioxide at an annual average of 734 Gg during the period 1989-1992. This accounted for 98% of the total carbon dioxide output.

8.12 Pulp and Paper Manufacturing

This sector uses the wet Kraft process. The key components of this process are: formation of sodium hydroxide, formation of sodium sulphide, combustion of organic

substances, separation of materials, removal of water and by-product recovery.

8.2 Technology Needs for Two Energy Intensive Industries

8.21 Pulp and Paper Sector

- Energy conservation technologies;
- Generation of electricity from other alternative sources such as micro-hydro-power plants;
- An EST to eliminate the present smell nuisance possibly due to mercaptans:
- Technology that emits less CO_2 from the processes.
- Preventive technology maintenance skills;
- Technologies to reduce raw material losses; and
- Diagnostic and measuring technologies.

8.22 Cement Sector

- Energy conservation technologies;
- Generation of electricity from other alternative sources such as micro-hydro-power plants;
- Technologies to reduce raw material losses; and
- Diagnostic and measuring technologies.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The following are recommended for UNIDO support in capacity building:

- Undertake a study on information flows within the stakeholder institutions dealing directly or indirectly with UNFCCC with a view to enhancing networking.
- Formation of an association to co-ordinate activities of these institutions.
- Building capacity to vet CDM projects to make them consistent with national sustainable development priorities such as poverty alleviation, job creation, food security etc.
- Financial support in CDM project implementation.
- Support for strengthening institutional capacity.
- Establishment of a national clearing-house for vetting projects and technologies under CDM.
- In Kenya, the demand for energy outstrips supply which therefore calls for the promotion of the development of renewable sources of energy such as solar, wind, geothermal, tidal, mini and micro-hydro potential sites, hence, the need to increase funding to such projects.
- Promotion of conservation of all forms of energy at various levels by adopting efficient energy utilization technologies.
- Education, public awareness raising and environmentally sound technology transfer to be enhanced at all levels of the society to create a collective responsibility in CDM projects implementation.
- Strengthen capacity for R & D in appropriate technologies and to facilitate

establishment of environmental management systems, management information systems and necessary infrastructure frameworks.

- There is need to establish a more defined and focused policy framework for addressing Climate Change issues.
- There is need for upgrading current mining technologies in Kenya and empowering miners in mine-rehabilitation practices such as those of quarry sites etc.
- Establishment of criteria for and development of baselines in all sectors of industrial development. There is also need for training in methodological principles to be used in baseline studies and environmental additionality.
- There is need for capacity building to develop SID indicators.
- The proponents of CDM hoped that it be market-based and be run by industry. KIRDI was therefore urged to facilitate industry to be pro-active in CDM activities. UNIDO needs to strengthen KIRDI to spearhead industry towards this goal.
- To attract CDM in industry, there is need for the removal of industrial investment barriers such as infrastructure, taxation policies and high interest rates. Thus, UNIDO should assist in overcoming these barriers.
- In SMEs, awareness, policy, capacity building, financial and technological support were identified as the major impediments to technology transfer. In addition there is disjointed effort by KIRDI, KAM, KIPO, and Ministry of
- Industry in addressing these needs. UNIDO's empowerment of KIRDI to create impact in this industrial sector was recommended. Demonstration projects on ESTs were also recommended.
- There is need to open a window for CDM within the existing Climate Change National structure to specifically address capacity building within industry.
- There is need for capacity building to package and transfer CDM information in a format that is appealing to industry so that it can cause a ripple action.
- Roundtable meetings and workshops were recommended as a good means of overcoming the existing mistrust between industrialists, researchers, consultants etc. UNIDO needs to facilitate these roundtable meetings.

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Chapter Five

Concept For Developing National Capacity To Implement Industrial Clean Development Mechanism Project In Africa

Nigeria Case Study

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1.0 INTRODUCTION

1.1 Background

The basic aim of the United Nations Framework Convention on Climate Change (UNFCCC) is the stabilization of atmospheric concentrations of greenhouse gases (GHGs), at a level that will prevent dangerous anthropogenic interferences with the global climate system. Nigeria is a party to the UNFCCC; and as such, is an active participant at the various international meetings on climate change issues, including the annual Conference of Parties, (COPs). The adoption of the UNFCCC in 1992 by the international community can be said to be an endorsement for the need to reverse the negative impact on the global environment, and as such, a launching pad for stronger actions aimed creation of global sustainable environmental policies in the future. The framework provides for regular review of the performance of the convention, especially in response to changes in scientific understanding.

At one of such reviews, specifically at the first conference of parties (COP.1), which was held in Berlin, Germany, in 1995, the Parties concluded that the commitments of the developed, industrialized nations of the world, namely, to the goal of returning emissions of GHGs in the year 2000 to the 1990 levels may not be achieved if further commitments were not obtained from this group of nations. As a result of this conclusion, an Adhoc Group known as the Berlin Mandate (AGBM) was set up to draft an agreement, which was subsequently presented at the COP.3 for discussion and final negotiation. The result of the negotiation was the consensus decision (1/CP.3) to adopt a protocol under which industrialized countries will reduce their combined greenhouse gas emissions by at least 5% compared to the 1990 levels by the period 2008 – 2012. This decision was reached at the COP.3, which was held in Kyoto, Japan in December 1997. The decision gave birth to the Kyoto Protocol. Although the Protocol was adopted at the COP.3, the implementation mechanisms constituted the bulk of the discussions and negotiations at COP.4, which was held in Bueno Airres, Argentina in November 1998. One of the mechanisms for achieving the objectives of the consensus decision that emanated from these discussions is the Clean Development Mechanism (CDM).

The CDM is elucidated in Article 12 of the Kyoto Protocol. For the purpose of this paper, we present an outline of some of the salient features of the CDM below:

(a) The CDM is to assist Parties not included in Annex I (mostly developing countries) to achieve sustainable development and to contribute to the ultimate objective of the convention;
(b) The CDM is to assist Parties included in Annex I (mostly developed, industrialized countries) to achieve compliance with their quantified emission limitation and reduction commitments (QELRC);
(c) The CDM will enable Parties not included in Annex I to benefit from project activities resulting in certified emission reductions;
(d) The CDM will enable Parties included in Annex I to use Certified Emission Reductions earned from such projects (funded by them in a non-Annex I country), to contribute to their QELRC as stipulated in Article 3 of the Protocol;

(e) Emission reductions resulting from such project activities shall be certified by operational entities to be designated by the Conference of the Parties serving as the meeting of the Parties to Kyoto Protocol on the basis of:

- Voluntary participation, approved by each Party involved;
- Real, measurable, and long-term benefits related to the mitigation of climate change, and;
- Reductions in emissions that are additional to any that would occur in the absence of the certified project activity;

(f) The CDM shall assist in arranging funding of certified project activities as necessary;

(g) The COP serving as the meeting of Parties (Annex I and Non-Annex I) has been given the mandate to organise and elaborate modalities and procedures that will ensure transparency, efficiency and accountability of the CDM processes.

(h) Share of the proceeds from certified project activities shall be used to cover administrative costs of the process and assist developing country Parties, especially those Vulnerable to the adverse effect of climate change, to meet the cost of adaptation;

(i) Participation under the CDM, may involve private and/or public entities and will be subject to guidance that will be provided by the Executive Board of the CDM;

(j) Certified emission reductions obtained during the period 2000 – 2008 can be used to assist in achieving compliance during the commitment period 2008 – 2012.

Prior to the COP.4, workshops on CDM were held in three centers in Africa, namely: Nairobi, Kenya; Abidjan, Cote d'Ivoire; and Accra, Ghana. The position of African Parties was developed at these fora. The results from the fora, point to a consensus on interest among the African Parties to the UNFCCC to embrace CDM. The African parties resolved after these workshops, to call for more elaboration on principles and modalities for operationalizing the CDM. The African Parties also concluded that of all the three mechanisms included in the Kyoto Protocol, the CDM is the most relevant to African Countries. The consensus opinion of the experts from these nations are however that for CDM to contribute effectively, issues such as: capital needs and funding mechanism; infrastructural deficiencies in the countries; project sustainability; equity in terms of benefits and access to technology; technology transfer, must be comprehensively addressed prior to the take-off of the CDM. As a result, these nations, including Nigeria, view capacity building as an essential component of the CDM if it is to become a sustainable development strategy. In this respect, CDM must involve capacity building, especially prior to its take-off in these nations. Assistance must be offered to these non–Annex I nations in the areas of CDM project design, implementation and evaluation. The ability of existing institutions to handle the CDM processes must be enhanced, while new institutions to guarantee the involvement and coordination of necessary stakeholders must be put in place.

At the recently concluded COP.5 in Bonn, Germany, the Nigerian delegation led by the Honourable Minister of Environment, Dr. Hassan Adamu, reiterated the seriousness accorded climate change activities by the Nigerian Government. In his speech at the fifth conference of Parties, Dr. Adamu who is to assume the Chairmanship of the Group of 77 and China by January 2000 stressed the need for both developed and developing nations to take their commitments to climate change issues more seriously. The Minister said, "Five years after entry into force of the UNFCCC, very little has been achieved in terms of fulfilling our, and especially, Annex I Parties commitments under the convention. Yet, we are seeking the entry into force of the Protocol by the year 2002, a landmark that will be reached before we act. In fact, there is a tendency to believe from corridor discussions, the unwillingness of some developed countries to ratify the Protocol in order to stall the whole process". The Minister continued, "Nigeria believes it is high time we stopped this stalling tactics. COP.5 must come up with concrete decisions that will assist developing countries to achieve sustainable development".

The Minister reiterated the need for capacity building, development and transfer of technology as major steps along this direction and made a call for a substantive review of the proposed CDM mechanism. On CDM, the Minister said, "Despite the advances made so far in CDM elaboration, COP.5 should endeavor to arrive at substantive decisions regarding implementation of the CDM. Nigeria according to the Minister believes that not only should projects under CDM be equitably distributed, they should pursue real economic growth and sustainable development in the non-Annex I countries. This he said, is the reason behind the Nigerian delegation's proposal of a CDM Equitable Distribution Fund to COP.5. Nigeria he further elucidated, is willing to participate in a viable and transparent CDM that will consider African participation in its governance. He argued that CDM must be made competitive with other flexible mechanisms (JIs and AIJs) while being additional to domestic efforts in these nations. He stressed the fact that Nigeria's doors are widely opened to all potential investors from Annex I Parties who are willing to invest in CDM projects in the country. The Minister informed that some of the potential CDM projects that Nigeria have identified towards this end, include: the Trans-West African Gas Pipeline; Gas extraction/Enhancement of the Liquefied Natural Gas (LNG) Plant's capacity; Sub-regional Integrated Railway Transportation and Hydro-Power Generation Enhancement in the ECOWAS sub-region.

The UNIDO project, "Concept for Developing National Capacity to Implement Industrial Clean Development Mechanism Project", in six selected African countries namely, Ghana, Kenya, Nigeria, Senegal, Zambia and Zimbabwe, will go a long way, in addressing some of the issues of concern to African countries elucidated above. Specifically, UNIDO with its experience, should be able to use the present project to assist Nigeria (and the other five nations), to develop adequate institutional infrastructures for the identification and development of CDM projects. The process should also create an enabling environment to illuminate the requirements needed for the channeling of investment resources for CDM projects within the country. The UNIDO initiative will result in: the preparation of a framework for capacity building in each of the six countries to enhance CDM processes; identification of potential CDM projects; preparation of specific project documents for each country for the purpose of assessing funds for some demonstration CDM projects; activities to enhance institutional and technical capacity building in each country; and actual implementation of CDM projects in each of the six nations.

1.2 Nigeria's National Circumstances

1.21 Geographical Setting

Nigeria, a West African nation, shares borders with the sahel fringe of the Sahara desert to the North and the Atlantic ocean to the south. The nations at Nigeria's borders include: Benin and Niger Republics to the West; Chad Republic to the North; Cameroun to the East. The Gulf of Guinea is at the southern border. Nigeria is the most populous nation in Africa. With an estimated population of about 104 million, it is the 11th most populous nation in the world. The country is endowed with a total land area of about 924,000 square kilometers and hence an estimated population density of about 96 person per km^2.

Nigeria is located approximately between latitude 4° and 14°N and longitude 2°2" and 14° 30" E. Of the land area endowment, 35% is cultivable / arable land, 30% is non-cultivable, 15% is pastures, 10% is forest reserves, while the remaining 10% are settlements and other natural features.

The major climatic features of Nigeria results from the influences of two main wind systems: the moist relatively cool monsoon wind which blows from the south – west across the Atlantic ocean towards the country bringing rainfall; and the hot, dry, dust laden harmattan winds, which blows from the north – east across the Sahara desert, with its accompanying dry weather and dust laden air. There are thus two distinct hydrological regimes in the country, rainy and dry seasons. Atmospheric temperatures are continually high and relatively stable throughout the year. Temperature ranges between 25°C (77°F) and 30°C (86°F) in the rainy season, and between 20°C (68°F) and 30°C (86°F) in the dry season. Lower temperatures are experienced in the southern parts, which are mostly coastal due to the moderating influences of the sea. Higher temperatures are experienced in the Northern parts which are proximal to the Sahara desert. Rainfall ranges between less than 500mm to over 3,000 mm per annum. In the southern areas, rainfall persists virtually all year round, and is characterized by a double maximal. Rainfall decreases towards the north, both in quantity and duration. As such, it is typical to have rainfall for 10 – 11 months in Warri, a southern location, whereas in Kano in the upper North, rainfall is restricted to the period between May and September. A consequence of the intensity of rainfall in different part of the country is the wide variation in vegetation type and structure.

Five major vegetation belts are found in the country. The mangrove swamps are located along the coastal bounds of the country, and extend inwards, within the reaches of the tidal influence. Immediately after the mangroves, the rain forest can be found, which stretches, almost to the middle parts of the country. Next to this is the Savannah grassland, which characterizes areas of medium to low rainfall. The guinea Savannah occurs in areas of moderate rainfall while the Sahel Savannah can be found in areas with the least rainfall.

1.22 Economic Setting

Economic Development as measured by the growth of real-GDP declined consistently in Nigeria during the period 1985 – 1994. As shown in Table 1 below, after this period of declining growth, the country's economic condition improved marginally by the end of 1996.

Real GDP growth improved from the 1994 level of 1.3 % per annum to 2.2% per annum by 1995 and 3.3% p.a by the end of 1996. During this period, i.e. 1995 to 1996, inflation declined from 72.8% to 29.3% while other macro-economic indicators stabilized.

Table 1:THE CHANGING STRUCTURE OF GDP IN NIGERIA 1985 – 1996 (IN PER CENT)

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
GDP at 1984 factor Cost (=N=' million)	68,916.3	71,075.9	70,741.4	77,752.5	83,495.2	90,342.1	94,614.1	97,431.1	100,015.2	101,330.0	103,510.0	107,030.0
GDP Growth Rate (in %)	0	3.0	-0.4	9.0	6.9	7.6	4.5	2.8	2.5	1.3	2.2	3.3

Source: Central Bank of Nigeria Statistical Bulletin, Vol. 8 (No. 1), June 1997.

A comparison of economic performance indices for Nigeria and other developing economies during the period 1965–1995 showed that the country's economy experienced serious declines. In 1965 for example, Nigeria's GDP was about US$ 5.8 billion. During the same year the GDP of the following developing countries were: US$ 3.8 billion (Indonesia); US$ 3.1 billion (Malaysia) and US$ 9.8 billion (Venezuela). Thirty years later in 1995, these nations economic performance as measured by their GDPs were: Nigeria (US$26.8 billion); Indonesia (US$ 198 billion); Malaysia (US$ 85 billion); and Venezuela (US$ 75 billion). These numbers showed that while Nigeria's GDP grew by about 3.6 fold during this thirty years period, the minimum among these other developing country was that of Venezuela which grew 20 fold, and the maximum was Indonesia which recorded about 52 fold increase over the 1965 levels. Both Venezuela and Indonesia are Oil Producing and Exporting Countries (OPEC) like Nigeria, and clearly, they have been able to utilize revenue from their oil and gas resources to enhance productivity, income generation and general economic development during there thirty years period. It is therefore not surprising, that the overall quality of life of the average Nigerian as measured by the Human Development Index (HDI) is low compared to that of those countries. As an example, in 1993, the HDI for Nigeria, according to the UNDP Human Development Report (1996) was put at about 0.4 while that of Ghana was (0.48), Indonesia (0.68) and developing countries average about 0.6.

The economic growth philosophy followed by governments in Nigeria, over these thirty years was the reason behind the lack-lustre performance of the economy. The pre-independence era in Nigeria was characterised by domination by raw material exports. As soon as independence was achieved, economic philosophy shifted to a public sector/state led economic development policies. The government was assumed to be in the best position to rapidly develop and industrialise the economy, and given the large inflow of revenue from crude oil exports in the 1970s, the government was also thought to have the best wherewithal for funding economic development.

Focus later shifted to Import Substitution Industrialization (ISI) whereby government aimsed at industrializing the country to produce what is being imported, thereby conserving scarce foreign exchange. This strategy led to the importation of machinery and equipment for the industrial facilities, with the process being funded by revenue from export of raw

commodities. To enhance the success of the ISI, local industries were protected from foreign competition by the imposition of high import barriers. Industries promoted during this period (mid 1970s – early 1980s) include: Steel Rolling Mills; Machine Tools; Vehicle Assembly; Fertilizer Manufacturing; Sugar Mills; Aluminum Plants; Paper Mills; Development Banks; Textile Factories; Insurance etc. The protection provided initially encouraged the private sector participation in ISI. Only to discover that scarcity of foreign exchange to meet import requirements was a limiting factor. With time, protected industries became inefficient and import dependent, thereby signaling the flopping of ISI.

Another philosophy, which was also utilized to promote economic development during part of the period mentioned above, was the Indigenization decree of 1972 and 1977. This, it was believed would give Nigerians greater opportunities compared to preceding period, to participate in the productive sectors of the economy. The idea behind indigenisation was to localize ownership through equity transfer to individuals, and direct government participation and the listing of part of the equity of foreign companies on the Nigerian Stock exchange. The decree also sought to limit the section of the economy in which foreign companies can operate. The aim was to push foreign capital into higher technology areas, thereby creating opportunities for Nigerians in other areas. The Indigenisation decree was partly successful. It did not shift control to Nigerians and it significantly reduced foreign direct investment (FDI) in Nigeria.

The Structural Adjustment Programme (SAP) was introduced in 1986 to serve as a departure from public sector led development process that has been practiced over the years. Instead of public sector control, SAP was aimed at creating a market oriented development process with emphasis on smaller government, efficient resource allocation, and market determined prices. The embodied economic development policy had the government still playing a major role in the economy, but within the ambit of market forces and enhanced private sector investment. Generally speaking, it is the general consensus in Nigeria that the goals and objectives of SAP were not realised. The result is a weak economic infrastructural base, a substantial decline in consumer's buying power and lowered quality of life. The Vision 2010 Report that was released in September 1997 gave a very sound elucidation of where we are on specific economic issues in Nigeria. Some salient summaries of the elucidation is presented below:

1.221 Macroeconomic Issues

(i) **Fiscal Policy**

The Nigerian government has moved in recent years towards a low tax regime, however, current personal and corporate tax rates are still considered to be too high to promote compliance and attract investment. This situation is also exercerbated by weak and corrupt tax administration and tax evasion. The Federal Government expenditure during the period 1995 – 1997 averaged about 75% of total expenditure pointing to a high level of centralization. A large proportion of government's recurrent expenditure, about 45% of total expenditure, is used to service external debt, an unhealthy position for the country's economic growth potential. Although there was a substantial increase in non-oil revenue during the period 1995 – 1997, the increase has been attributed to the improved collection of Custom and Excise Duties and

the Value Added Tax (VAT) rather than a marked increase in the productivity of the real sectors.

(ii) **Monetary Policy**

The promulgation of the Central Bank of Nigeria (Amendment) Decree No. 3 of 1997 has seriously constrained institutional arrangements for the execution of monetary policies. Past efforts, starting from the 1980s to deregulate interest rates and credit management have not succeeded due to delays in policy reaction. Excess liquidity has remained a permanent feature of the system, and this has caused instability of prices.

(iii) **International Trade**

Nigeria's export is dominated by crude oil exports, with crude oil exports accounting for 95% of total exports in 1995. Not only is the economy mono-commodity dependent, the country's share in World's total trade is small compared to those of similar developing economies. For example in 1995, the figure was 0.3% for Nigeria compared to 1.1% for Thailand and 1.3 for Malaysia. While Nigeria has failed to improve its total exports by increasing the volume of value added manufactured goods, Malaysia and Indonesia with a similar resource base have managed to do exactly that. Reasons for policy failures in this direction in Nigeria as elucidated in the Vision 2010 document include: weak technological skill base; in-adequate infrastructure; poor product quality; the persistence of import substitution industrialization; and ineffective implementation of export incentives.

(iv) **Trade and Distribution**

The Trade and Distribution sector of the Nigerian economy accounted for about 13% of the GDP in 1997. Nigeria has a very large market potential with a population of well over 100 million. The potential of this market has however largely remained undeveloped due to various reasons including: dilapidated infrastructure; over dependence on road transport which is already in a bad state; high cost of distributive trade; predominance of cash as the payment system; poor quality of goods and presence of fake, adulterated, illicit and poorly copied products in the market; inadequate availability of preservation facilities, cold stores silos etc; poor implementation of regulation; etc.

1.222 The Real Sectors

(i) **Agriculture**

Farms below 10 hectares account for almost 95% of total agricultural production in Nigeria. The sector is characterised by predominantly small holder subsistence farmers. About two thirds of Nigerian population earn a living from this sector. The sector accounted for 30.1% of Nigeria's GDP in

1996, this is compared to over 60% in 1960. Agricultural exports averaged over 60% in the 1960s. But with the development of the oil sector in subsequent years, and the dominance of the export sector by crude oil, the share of agriculture declined considerably. The Oil boom of the 1970s led to a neglect of the agriculture sector and a decline in agricultural output. Efforts were made in recent years to reverse this trend by the introduction of SAP. However, SAP only improved the export of cash crops, a gain that could not be sustained due to: ineffective government support; weak and poor funding; failure to transfer technology to the sector; poor infrastructure; unclear land tenure; continued dependence on nature; substantial rural-urban migration; poor or non-existing storage and preservation facilities; and poor linkage to agricultural processing industries.

(ii) **Industry**

Compared to the Asian tiger economies, the manufacturing sector of Nigeria has been performing below expectation. Its contribution to GDP in 1996 was only 6.9%. The mono-cultural dependence of the Nigerian economy on oil exports has dominated economic performance year-in year-out. Manufacturing has stagnated in its contribution to GDP. Some of the reasons that have been cited for the poor performance in this sector include: high import dependence for skilled manpower and industrial inputs; funding problems resulting from low domestic savings and restrictions on foreign ownership; poor implementation plans; inadequate infrastructure; lack of enabling environment; failure to promote linkage with other sectors; and lack of venture capital.

(iii) **Solid Minerals**

Despite the considerable abundance of precious, semi precious, and industrial mineral deposits in Nigeria, exploitation of solid minerals contributed only about 0.3% to Nigeria's GDP in 1996. Many minerals, which are available in Nigeria and can be commercially exploited, are imported to meet local demands. The poor performance of this sector has been attributed to the following factors: absence of a policy framework; retrogressive and non-competitive laws and regulations; inadequate funding; lack of infrastructure; absence of an enabling environment; dearth of trained manpower and technological know-how; and insufficient promotional activities. With the putting in place of a Ministry of Solid Minerals at the Federal level, and given the types of programmes they are promoting, it seems some of these constraining factors may be on the way to being mitigated in the years to come.

(iv) **Petroleum–Upstream**

Nigeria currently has a crude oil reserve base in excess of 22 billion barrels. In terms of natural gas endowment the country is more of a gas island, with a reserve in excess of 120 trillion cubic feet (TCF). Nigeria currently produces about 2.2 million barrels of oil per day (mbpd) including condensates, which is about 3% of world production. Associated natural gas is produced on a by-

product of crude oil production. Nigeria produced an average of about 36.01-billion $m^3$of natural gas in 1997. Of this over 77% is flared due to the non-availability of domestic gas markets. Export of crude oil accounts for about 95% of Nigeria export revenue and about 80% of total government revenue. Apart from the slowly developing domestic natural gas markets, export of gas in form of Liquiefied Natural Gas (LNG) just commenced in late 1999 and is expected to enrich the base of the country's export profile in years to come. Some of the challenges facing the Upstream petroleum industry in Nigeria includes: poor funding; erosion in value of incentives given to operators due to inflation; lack of level playing field; lack of adequate consultation with industry partners before policy changes are made; lack of effective dialogue and openness between the government and stakeholders; community disturbances related to environmental pollution and inadequate compensation for loss of means of livelihood; the lack of adequate development of natural gas, much of which is currently flared. A number of these challenges can be attributed to inadequate pricing, markets, investment, timing cycles and incentives; the absence of a linkage with local industries.

(v) **Petroleum-Downstream**

The downstream petroleum sector consists of: several kilometers of product pipelines; refineries; petrochemical and fertilizer plants. The total installed refining capacity in Nigeria is currently 445,000 barrels per day. The operational capacity is however much lower, due to lack of maintenance, and general decay in the sector. The sector is characterised by: inadequate funding; poor operating conditions; insufficient and irregular supply of products; a highly regulated environment; and a large appetite for importation of petroleum products to satisfy domestic demand. The sector is so inefficient that government is currently seriously considering alternatives such as turning over the management of the refineries, pipelines and depots network to the private sector. Also two private refineries have been approved, but are yet to be built.

(b) **Development Issues**

Critical development issues facing Nigeria as we approach the next millenium include: the role of Small and Medium Scale Enterprises (SME) in national development; the role of the informal sector as compared to the organised private sector; issues surrounding rural development; the proper perspective of urban development in the national economic development; poverty alleviation; and development of adequate infrastructural base to support economic and social activities.

2.0 CLIMATE CHANGE ACTIVITIES

Nigeria is a Party to the United Nations Framework Convention for Climate Change (UNFCCC). She is an active member of the Group of 77 and China, and as a matter of fact, she will be assuming the Chairmanship of the group by January 2000. The Federal Government of Nigeria has over the years, encouraged activities towards meeting its climate change objectives. The activities are discussed below:

2.1 National Climate Change Activities

2.11 Inter-ministerial Committee on Climate Change (ICCC)

For the effective coordination of climate change activities in the country, the Ministry of Environment (MOE) has been selected as the focal point by the Nigerian Government. It is responsible for the coordination of the activities of the ICCC. The ICCC was set-up by the Federal Government some few years ago, with mandates to: look at all issues related to climate change; deliberate on such issues; and advise government on actions to be taken. The committee is made up of representatives drawn from various Federal Ministries such as: Environment; Justice; Finance; Water Resources; Industries; National Planning; Commerce and Tourism; and Agriculture. Membership of the committee is also drawn from Federal Parastatals such as: Nigerian National Petroleum Corporation; Department of Meteorological Services; Department of Petroleum Resources. Other members come from: Organised Petroleum Trade Sector (OPTS); Research Institutes–Nigerian Institute for Oceanography and Marine Research, Center for Energy Research and Development. An environmental non-governmental organisation, the Nigerian Environmental Study/Action Team (NEST) is also represented on the committee. The committee meets regularly to deliberate on climate change issues and to develop Nigeria's position on such issues. Its activities are coordinated by the MOE. Its deliberations in recent times have focused on the review of activities towards the implementation of national efforts on the convention on climate change, and pending issues before any conference of parties (COP) meetings. Technical activities of the committee in recent times have been focused on the methodological framework and modus operandi for the development of inputs into the planned national communications. Over the past few months, the committee has been involved in concretizing ideas about Nigeria's approach to the CDM.

2.12 A Survey of GHG Emissions from Municipal Solid Waste Dumps in Nigeria

In 1994, the Federal Environmental Protection Agency Funded the implementation of a survey aimed at putting quantitative considerations on GHG emissions from the several uncoordinated and unplanned solid waste disposal sites in the country. The survey was contracted out to a local environmental consulting firm, Josef Ross Energy and Environment Company (now Global Environmental Technology Ltd.). The evaluation covered several municipal solid waste dumpsites in various parts of the country. Our evaluation of the reports obtained from GET Ltd. showed that the survey was not comprehensive. However, it yielded results that can be useful in putting quantitative ideas on emission factors from such facilities in Nigeria. The evaluation of the report of the survey which involved various measurements and estimations led to the following conclusions: solid waste generated in Nigeria in 1993

averaged about 0.252 tonnes/cap/year; the composition by weight of typical urban waste in Nigeria is made up of, 62-79% biodegradable matter, 18-33% non-biodegradable, 1.7 –3.2% of other materials: methane emissions from such dumpsites in Nigeria ranges between 907 – 1,346 Gg/yr in 1993. Two methods recommended in the IPCC workbook, i.e. Bingemer and Crutzen (1987), and Ahuja (1990) were utilized by the consultants in arriving at the emission estimate quoted above. In both methods, a 10% reduction factor was factored into account for methane oxidation.

2.13 Climate Change Activities in Economic Sectors

Apart from government, our investigation showed that climate change related activities had been carried out in some industries. Many of these activities were initiated, planned and executed not for climate change mitigation reasons but mostly from productivity or profit maximization point of view. These initiatives were mostly studies, some of which led to the implementation of projects while others ended on paper. Some of these, for which information were readily available are elucidated below:

(a) Energy Efficiency Improvement at Benue Cement Company, Gboko

Towards the late 1980s, Management of BCC, Gboko included the evaluation of energy utilization of their cement works as a component of an overall plant optimization work. The goal of the plant modernization was to identify key areas of improvement in plant productivity and capacity expansion. The energy efficiency component was handled by IBCON Associates/Triple "E" Systems Associates Joint Venture. Key findings of the evaluation include: shift to alternative energy sources; improvement in both fuel and electricity end-use efficiencies; material management; implementation of several simple but feasible housekeeping mechanisms; etc. The indirect connection to the CDM is that the study concluded that a more efficient production process can be achieved at the plant, characterized by a lower energy utilization index compared to historical records. And this stage can be achieved via the implementation of a combination of simple housekeeping measures and the implementation of cost-effective plant retrofits.

(b) Initial Energy Audit of Kaduna and Warri Refineries

Kaduna Refining and Petrochemical Company with refining capacity of 110,000 bbls/day and Warri Refining and Petrochemical Company with refining capacity of 125,000 bbls/day are two of the four crude oil refining facilities owned by the Federal Government of Nigeria through the Nigerian National Petroleum Company. Sometime in 1988, the Consultancy unit of the Obafemi Awolowo University was awarded a project to audit energy efficiency at the Warri and Kaduna Crude Oil Refining Facilities. The initial audit led to the conclusions that: there are potentials to improve energy efficiency at each of the refineries, with simple housekeeping measures amounting to savings of several million US$ per year. Substantial savings can be identified when retrofit options are elucidated in a comprehensive audit programme. Such an audit will involve comprehensive process simulations at each of the refineries.

(c) **Opportunities for Natural Gas as an Alternative Fuel for Industries in the Lagos Area**

This was a study commissioned in early 1990s by the Nigerian National Petroleum Corporation, to evaluate fiscal, technical and other policy issues that must be put in place by the Federal Government of Nigeria, to promote the use of natural gas as fuel in industries in the Lagos Area. This study was carried out by Triple "E" Systems Associates Ltd. The study identified various fiscal, technical and financial incentives that must be put in place to enable natural gas to compete favourably with alternatives, mostly oil based products, in such industries. The linking of the various Industrial Estates to the then emerging natural gas network, spurring out of the Escravos to Lagos Pipeline (ELP) was identified as the most crucial catalyst for this development. The subsidy on petroleum products was also fingered as an important element mitigating against the proliferation of natural gas into industries in the Lagos Area. The study called for the introduction of integrated energy pricing policy, geared towards promoting the development of environmentally sound alternatives

(d) **Techno-Economic Evaluation of Natural Gas as an Alternative Fuel at Cadbury Nigeria Plc.**

A study to explore the technical and economic feasibility of utilizing natural gas as an alternative fuel in the manufacturing operations of Cadbury Nigeria Plc was commissioned in 1995. Triple 'E' Systems Associates Ltd. carried out this study which concluded that not only is the shift technically feasible, it will yield substantial savings in fuel bills to the company. Fuels that will be displaced include: fuel oil – which is currently used for generation of all process heat requirements and diesel – which is the fuel for the generation of electricity. The company generates its own electricity and was not connected to the national grid as at the time of this study. The Consultant came up with a scheme that will lead to retrofitting the fuel oil burners at the steam boilers to dual fired burners - natural gas and fuel oil; and dual fired system for the on-site electricity generators. This project it was observed will lead to the emission of lower quantity of greenhouse gases as a result of the shift to natural gas.

(e) **Fuel Substitution Promotion Projects**

A major fuel substitution promotion initiative currently being financed by the Federal Government that has implications for domestic emission of GHG is the proliferation of gas pipelines to industrial parks. A principal example in this respect is the extension of the 40km Escravos to Lagos Pipeline to industrial areas along the route. The Nigerian Gas Company (NGC) recently commissioned what it called the Lagos City Gate a few months ago. The City Gate links the ELP with a 40km pipeline. At the City Gate, gas from the ELP will be conditioned to the specifications, required by industrial users in the Lagos industrial areas, before being metered into distribution lines that will transport the gas to end-users. The implementation of the gas distribution lines, which will link the City Gate to about twenty-four manufacturing facilities in the Ikeja Industrial Area. The project is being handled under Build Operate and Transfer (BOT) arrangement between the NGC and UNIPETROL, a petroleum product distribution company in Nigeria. The project when commissioned in mid-2000, is expected to

displace a large quantity of Fuel Oil currently fired these facilities. Other operators are also putting in place plans to take the gas from the City Gate to other industrial areas such as Apapa, Oshodi, Agbara etc. all in the greater Lagos area. A significant collaborator with the NGC in this respect is Shell Gas Nigeria Ltd, a new outfit recently put in place by Shell Petroleum Development Company for domestic natural gas facility development.

It is worth noting that the ELP, which was developed and implemented by the NGC for the purpose of making fuel available for electricity generation at the Egbin Thermal Power Station in Lagos, has led to the proliferation of natural gas to industries along the line. In the Lagos area, the two cement works of the West African Portland Cement Plc has been converted from fuel oil to natural gas. In 1999, PZ Industries Plc converted its Ikorodu manufacturing facilities from burning fuel oil to natural gas. It is expected that many others will follow suit as time progresses.

(f) Turning –Off the Natural Gas Flares

Associated natural gas, produced with crude oil and for which ready markets are not yet available is currently flared in Nigeria. Preliminary GHG invetorization efforts showed that in 1990, flaring of associated natural gas in the Nigerian Oil producing sector, contributed 32.0% to total CO_2 emissions in Nigeria. As a result, all projects that will reduce the amount of natural gas flared in Nigeria are seen not only from the perspective of economic benefit but also from the environmental perspective of reducing GHG emissions. The proliferation of natural gas to industrial centers, far away from the oil producing areas of Nigeria, through the implementation of gas pipelines is a good example. Another and perhaps a larger potential contributor to GHG emission reduction from gas flaring is the liquified natural gas project. The first phase of this project has recently been completed and the first shipment has been effected. Additional liquiefaction trains are currently being planned. Another significant development in this area is the currently planned West African Gas Pipeline. The project when implemented will transport natural gas, sourced from the ELP to Ghana, through the Republic's of Benin and Togo. Our investigation showed that the sub-sea route being planned by Chevron Nigeria Plc is much favoured over the predominantly land route of Shell Petroleum Development Company. When the project is completed, it will contribute to the reduction of gas flaring in Nigeria and promote the shift from fuel oil to natural gas in industries along the West African Coast, resulting in both GHG emission reductions and new economic developments.

2.2 Bilateral Climate Change Activities

2.21 Greenhouse Gas Emission Reduction in Nigeria: Macroeconomic Impact and Least Cost Reduction Strategies

This study was funded by the United States Environmental Protection Agency (USEPA) as part of its support for country studies to address climate change issues. The project was coordinated by the center for Energy Research and Development and had as a focus, the study of anthropogenic sources of greenhouse gases, specifically: carbon dioxide (CO_2); and

Methane (CH_4). To facilitate its implementation; the study was divided into six major elements, namely:

(i) Determination of emissions from natural gas, crude oil, coal production, and the evaluation of needs for additional work on emission factors;
(ii) Determination of emissions from agriculture, land-use and other non-oil and gas, and non-industrial sources;
(iii) Determination of emissions from industry sources;
(iv) Least cost mitigation plan;
(v) Evaluation of the macroeconomic implications of greenhouse gas reduction on the Nigerian economy;
(vi) Evaluation of the least-cost mitigation plan implementation strategies.

These elements were assigned to a number of public and private institutions which include: Faculties of Social Sciences and Agriculture both of the Obafemi Awolowo; University of Agriculture, Abeokuta; and Triple "E" Systems Associates Ltd. Lagos.

In all the key elements, the approach used for estimating greenhouse gas emissions were based on the methodology developed by the Inter-government Panel on Climate Change (IPCC) in line with the international agreement to standardize the methodology for estimating emissions. The IPCC methods were in many cases buffered by the incorporation of local factors into the overall methodology. In many cases, especially where data were sparse, IPCC default emission factors and conversion coefficients for example, were utilized.

2.3 Multilateral Climate Change Activities

Our investigation came up with the following two activities that can be categorized as being multilateral:

2.31 Building Capacity in Sub-Saharan Africa to Respond to the UNFCCC

GEF/UNDP recently approved funding for this capacity building project to enable Nigeria to generate the inputs needed in the preparation of its first initial National Communications, in accordance with Article 4.1 of UNFCCC. Under this project, the ICCC held a workshop on awareness creation, climate change impacts and mitigation at the national level. It has however not implemented the awareness campaign at the grassroots level. The national workshop was held in August 1999 at Kano Consultants. Kano Consultants have also been appointed to implement studies aimed at developing country GHG emission profiles, that will form the basic input of the initial national communications to the UNFCCC. The study, which was still progressing at of the time of compiling this report focuses on: creation of an inventory of GHG sources and sinks; identification and evaluation of mitigation options; and adaptation mechanisms. The inventorization efforts we understand are focused mostly on the energy sector and land-use, while the mitigation study is covering all sectors of the economy. Preliminary results emanating from the mitigation study points to the following as key components of the viable options, for reducing GHG emissions in the Nigerian energy sector:

(i) Energy efficiency improvements in industries;

(ii) Reduction of natural gas flaring;
(iii) Utilization of renewable energy;
(iv) Fuel substitution, particularly away from oil and coal to natural gas in many sectors.

2.32 Invetorization and Modeling of the Emission of Greenhouse Pollutants in Nigeria

The European Community provided funds for this research under EEC-ACP-Lome III project (EDF Project No.6100.52.41.025). Emission rates and pathways for GHGs and other toxic air pollutants were determined in this study. This enabled the proper understanding of emission processes and their potential impacts. Such information facilitated the modelling of such impacts on the Nigerian environment. The results provided an initial input to a National Emission Data Systems (NEDs) which is currently being developed. NEDs is being prosed as a modeling warehouse for emission, dispersion/deposition, atmospheric physico-chemical reations, global warming and cost-effectiveness analysis of control measures for these pollutants. The research work which was carried out under the supervision of Prof. A.F. Oluwole of the Department of Physics of the Obafemi Awolowo University, Ile-Ife, Nigeria, and formed the partial fulfillment for the award of the degree of Doctor of Philosophy in Physics for candidate Imoh Bassey Obioh in 1994.

3.0 NATIONAL COMMUNICATIONS

In accordance with Article 4.1 of the UNFCCC; all parties to the convention are required to periodically update and report on the national inventory of anthropogenic emissions and sinks of GHGs. Although Nigeria ratified the treaty sometime in 1994, she is yet to finalise her first initial national communications to the UNFCCC. The country has however being making serious efforts in recent years to put in place mechanisms to facilitate the gathering of the needed data, and to prepare the initial communication for submission to the UNFCCC. The efforts in this direction are being coordinated by the Ministry of Environment, with salient inputs and reviews from the ICCC. The national workshop which was geared at raising public awareness, which was held in Kano in August 1999 is a step in that direction. We understand that the workshop is part of the recently approved multilateral funding by GEF/UNDP for capacity building projects designed to enable Nigeria to generate the needed database in the preparation of the initial national communication. The Consultants for this project have been chosen and work is currently underway. The analysis of the information available to us show that Nigeria, may be in a position to submit its initial national communication to the UNFCCC before the next COP meeting.

4.0 CLIMATE CHANGE AND INDUSTRY

4.1 Introduction

Global Climate Change has been traced to a number of factors, mostly human. Although natural factors such as methane (CH_4) emissions from swamps, and carbon-dioxide (CO_2) emissions from forest fires resulting from lightning, contribute in no small measure towards Climate Change, the most significant input of Climate Change (CC) factors result from

human activities, especially industrialization. Climate Change factors such as Ozone Depleting Substances (ODS) emission and noxious gases (CO_2, N_2O etc), from gas flaring etc are direct effects of industrial activities. In this section, we present a summary of industrial aspects of climate change in Nigeria, and possible actions to redress them.

4.2 Sources and Types of Greenhouse Gases (GHG) in Nigerian Industries

Greenhouse gases (GHG) in Nigerian Industries result mostly from emissions as a result of fuel combustions, gas flaring and other industrial processes. Combustion of fuels such as Fuel Oils (HPFO and LPFO), PMS and AGO, yield large volumes of GHGs. The most important GHG contribution from the industry is CO_2, although some other GHGs such as N_2O, CH_4 etc also result from industrial processes. As a result, previous studies have focussed largely on industrial emission of CO_2. The most recent of such studies was carried out by Obioh and Adegbulugbe (1996). In the study, it was reported that a total of 3,658.3 Gg of CO_2 was emitted by industrial energy consumption while a total of 2,140.54 Gg was estimated as the CO_2 emission from the various industrial production processes. From these reports, it is obvious that some efforts have to be made towards addressing GHG emissions and the issue of Climate Change, as it relates to the Nigerian Industry. This is more so, given the fact that most of these GHG emissions result from energy consumption.

4.3 Reduction/Elimination of Climate Change Emissions in the Nigerian Industry

Given the urgent need to address issues of climate change in the Nigerian industry, it follows that serious efforts must be made to reduce the emission of CO_2, the main industrial GHG. If the problem of CO_2 emission is effectively tackled, then, climate change can, by implication, be addressed. There are three basic approaches that have been identified as critical towards addressing Climate Change in Industries in Nigeria. They are:

i. Improved Fuel efficiency;
ii. Conversion from high carbon to low carbon fuels;
iii. Improved Productivity.

4.4 Improved Fuel Efficiency

Previous studies have revealed that a lot of resources are wasted in industries due to inefficient fuel utilization. Such wastage results from malfunctioning equipment, sub-optimal fuel consumption, losses within the system, etc. Due to these problems, more fuel is consumed for less output, with the result that higher amounts of GHGs (CO_2) are emitted into the atmosphere. Therefore, efforts at reducing GHG from industries must, of necessity, focus on improving fuel efficiency/utilization. Such efforts must include fine-tuning of plant systems so that fuel consumption is lower and/or more efficient.

4.5 Conversion from High Carbon to Low Carbon Fuels

CO_2 emissions during combustion, is a function of the carbon content of the fuel being used. As usage of high carbon fuels such as high and low pour fuel oils (HPFO and LPFO), which are the most common industrial fuels in Nigeria, continue to increase, CO_2 emissions from industrial combustion will also increase. An obvious solution would therefore be to shift from these high carbon fuels to lower carbon fuels. The most easily available alternative in Nigeria is Natural gas. Therefore, a logical approach towards reducing GHG emissions in Nigerian industries would be to convert from fuel oils to Natural gas.

4.6 Improved Productivity

A typical characteristic of Nigerian industries is sub-optimal capacity utilization, which is largely due to the economic conditions of the country. However, it is possible to increase productivity/capacity utilization, without necessarily increasing fuel consumption. Such alternatives would ensure that more outputs are produced without any marked increase in fuel consumption. This has the long-term effect of leading to a reduction in GHG emissions/unit of output produced.

In summary, the three GHG reduction options describe above have in common the fact that:

i. They lead to increased output, with marginal increase in waste generation.
ii. They are also environment-friendly, since they result in a reduction of GHG emission.

Therefore, these three options must be vigorously pursued, if any meaningful impact is to be made in reducing GHG emissions from Nigerian Industries. It is particularly noteworthy that Nigeria is strategically placed to adopt these recommendations, given both her natural resource endowment and the Federal Government Policy initiatives. Both of these are favourably disposed towards enhancing the minimisation of industrial GHG emissions. For instance, Nigeria, with a conservative estimate of 120 Tcf (Trillion Cubic Feet) of natural gas reserves is strategically placed to meet industrial requirement for this "Clean Fuel". As such, availability of alternative fuels cannot be regarded as a constraint to reduction of Climate Change factors from industries. Also, the Federal Government has, since the early 1970s commenced aggressive initiatives toward reduction of gas flaring (a major contributor to CO_2 emissions) and natural gas utilization projects. This aggressive stance is already yielding positive results in terms of reduction in flaring and significant increase in the industrial utilization of natural gas. Some of such projects that have resulted from this initiative include: the Liquefied Natural Gas project; the Escravos Gas Project; the Natural Gas Condensate project; and conversion to gas by some industries such as the West African Portland Cement Plc (WAPC Plc). Plants in Sagamu and Ewekoro, PZ factory at Ikorodu, etc.

It is expected that the Federal Government will intensify its efforts towards enhancing Natural gas utilization. The government is also expected to provide additional incentives to prospective industries to shift to natural gas as industrial fuels, leading to a further reduction in industrial emission of GHG, and a positive contribution to the problem of Global Climate Change.

5.0 STRATEGIC INDUSTRIAL DEVELOPMENT IN NIGERIA

5.1 Historical Perspectives on Industrial Development in Nigeria

Prior to attaining independence in 1960, economic activities in Nigeria were essentially in commerce and aimed primarily at exporting raw materials for industries abroad, while importing finished goods for consumption in the country. The industrial sector of the Nigerian economy during this period was at best, non-existing. The attainment of independence changed this picture. Post-independence industrial policy regimes recognized the need to develop the industrial sector of the Nigerian economy. The development process was however recognized to be dependent on inflows of foreign capital and skills. It was not surprising therefore that the early post-independence policy of the Nigerian government promoted foreign direct investment flow. Not surprisingly, most of the trading posts of multi-nationals operating in Nigeria before independence transformed into manufacturing outfits, participating in the import substitution strategy of the country. While this translated to a marked reduction in the country's import bills, it did not contribute to the development of the rich raw resource base, to which the nation is richly endowed. Industries for food processing, textiles, furniture, fixtures and fittings etc sprung up to fulfill the import substitution goals of government. However, most of these industries relied not only on the importation of machinery and spare parts, but also raw materials and manpower. The result was an almost complete absence of indigenous participation in productive activities. This situation created the next challenge for industrial policy direction in subsequent times, i.e., how to encourage and promote indigenous entrepreneurship.

The response to this policy challenge was the promulgation of the Nigerian Enterprises promotion Decree (NEPD) in 1972 to promote indigenous participation. The basic focus of NEPD is to reserve participation in some enterprises solely to Nigerians. Amendments to the original decree were carried out in 1977 and 1989, with the amendments focusing on streamlining participation for foreigners. The decree was abrogated in the 1995 budget in order to attract foreign investment needed to revamp the ailing economy. Another characteristic of industrial development in the early seventies was that indigenous and foreign private business in Nigeria were concentrated in areas with short gestation periods, low risk and quick returns. Heavy industries that were strategic to the industrial development of the nation and with linkage effects were neglected. Government intervened by using available oil revenue to finance the establishment of such primary industries such as pulp and paper, petrochemicals, iron and steel, cement, sugar, fertilizer and motor assembly plants. The collapse of the world oil market in the early 1980s signaled the beginning of the failure of this intervention. Many of these primary industries were not completed due to lack of funds, leading to further expansion for the demand for imports. The increased import bill coupled with the already escalated capital requirements to complete the abandoned projects placed a very great stress on the country's economy. This led to the effort to restructure the economy through the introduction of the Structural Adjustment Programme (SAP) which did not achieve the desired result, in that productivity and export of manufacture goods remained low despite many incentives granted to promote exports. Unemployment became high, technological skills dwindled, local content of industrial output remained low, and divestment in many manufacturing sub-sector set in.

It was with this situation that we commenced with the decade of the 1990s. Situations were however worsened in this decade due to a myriad' of factors including undemocratic rule in the country, non-transparent practices and a lack of discipline in the general management of the economy. The successful implementation of a democratic programme in 1999 after about 18 years of Military dictatorship seems to have launched the nation in a saner industrial development path. One of the first assignments of relevance by the new civilian administration was the setting up of a Ministerial Committee that prepared the "Industrial Blueprint" which sets out the "Strategies for Action" both in the short–term (one year), medium-term (two years) and long-term (four years) for turning around the Nigerian industrial sector.

5.2 Problems Hampering the Growth of Nigeria's Industrial Development

In this section we present a summary of key issues that were identified by the Ministerial Committee as hampering the development of the Nigerian industrial sector:

(a) Weak Infrastructural Development

Components identified under this heading include:

- Energy Supply

Inadequate electricity supply by the national electric power authority (nepa) has forced industries to invest in generators whose operation adds to the cost of manufacturing. Another angle to the issue of energy supply is fact that industries are made to pay higher tariffs than individual households, unlike what applies in industrialised countries such as the UK, USA, Indonesia and Malaysia.

- Water Supply

Water supply from the Utilities Board (Water Corporation) is, at best, erratic. So much so, most industries spend huge sums of money on drilling and operating boreholes.

- Transportation

Road haulage, in spite of its relatively higher costs, is the predominant means of bulk transportation in Nigeria. The railway and inland waterways, which are cheaper and more cost-effective alternatives, are currently under-developed/inadequate in the country.

- Telecommunications

Due to the inadequacy and undependable nature of existing telecommunication facilities, most industries have had to invest in their own communication system.

- Environmental Issues

Many industries were established without adequate attention being paid to environmental protection. Also, in many parts of the country, industrial estates/layouts are not clearly separated from residential areas. As a result, pollution from industries very easily affects human populations within nearby residences.

(b) Import Dependence

The Nigerian Industries sector is mostly dependent on external inputs, with serious implications on domestic value addition, and demand for foreign exchange. This has imposed severe leakages on the economy, rendering fiscal and monetary incentives less effective. The import dependence of Nigerian industries has also been substantially promoted by the failure of Government to complete vital and strategic projects such as the Petrochemical, Machine Tools and iron and Steel complexes. This has also led to poor inter and intra-sectoral linkages. These poor linkages have thus militated against effective resource utilization, value addition, ancilliarization, and contracting/sub-contracting between large, medium and small-scale enterprises in the country. All of these have culminated in the over-dependence of the economy on the external (import) sector for industrial inputs.

(c) Finance

The low level of funding and high costs of such funds is the main concern in this case. Interest rates have sky-rocketed from the previous high of 24% to between 35 and 40%. As such, adverse effects have been manifested on new investments and rehabilitation/modernization of existing industries.

(d) Lack of Patronage of Domestic Products

In spite of the good intentions of most Monetary and fiscal policies of Government, gaps between policy postures and actual implementation have combined to affect, negatively, the growth of the Nigerian Industry. For instance, most Government and Private Establishments prefer foreign goods, at the detriment of local products. As a result, the Nigerian market is filled with foreign goods, many of which are also being produced locally. Therefore, local enterpreneurship is not encouraged since demand for foreign equivalents are higher.

(e) Dumping

There is general concern about the dumping of subsidised and sub-standard goods from overseas. This has been compounded by the delay in the take-off of the Anti-dumping Committee set up in Nigeria in early 1999.

(f) Standardization and Quality Control

Although the Standards Organisation of Nigeria (SON) has taken various measures to improve the standards and quality of imported and/or locally produced goods, there are still gaps in the implementation of quality control and standards.

(g) Training and Manpower Development

The main concern on this issue is the quality of existing manpower, institutional arrangements for their training and the standardization of such training. This has been attributed to the gap between training institutions and industry, inadequacies of on-the-job training and general lack of training facilities.

(h) Research and Development (R&D) Activities

Despite existing incentives of tax relief (between 120% and 140%) on R&D expenses for companies that engage in R&D activities, not much of it is currently taking place in the country. Most big industrial establishments undertake their R&D activities abroad, to the detriment of the Nigerian economy.

(i) Poor management

This is most relevant to public sector enterprises where occasional failures and not-so-impressive performance and traceable to mismanagement, corruption, external interference and indifference on the part of those entrusted with the management of such enterprises can be observed.

(j) Under Capitalization

Again, this is particularly applicable (although not exclusively so) to public enterprise where there is a gross inadequacy of working capital.

(k) Obsolete Machinery and Equipment

Due to economic constraints, many industries in the country use old and obsolete machinery and equipment, with dire consequences on their level of efficiency, productivity and competitiveness.

(l) Low Capacity Utilization

Capacity-utilization in the Nigerian Industrial sector is very low, and, in some cases, has fallen below the break-even point. In consequence, most industries are currently having a lot of idle capacities, with the result that unit costs are high and products non-competitive.

(m) Corruption, Bureaucracy and Excessive Taxation

The effects of corruption and bureaucracy are manifested on Nigerian Industries, in many ways, for example: demand for unofficial payments by Government Officials for services; demurrage costs; pilferage at Ports; and insecurity of lives and property, arising from easily compromised security agencies. Also, the few visible operators in the real industrial sector have become the targets of various tiers of Government, as a ready source of revenue through indiscriminate taxation.

All of the problems described above have led to a trend of de-industrialization of the Nigerian economy, thereby shrinking the absorptive capacity of the economy. There is therefore an urgent need to prepare and implement a sound industrial development plan for the future.

5.3 Future Industrial Development

The Federal Government has recognised the need to strategically industrialise Nigeria, if she is to maintain her position as the "Giant of African". In line with this, the Vision 2010 committee was set up to assess various issues concerning the global development of Nigeria. The Committee, in its report offered, among other things, a panacea for the industrialisation and sustained economic growth of the nation. According to the report, this global objective can be achieved through the implementation of certain critical action plans, which include:

a.) Reduction of the dominance of the public sector in the economy, and development of a viable, dynamic, highly motivated, socially and environmental responsible private sector;
b.) Development of a strong public and private sector partnership which fosters a strong economy that is private sector driven, with the government as the enabler;
c.) Maximum utilization of the country's wealth of oil and gas, agriculture, solid minerals and other resources to diversify the economic base, as well as develop, an export-driven production, manufacturing and industrial non-oil sector;
d.) Development and/or acquisition of production technologies to accelerate the growth and development of small and medium-scale business to provide wider economic opportunities, employment and poverty alleviation;
e.) Full development of the oil and gas sector to provide the launching pad for developing the rest of the economy and development of a sustainable internationally competitive oil service base.

Towards the **Strategic Industrial Development** (SID) of the nation, the following action plans have been identified for pragmatic implementation:

(i) Promotion of private sector participation in primary extraction manufacturing or exports in specific industries, as well as provide a minimum level of capital funds for research in these industries;
(ii) Land ownership laws reformation in order to make land readily and speedily accessible to both local and foreign investors; provision of infrastructural facilities such as access roads, telecommunications, water supply and electricity supply at strategic locations;
(iii) Reduction of imposed costs of doing business and active promotion of competition by deregulating and liberalizing the economy;
(iv) Establishment and promotion of small and medium scale business industrial clusters, which specialize in products and technologies for specific industries;
(v) Establishment of small business information/industrial centers to offer legal, business advisory and technical assistance, as well as promote skill development and information dissemination;
(vi) Promotion of activities towards increased proven oil reserve base expansion in the long term and establishment of oil production and technology targets for the oil

industry; effective funding of oil and gas operations towards evening the long-term strategic health of the sector and the country in general;

(vii) Minimization of community related disruption of operations in the oil and gas sector by making the community a stake holder in the operations of the sector;

(viii) Maintenance of environment friendly conditions; continuous upgrade of oil and gas production and export facilities to latest international standards to minimize the industry impact on the environment and encouraging high standards of practice in operations to ensure healthy and safe conditions for staff and the community;

(ix) Enhancement of local contractors capability to compete with foreign service providers in quality and price; make it a requirement for oil companies to set aside a specific percentage of contracts for local contractors and provide quality assurance assistance to ensure target standards are met.

The options presented above are deemed to be adequate to achieve a positive turn-around of the Nigerian Industrial sector. Government is poised to implement the action plans. Successful implementation of which will bequeath a sustainable industrial development pathway to the nation.

6.0 CONSTRAINTS TO CLEAN DEVELOPMENT MECHANISM (CDM)

6.1 Introduction

In spite of the desirability of the Industrial Clean Development Mechanism (CDM), a lot of constraints are currently hampering its workability in Nigeria. If this initiative is to gain any remarkable foothold in Nigeria, these constraints must, not only be elucidated, but must also be removed. For the purpose of this presentation, these constraints have been grouped into 2 major classes, namely: General barriers; and Sector-specific barriers. In the proceeding sub-sector, we shall take a look at these barriers.

6.2 BARRIERS TO CDM IN NIGERIA

6.21 General Barriers

General barriers to CDM in Nigeria revolve around inadequate knowledge base, lack of support services, and a myraid of other problems that are associated with developing countries, like Nigeria.

(a) Inadequate Knowledge Base

Generally, there is a lack of awareness among industries on efficient devices and methods for curbing wastages. Most innovations introduced into the country, to curb wasting behaviours and enhance efficient resource utilization appear unrealistic, and are therefore ignored. In the few cases where they appear credible, the high costs of initial investments on equipment and the development of in-house technical capability to handle such equipment has continued to discourage would-be investors. Also, industrialists are more interested in investing their

available funds in profit oriented projects and therefore place secondary interest in energy efficiency. As a result, energy resources are wasted, with resultant high level of emission of GHGs.

(b) Lack of Adequate Support Services

Although a number of consultancy outfits that are in a position to assist industries in developing and implementing the CDM exist, most of these outfits are not adequately equipped to face the challenges of CDM. For instance, many of the existing consultancy outfits do not have the right diagnostic and measuring devices to carry out detailed energy audits. Also, there is a dearth of skilled technical and managerial personnel to effectively implement such mechanisms. In addition, financial support is a serious bottleneck, especially for small enterprises. Most financial institutions are hesitant to bankroll long-term projects. As such, even when there is apparent willingness on the part of enterprises to embark on CDM, financial constraints dictate otherwise.

(c) Government Bottlenecks

The Government unintentionally creates an atmosphere that is not conducive for making industries to embrace clean development technologies. For instance, various subsidies on energy make fuels, more affordable for industries. As such, these industries find it difficult to rationalise the need to use fuel more efficiently, when it is so easily affordable.

Also, inappropriately designed duties and taxes that tend to bias purchasing decisions towards less efficient or polluting technologies exist. This makes it more problematic and expensive for willing industries to embark on CDM related projects via efficient energy utilization.

6.22 Sector–Specific Barriers

In addition to the general barriers described above, some sector-specific barriers also exist. For the purpose of this presentation, we have focussed on only two sectors of the Nigerian industry: the cement sector; and the food and allied products sector. We present some of the major constraints of these sectors, as identified by our study in this sub-section. It should be noted that our case studies consist of two industries within the cement sector, and one in the food and allied products sector. These industries are:

i.	West African Portland Cement Co.	-	Cement Sector
ii.	Ashaka Cement Company	-	Cement Sector
ii.	Cardbury Plc.	-	Food and Allied Products Sector

6.221 Sector-Specific Barriers in the Cement Sector

(a) Technical Knowledge Base

In order to successfully implement CDM projects, the cement sector of Nigeria requires the provision of adequate in-house knowledge base. This will be complemented by the available

foreign technical knowledge and expertise of multinationals such as Blue Circle Industries. Hence, there is a need to develop local staff capacity in the process of identifying, designing, packaging and implementing CDM projects in line with the Kyoto Protocol. Local staff also needs to be trained in the operation and maintenance of automated and fuel efficient cement plants.

(b) Government Input

Apart from the issues listed in (a) above, there is a need for government to provide background support in a number of ways. Some of these include:

i. Provision of improved telecommunication facilities, roads, electricity, water and other social infrastructure;
ii. Reduction/elimination of bureaucratic bottlenecks within Government circles;
iii. Creation of an enabling environment for potential investors especially in terms of reduced importation costs, stabilization of exchange rates, and elimination of some taxes and duties.

6.222 Sector-specific Barriers in the Food and Allied Products Sector

(a) Expanded Technology Base

Although the industry assessed for this study (Cardbury Nig. Plc) consists of seasoned professionals and sound administration, there is a need to expand its technology base through human resource training and technology transfer. This is critical, if CDM projects are to be successfully implemented within the company.

(b) Government Input

Government support towards the successful implementation of CDM is particularly necessary in the areas of:

i. Mobilisation of adequate funds for background support;
ii. Technical support as and when necessary;
iii. Provision of necessary infrastructural support, such as electricity, water, roads, etc.
iv. Incentives in the form of tax and duties relief, to encourage CDM implementation.

7.0 STAKEHOLDERS

7.1 Stakeholders Sensitization

Stakeholders for the proposed CDM projects in Nigeria can broadly be classified by institutions into four main categories. These are: Government Institutions; Private Sectors Institutions; International Institutions; and Non-governmental Organizations (NGO's). Most of these stakeholders in the above categorizations have been contacted and appropriately sensitized on the goals and objectives of the Kyoto Protocol and the CDM initiative currently been put-in-place by UNIDO. Some of these stakeholders include:

7.11 Government Institutions

These are government institutions that were set-up at the Federal level primarily to control, regulate and manage the activities of various sectors of the country's economy. The involvement of these institutions in the current CDM initiative is particularly important as a large number of projects exist in these sectors that have a direct or indirect impact on the ozone layer and their implementation could be facilitated under the initiative. Some of these institutions are;

1. Federal Ministry of Industry

The Federal Government has set-up the Federal Ministry of Industry (FMI) primarily to formulate and implement appropriate policy measures that will improve and sustain the investment climate and also ensure the most efficient allocation of functions and resources between the public and private sectors of the economy. The contact person of the Federal Ministry of Industry is the Honorable Minister of Industry, Dr. Iyorchia Ayu. The head office of FMI is located at the Federal Government Secretariat, Garki, Abuja.

2. Federal Ministry of Science and Technology

This Ministry was set-up by the Federal Government for management, regulation and development of all issues and activities in the Science and Technology sub-sector of the nation. The contact person for the institution is the Honourable Minister of Federal Ministry of Science & Technology Chief Ebitimi Banigo. The head office of the institution is located at the New Federal Secretariat Complex, Shehu Shagari Way, Abuja.

3. Federal Ministry of Power & Steel

The Federal Ministry of Power and Steel, as the name implies control and manages various activities that are carried out in the Power and Steel sub-sector. The contact person for the institution is the Honourable Minister for the Federal Ministry of Power & Steel, Chief Bola Ige. The head office is situated at the federal secretariat complex, Abuja.

4. Nigerian National Petroleum Corporation (NNPC)

The Nigerian National Petroleum Corporation (NNPC) is a Federal government institution with the mandate of managing, controlling, regulating and administering the upstream and downstream activities of the petroleum sector. The contact person for the purpose institution is the corporations Group Managing Director, Mr. Gaius Obaseki. The head office of the institution is located at; NNPC Towers, Herbert Maucaulay Way, Central Business District, Garki, Abuja.

5. National Electric Power Authority (NEPA)

National Electric Power Authority (NEPA) is the Federal Government institution saddled with the responsibility of managing and controlling all activities that relate to electric power generation and distribution in the country. The contact person of the organization is Mr. Bello Suleiman who is the appointed Managing Director NEPA.

6. Energy Commission of Nigeria (ECN)

The Energy Commission of Nigeria is a Federal government institution that is set-up to implement policies that will facilitate the adequate and sustainable development of energy and its supply at acceptable costs to meet the needs of the country's inhabitants using optimal production and end-use efficient facilities. The contact person for the institution is Professor Ibrahim Umar who is the Director-General of the institution. The contact address of the institution is 10 Okotie- Eboh Road, Ikoyi, Lagos.

7. Centre for Energy Research and Development (CERD)

The Centre for Energy Research and Development (CERD) is an institution that was set-up by the Federal government to facilitate research and development of energy issues in the country. In addition to this, the institution is also to effectively co-ordinate the activities of the various energy institutions in the country. The Director General of CERD is Prof. A. O. Adegbulugbe and the contact address is the Centre for Energy Research and Development, Obafemi Awolowo University, Ile-Ife, Osun State.

7.12 Private Sector Institutions

1. Manufacturers Association of Nigeria (MAN)

This is a private institution that is set-up through the alliance of all manufacturers in the country. In principle, MAN protects the interest of all manufacturers in the country and serves, among other things, as the common forum for communicating with various governmental agencies. The contact person for the association is Dr.U.E. Okeke who is the Director-General of the association. The contact address of MAN is 77, Obafemi Awolowo Way, Ikeja, Lagos.

2. Dunlop Industries Plc.

Dunlop Industries Plc is a private company that specializes in the manufacturing of tyres, syntetics, plastics and paints. The contact person of the company is Mr. J. D. Lawuyi who is the company's Group Managing Director. The head office of the company is located at Oba Akran Avenue, Ikeja, Lagos.

3. Cadbury Nigeria Plc.

Cadbury Nigeria Plc. is a leading private industry in Nigeria that manufactures food drinks, foods and confectionery. The contact person of the company is Mr. Bunmi Oni

who is the company's Managing Director. The company is situated at Agidingbi, in Ikeja Industrial Area, Lagos.

4. West African Portland Cement Plc. (WAPCO)

West African Portland Cement Plc. (WAPCO) is the largest producer of cement in Nigeria. The company's contact person is Engr. J. O. Makoju who is the Managing Director/Chief Executive. The company's headquarters is located at Elephant Cement House, Assbifi Road, Ikeja Business District, Alausa, Ikeja, Lagos.

5. Benue Cement Company

Benue Cement Company is also one of the cement producer in Nigeria. Engineer S. I. Nyagba is the Managing Director/Chief Executive of the company and is the contact person for the current initiative. Benue Cement Company head office is situated at Plot 306, Adeola Odeku Street, Victoria Island, Lagos.

6. Ashaka Cement Plc.

Ashaka Cement Plc (Ashaka Cem) is another cement producing company that is located in Gombe, in the North eastern part of Nigeria. Mr Jammes Cook who is the compny's Deputy Managing Director is the contact person for the company.

7. Nestle Foods (Nigeria) Plc.

Nestle Foods (Nigeria) Plc. is a private industry that manufactures food and food drinks. The contact person for the company is the Managing Director, Mr. Jean Louis Chaumel. Nestle Foods (Nigeria) Plc headquarters is located at Ilupeju Industrial Estate, Oshodi, Lagos.

8. Cement Manufactures Association of Nigeria (CMAN)

This is a private institution that is set-up through the alliance of all manufacturers of cement in the country. Just as with MAN, CMAN protects the interest of all cement manufacturers in the country and serves, among other things, as the common medium for communicating with various governmental agencies. The contact person for the association for the current initiative is Mr James Cook, the Deputy Managing Director of Ashaka Cement.

9. Chevron Nigeria Limited (CNL)

Chevron Nigeria limited is a subsidiary of Chevron Corporation that operates for and on behalf of Nigerian National Petroleum Corporation (NNPC) in the exploitation and exploration activities of the country's Petroleum sector. The company's Managing Director is Mr Kirkland and the head office is located at 2, Chevron drive, Lekki Penninsula, Lagos.

10. Shell Petroleum Development Company (SPDC)

SPDC in joint venture with NNPC, is another major operator in the Nigerian Petroleum sector.

7.13 Non-Government Organizations (NGO's)

1. Nigerian Conservation Foundation (NCF)

Nigerian Conservation Foundation (NCF) is one of the non-governmental organizations in the country. The contact person for the organization is Mr. J. A. Dosunmu. The head office of NCF is located at Plot 5, Moseley Road, Ikoyi, Lagos.

2. Friends of the Environment (FOE)

Friends of the Environment (FOE) is also one of the non-governmental organizations in existence in the Nigeria. The organization is Chaired by Engr. (Mrs) J. O. Maduka FOE head office is located at 106/110 Lewis Street, Lagos.

3. Enabling Environment Forum (EEF)

Another non-governmental organization that is in active existence in the country is the Enabling Environment Forum (EEF). Mr. Udochuku Uwakaneme is President of EEF. The head office of the organisation is located at the General Motors Building, Oregun Road, Ikeja, Lagos.

7.14 International Institutions

These are institutions that are internationally based and have memberships from governments of various countries of the world. The following are the identified international institutions, their local representatives and contact addresses.

1. Food and Agricultural Organization (FAO)

The FAO Representative in Nigeria is Dr. Hashim A-Shami and could be contacted at No.17, Ontario Crescent, Maitama, Abuja

2. World Health Organization (WHO)

The contact person of WHO in Nigeria is Dr. Evarist Njelesani and can be contacted at No. 443, Herbert Macauley Street, Opposite Yaba College of Technology, Yaba, Lagos.

3. International Finance Organization (IFC)

Mr. Akbar Husain is the IFC representative in the country and can be contacted at No. 1, Mekunwen Road, Ikoyi, Lagos.

4. United Nations Information Center (UNIC)

The director of UNIC in Nigeria is Mr. C. F. Njinga and the contact address of the organisation is No. 17 Kingsway Road, Ikoyi, Lagos.

5. United Nations Fund for Population Activity (UNFPA)

Mr. J. Bill Musoke is the UNFPA representative and the organisation contact address is No. 11, Oyinkan Abayomi Drive, Ikoyi, Lagos.

6. United Nations Educational Scientific and Cultural Organization (UNESCO)

Mr. Emmanuel Apea is the UNESCO representative in Nigeria and can be contacted at Plot 777, Bouake Street, Off Rabat Road, Off Herbert Macaulay Way, Wuse, Zone 6, Abuja.

7. World Metallurgical Organization (WMO) – West Africa

The representative of WMO for West Africa in Nigeria is Mr. M. Y. Boulama. WMO office in Nigeria is located at No. 14, Broad Street, Lagos.

8. United Nation International Children and Education Fund (UNICEF)

Dr. Christian Voumard is the UNICEF representative in the country and can be contacted at No. 30a, Oyinkan Abayomi Drive, Ikoyi, Lagos.

9. United Nations High Commission for Refugees. (UNHCR)

UNHCR representative in the country is Mr. Godfrey Sabiti. The head office of the institution is 13 Awolowo Road, Ikoyi, Lagos.

10. United Nations Drug Control Programme (UNDCP)

Mr. S. B. Raza is the UNDCP representative in Nigeria. UNDCP office is located at No. 11, Oyinkan Abayomi Drive, Ikoyi, Lagos.

11. United Nations Development Fund for Women (UNIFEM)

Ms. R. Amadi-Njoku is the UNIFEM advisor in the country and he can be contacted at No.11, Oyinkan Abayomi Drive, Ikoyi, Lagos.

12. International Labour Organisation (ILO)

Ms. Cynthia Yinusa is the Officer-in-Charge of ILO in Nigeria. The head office of the organisation is located at Glass House, 188 Awolowo Road, Ikoyi, Lagos.

Apart from the above listed stakeholders, efforts are current on towards the sensitization of other identified stakeholders on the CDM initiative. During such sensitization exercises, the expected role to played by these various stakeholders will be appropriately communicated to them.

8.0 NIGERIAN INDUSTRIAL SECTOR PARTICIPATION IN THE CURRENT UNIDO INITIATIVE

Some of the Nigerian industrial sub-sectors considered during the selection of participating industries for this current initiative include: petroleum refining and petrochemicals; cement manufacturing; iron and steel; fertilizer; food and allied products. In each of these sub-sectors, green house gases (GHG) are emitted from energy and non-energy base industrial processes. The two main categories of GHG emissions from energy systems are from combustion and non-combustion (fugitive) processes. While significant amounts of CO_2 are emitted during combustion, the most significant GHG gas emitted during non-combustion industrial processes (processing, transmission and storage of fuels) is methane.

CO_2 on the other hand, forms the most significant GHG gas emitted in non-energy based industrial process. In fact, the CO_2 emitted during cement production process represents the largest non-energy source of industrial CO_2 emission. This explains the reason why cement production accounts for about 2.4% of total global industrial and energy CO_2 emissions (Marland et al. 1989).

Based on GHG emission contributions and the energy intensiveness of industries in each of these subsectors, five industrial establishments were contacted to participate in the current CDM initiative. These establishments include: West African Portland Cement (WAPCO); Cadbury (Nigeria) Plc.; Nigerian National Petroleum Corporation (NNPC); Ashaka Cement Plc and Dunlop (Nigeria) Plc. Three of these five establishments were able to supply the necessary data to ensure their being packaged for the CDM pilot project. Brief descriptions of these industries are presented in the following subsections.

8.2 Brief Description of Participating Industries

8.21 West African Portland Cement Company (WAPCO)

Company Background

West African Portland Cement Plc. (WAPCO) is the largest producer of cement in Nigeria with an installed capacity of 1.7 million tonnes per annum. The company's headquarters is located at Elephant Cement House, Assbifi Road, Ikeja Business District, Alausa, Ikeja, Lagos. The shareholders of the company are: Federal Government of Nigeria (16.6%); Odu'a Investment Company Ltd. (26.8%); Nigerian Public (17.2%) and Blue Circle Industries Plc. (39.4%).

The company operates two cement works, which are located at Ewekoro (with an installed capacity of 700,000 tonnes per annum) and Shagamu (with an installed capacity of 1.0 million

tonnes per annum). Based on the data made available to us, the actual production figures and the estimated capacity utilization for the two cement works are presented in Table 2 below. From the table, it can be observed that the overall capacity utilization of the company increased from 75.53% in 1996 to 79.24% in 1997 and then decreased to 78.17% in 1998. The decrease in production in 1998 can reasonably be attributed to low sales owing to the lull in construction activities in the country at that time.

The Ewekoro works is situated at Km 64, Lagos – Abeokuta Express Road, Ewekoro, Ogun State while the Shagamu works is situated at Km 64, Lagos – Shagamu Road, Shagamu, Ogun State. The company technical support services is entirely provided by Blue Circle Industries Plc., a leading international cements company.

Table 2: Actual Production and Capacity Utilization of WAPCO Cement Works (1996 – 1998).

CEMENT WORKS (INSTALLED CAPACITY IN TONNES/ANNUM)	1996		1997		1998	
	Actual Production (tonnes)	**Capacity Utilization** (%)	**Actual Production** (tonnes)	**Capacity Utilization** (%)	**Actual Production** (tonnes)	**Capacity Utilization** (%)
EWEKORO (700,000)	426,655	60.95	421,420	60.20	411,155	58.74
SAGAMU (I,000,000)	857,326	85.73	925,755	92.58	917,694	91.77
Total (1,700,000)	1,283,981	**75.53**	1,347,175	**79.24**	1,328,849	**78.17**

Source: West African Portland Cement Plc, Dec. 1999.

Existing Production Line

West Africa Portland Cement Plc's (WAPCO) existing production line is made up of the following;

- Limestore/Shale Extraction, Crushing and Conveying lines
- Raw Material Milling Line
- Kiln Burning Section
- Clinker Cooling Section
- Milling Line

The company has the following technologies in place for each of its process lines:

- Mobile plant, crusher and field conveyors
- 1,100 HP and 3,000 HP Raw Mills
- Wet and Semi – Wet Process Kilns
- Clinker Coolers and Silos
- 3,000 HP and 1,100 HP Cement Mills and Silos
- Packing Plant
- Gas Turbine and Diesel Generators

GHG Emissions

Energy requirements for WAPCO's cement works operations are met by the combustion of; Natural Gas, Automotive Gas Oil (AGO) or Diesel and Low Pour Fuel Oil (LPFO). Natural Gas is mainly used for kiln burning of cement clinker and electricity generation. AGO is used for electricity generation, running of vehicles and mobile plant while LPFO is used for klin start-up as well as in electricity generating plant. In addition, electrical energy needs of the cements works are also supplemented by the National Electric Power Authority.

The combustion of these fuels leads to GHG emission particularly CO_2. Apart from this, CO_2 is also emitted from cement production process especially during cement clinker production. Based on data supplied by WAPCO Management during the preparation of this report, the estimated CO_2 emissions in the WAPCO cement works are presented in Table 3 below:

Table 3: Estimated CO_2 Emissions from WAPCO Production Facilities (Gg of CO_2)

Year	Combustion Process (1)	Cement Production Process	Total
1996	522.01	640.06	1,162.07
1997	572.01	671.51	1,243.52
1998	557.14	662.43	1,219.57

(1) Estimated value excludes CO_2 emitted from Purchased Electricity generated from the National grid.

Previous Company GHG Emission Reduction Activities

WAPCO has in the past, implemented some climate change related projects within its facilities. These projects expected has led to substantial reduction in GHG emissions, particularly CO_2 from the company's cement works. These projects include:

1. The conversion of oil fueled kilns to gas fired kilns.
2. The installation of two gas turbine in preference to the use of diesel for the generation of electricity.
3. The provision of 2.6km long quarry conveyors at Ewekoro to replace the use of dumper trucks, which use diesel as fuel.
4. The installation of dust return scoops on No. 2 Kiln. The result of this is a significant reduction in the use of fuel and a consequent reduction in both CO_2 emissions and waste generated.
5. Reduction in the overall CO_2 and other emissions resulting from the company's transportation activities through the development and use of fuel efficient vehicles in the company's delivery fleet at Shagamu.

According to the information supplied by the company, the major barrier that the company had to overcome during the implementation of these projects is the difficulty in justifying capital expenditure on environment/GHG emission reduction projects, given limited funds, which are available for a large number of competing projects.

Initiative Company Priority Projects Suggested for Implementation within the CDM

It is the intention of the company to undertake the implementation of the following projects that are listed in the order of priority under the current UNIDO CDM initiative.

1. Replacement of the 3 existing wet and semi-wet process kiln lines at Ewekoro with one fuel efficient dry process kiln line. The overall costs of this improvement project is estimated to be US$130 million and would provide significant environmental improvements, particularly in GHG emissions. The energy efficient process would utilize state-of-the-art clean technology known as a dry pre-calciner process. It is estimated that fuel consumption per tone of cement produced would be 40% below that of the existing plant and therefore CO_2 emissions from fuel combustion would also be reduced by the same amount. The new plant would also offer the potential to increase capacity at the works, while still reducing the overall environmental impacts.

2. Introduction of dust return scoops on No 1 Kiln at Shagamu. Dust from the cement kilns is collected in highly efficient electrostatic precipitators that clean the exhaust gases before they are released to atmosphere. This dust is composed of raw and partially calcined materials, which have been quarried and prepared for the cement making process. The installation of kiln scoops, together with an associated conveying system, would allow dust which otherwise had to be disposed of to landfill to be returned to the process. This would result in reduced raw material usage, lower fuel and electricity consumption and hence reduced CO_2 emissions.

3. Implementation of high level (computer based) kiln control systems (with associated instrumentation) at Shagamu. The purchase, installation and operation of such systems for the kiln burning process will facilitate more effective process optimization and hence fuel efficiency leading to a reduction in GHG emissions. The implementation of this project will involve the purchase of the computer based optimization equipment, improved instrumentation and training of process operators and maintenance staff.

Capacity Building: In-House & Governmental

Towards the successful implementation of these projects under the current initiative, WAPCO will require, as a compliment to in-house engineering and environmental skills and technical knowledge and expertise of Blue Circle Industries;

* Local staff capacity building in the identification, design, negotiation, packaging and implementation of CDM projects as currently conceptualized in the Kyoto Protocol. Such staff will have adequate understanding of the systems and administration being developed in Nigeria to implement this mechanism.

* Local staff training in the operation and maintenance of modern fuel-efficient cement plants and computer based kiln control systems.

Furthermore, the company is of the opinion that necessary skills, organization, procedures and knowledge within the existing government framework needs to be developed in order to

ensure successful monitoring and evaluation of CDM projects. The company is willing to work closely with UNIDO and the Government of the Federal Republic of Nigeria on the proposed CDM of the Kyoto Protocol.

In addition to this, Blue Circle Industries Plc., the company's technical partner, has cement works throughout the Annex I and non-Annex I countries, and has already been involved in the development of GHG trading schemes in the United Kingdom (UK) and the United States of America (USA). This relationship could further facilitate the smooth implementation of CDM projects particularly as it relates to cement manufacturing.

8.22 Ashaka Cement Plc

Company Background

Ashaka Cement Plc (Ashaka Cem) is located in Gombe, the capital city of Gombe State, which is located in the North eastern part of Nigeria. Currently, the company produces only Ordinary Portland Cement but hopes to include the production of pozzolanic cement, if sufficient quantities of suitable pozzolanic minerals are sourced locally. Production of pozzolanc cement requires lower clinker content and therefore reduced greenhouse gas emissions (GHG) from cement production processes.

Existing Production Line

Currently, Ashaka Cem operates a dry cement production process line with a total annual installed capacity of 700,000 tonnes per annum. This process involves the quarrying, crushing and mixing of the limestone with a small quantity of siliceous secondary raw materials. The mixture is transported by electric powered conveyor to a stock pile where it is blended by a mechanical stacker-reclaimer. The reclaimed material is further transported into one of the two identical process lines, each with a 3,000 hp polysius raw mill. It is in this raw mill that the mixture is grounded into a fine raw meal-powder. After blending, the raw meal is blown into the top of a Gepol pre-heater from where it cascades down into a LPFO fired 350,000 tonnes/year polysuis rotary klin, for calcination at a very high temperature of about 1, 450°C. The calcinated materials leave the Klin and cools rapidly to form cement clinker which is a mixture of calcium, silica, aluminina and iron, at required proportions. The cement clinker is crushed in a clinker roll press and mixed with a small quantity of gypsum. Gypsum is added to regulate the setting quality of finished products. The mixture of cement clinker and gypsum is grounded into cement in another ball mill. The cement products are packed into 50kg sacks or sold in bulk to customers.

GHG Emissions

Ashaka Cem meets its energy requirement through the combustion of Low Poured Fuel Oil (LPFO) and Automotive Gas Oil (AGO) or Diesel. While LPFO is used for the generation of process heat used in Klins as well as electricity generation, AGO is used for the generation of electricity and for the running of mobile plants. Combustion of these fuels are known to be major sources of greenhouse gases (GHG), especially CO_2. Apart from the combustion process, the cement production process is also a source of CO_2. Specifically CO_2 is produced

during the production of clinker. In Ashaka Cement, CO_2 emissions from the production facilities are presented in Table 4.

Table 4: Estimated CO_2 Emissions from Ashaka Cement Production Facilities (Gg of CO_2)

Year	Combustion Process [1]	Cement Production Process	Total
1996	180.13	260.1	440.23
1997	211.17	307.7	518.87
1998	175.26	255.5	430.76

[1] *Estimated value excludes CO_2 emitted from Purchased Electricity generated from the National grid.*

Previous Company GHG Emission Reduction Activities

The management of Ashaka Cement, in 1996, installed a clinker roll process in its cement production facilities. The installation of this equipment was targeted towards the reduction of electric power consumption during cement production thereby reducing the level of CO_2 emitted from power generating set.

Given the fact that the level of CO_2 emission in the cement production process depends on the lime content of the cement product, Ashaka Cem plans to embark on the sourcing of pozzolanc minerals, which has lower lime content and will therefore lead to reduced CO_2 emissions from the cement manufacturing process. However, this plan is currently being hampered by lack of funds required for capital expenses such as importation of necessary equipment.

Company Prioty Projects Recommended for Implementation within the CDM Initiative

Given the UNIDO initiative towards the reduction of CO_2 emission in industrial processes, Ashaka Cement proposes the following Clean Development Mechanism Projects:

(1) Supplementing clinker with limestone within Nigerian cement standards through the provision of material preparation, proportioning and feeding, and monitoring equipment. This project has been estimated to cost about 50 million US dollars.
(2) Extensive prospecting of suitable local pozzolanic minerals to serve as a partial substitute for clinker production within Nigerian cement standards. An estimate sum of 60 million US dollars is required for this project.
(3) Extension and enhancement of pre-heater efficiency, estimated to cost about 800 million dollars.
(4) Re–installation of hydroelectric generating equipment at nearby Dadin Kowa Dam, jointly with Gombe State Government. This project has been estimated to cost about 1.5 billion US dollars.

Capacity Building

Ashaka Cem is well placed to undertake CDM projects, given the fact that the company is endowed with experienced and adequate technical manpower. To further strengthen this in-house technical capability, the company has Blue Circle Industries as a Technical Partner. However, in order to facilitate the smooth implementation of CDM projects in the company, Ashaka Cem will require in-house capacity building, particularly in the areas of personnel training towards the identification, design and implementation of such projects.

Areas requiring adequate attention by government towards the effective implementation of CDM include:

(i) Improvement on Telecommunication facilities, roads and other social infrastructures.
(ii) Reduction of bureaucracy within the government circle.
(iii) Provision of adequate training for technical manpower.
(iv) Creation of an enabling environment for investors through the reduction of importation costs, as well as stabilization of exchange rates, etc.

8.23 Cadbury Nigeria Plc.

Company Background

Cadbury Nigeria Plc. is a leading industry in Nigeria that manufactures food drinks, foods and confectionery. The company is situated at Agidingbi, in Ikeja Industrial Area of Lagos. Food Drinks produced in the factory include popular brands such as Bournvita, Pronto and Richoco. Food brands made include: Tomapep, Dadawa, Knorr cubes and Cheff Tomato Puree while confectionery range of products include: Tom-tom, Bultermint, Malta Sweet, Chocolate, Eclairs, Goody Goody and the Trebor range of products.

Existing Production Line

The products from the manufacturing process are drawn from three main lines. The lines produce:

(1) Food Drinks
(2) Foods
(3) Confectionery

A brief description of the process utilized in each of these production lines are presented below:

Food Drinks

Cadbury Nigeria Plc. Produces food drinks which are mainly cocoa based products. The products are Bournvita, Pronto and Richoco. Similar production processes are used for each of these products. For Bournvita production for example, the basic raw materials used are: cocoa powder, skimmed milk power, sugar, Glucose, Malt Extract, Vitamins and Minerals.

The raw materials are first mixed together in a mixer to form magma. The magma is sent into an *Oven* where process heat in the form of hot water is used for cooking the magma under vacuum. The vacuum is produced by Steam Ejectors. The bournvita produced from oven is sent into a *Cold Room*. In the Cold Room, an air conditioning system produces air at 24°C, 50 | 5% RH, which cools the hot bournvita from the oven. The cooled bournvita is then sent to the *Granulating unit* where it is ground in an air-conditioned atmosphere. The granulated bournvita then goes into another air-conditioned atmosphere for packing.

Foods

As earlier mentioned, food brand produced in the factory include knorr cubes (a meat flavoured seasoning in cubes), tomapep (a blend of pure tomato puree and ground pepper), Dadawa (a seasoning cube made from locust beans). The raw materials used in the production of knorr cubes for example include: fat, salt, MSG and spices. These are mixed in a mixer before passing them through sifter, cubing and wrapping, and lastly packing.

Confectionery

These are made up of various types of hard-boiled sweets. The general process involves the conversion of sucrose to glucose and fructose and partial inversion of sucrose. The raw materials utilized for its production include Sugar, Glucose, Flavours, Colours and Additives. The manufacture of sweets starts with the preparation of the syrup. The syrup goes into a *Cooker* where process heat in the form of steam is used to evaporate part of the water present. This process thickens the syrup. The thickened syrup is then sent onto a *Cooling Table*. Here, chilled water at 5°C is passed through coils imbedded in the surface of the Cooling Table. The chilled water comes out at 11.13°C. Heat exchange takes place between the thickened syrup and the chilled water. At this stage, the sweet is like plasticine. It is then sent to a Former where it is cast into various shapes. The sweets then go into a Cooling Chamber where an air-conditioning system allows chilled air at 24°C and 50 | 5% RH to cool the sweets. They are then sent to a Wrapping Machine for packaging.

GHG Emissions

The energy types utilized in Cadbury include LPFO, Diesel, Electricity. LPFO are mainly used in the furnances of the boilers for the generation of steam in the plant. Diesel oil is used to generate electricity. Electricity is also supplied to the factory from the Nigerian Electric Power Plc grid. The combustion of these fuels, results in the emissions of carbon dioxide and other green house gases. A summary of CO_2 emissions from Cadbury facilities for LPFO and AGO are summarized in the Table 5 below:

Table 5: CO_2 Emissions from Fuel Combustion in Cadbury (Gg of O_2)

Year	From LPFO Combustion	From AGO Combustion	Total
1996	17.0	15.4	32.4
1997	17.7	14.4	32.1
1998	17.9	16.2	34.1

Previous Company GHG Emission Reduction Activities

The management of Cadbury had over the years initiated and implemented a number of energy efficiency improvement and environmental pollution control projects. Specifically, projects implemented in the recent past include Techno-Economic Appraisal of Natural Gas as an Alternative Fuel; Installation of Factory Wide Steam Condensate Recovery Systems; Improved Maintenance practice through the use of FEMCA (Failure, Effect, Mode, Critical, Analysis) and Computer Based Vibration Monitoring and Control of Boilers CO_2 Emissions.

Company Priority Projects Suggested for Implementation within the CDM Initiative

Recently the company has initiated and proposed possible CDM projects for implementation. These projects are expected to have direct impact on greenhouse gas emission reduction. Projects initiated for priority implementation are: Conversion of the existing fuel oil fired boilers to a system that can fire natural gas; and installation of fuel economizers for boilers. These projects will involve retrofit of systems or outright replacement of critical components.

Projects proposed for implementation include the Conversion of diesel fired generators and forklifts to systems utilizing natural gas. Other projects of relevance include: Boiler blow down and flash steam heat recovery, Generators exhaust heat recovery, and R & A energy efficiency improvement and conversion of the refrigeration and air-conditioning (R & A) chiller unit to a non-CFC.

Capacity Building: In House & Governmental

Although Cadbury Nigeria Plc. is made up of seasoned and experience and technically sound personnel and managers, the company will still require the some level of technology know how, transfer and human resource training in order to successfully implement an identified CDM project.

In addition to technology transfer, and training, the company has further identified the lack of financial resources needed to embark on CDM projects as a further barrier. The company is of the opinion that given the necessary financial and technical support, it is ready to commit itself towards implementing all CDM related projects. At government level, the company will require the mobilization of sufficient funds, technical support, provision of necessary infrastructure such as electricity, roads and tax relief incentives to facilitate the smooth implementation of CDM projects.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

In view of the detailed information that have been presented in the preceding sections of this presentation, the following conclusions can be made:

i. Climate Change issues are critical in the Nigerian Industrial sector particularly in the area of efficient energy resource utilization;

ii. CDM projects are the most viable options for redressing climate change issues;
iii. A lot of constraints that constitute barriers for the successful implementation of CDM in Nigeria are currently in existence;
iv. The creation of awareness and funding appears to be the most critical constraints that must be removed if CDM projects are to be successfully implemented in Nigeria;
v. Stakeholder sensitization exercises should progressively be intensified regardless of the stage and progress of the pilot project.

In view of the conclusions drawn above, we make the following recommendations:

9.2 Recommendations

From our overview, it is obvious that the fulcrum of CDM in Nigeria is local capacity building and expansion. Capacity building is therefore recommended. There are two levels at which such capacity building has to be implemented, for any meaningful impact to be made. These levels are: Governmental and Industrial. A brief elucidation of the two levels are presented below:

9.21 Government Level

An Inter-ministerial Committee on Climate Change (ICCC) currently exists in Nigeria. The membership of which is drawn from various ministries, especially the Ministry of Environment, and other relevant parastatals. However, there is a need to expand the membership of the ICCC, to include trade groups such as the Manufacturer's Association of Nigeria (MAN); National Association of Chambers of Commerce and Industry, Mines and Agriculture (NACCIMA), etc.

In addition, relevant NGOs such as the NEST (National Environmental Study/Action team), NDES (Niger Delta Environmental Survey); etc should be brought into the expanded ICCC. Such an initiative will facilitate improved access to Climate Change information for various industries and other relevant groups.

9.22 Industry Level

Industries will be required to take positive Climate Change initiatives. These initiatives include the following:

i. Industries should organize themselves into groups for the purpose of addressing Climate Change issues. This will facilitate improved knowledge base and technical wherewithal required for the successful identification, design, implementation and maintenance of CDM projects within industries.
ii. The Enabling Environment Forum (EEF) is a very useful multi-disciplinary group institution that can serve as the pivot for Climate Change activities among industry members. It should therefore be facilitated to effectively dispense such functions;

iii. The Finance Sector should also be brought in at this level, to facilitate the mobilisation and implementation of international financial mechanisms for the smooth operation of the CDM project in the country.

The implementation of these recommendations will facilitate the success of CDM projects in Nigeria.

Chapter Six

Concept For Developing National Capacity To Implement Industrial Clean Development Mechanism Project In Africa

Senegal Case Study

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1.0 INTRODUCTION

1.1 National data

Data base	**Fiscal year 1995**	
Area	196 722 km^2	
Population	8 392 000 habitants	
Density	42 hab/km^2	
Demography growth rate	2,7 %	
Growth rate of urban population	39 %	
Urban population	37 %	
Growth rate of rural population	2 %	
Domestic National Production (CFA * billion)	1 603,2	
Percentage of the informal sector (% PIB)	31,84	
Percentage of the Primary sector	About 50 %	
Percentage of the secondary sector	19,9	
Percentage of the tertiary sector	19,1	
Growth rate of the DNP	6,09	
Arable land (million of hectares)	5 %	
Forest land (million of hectares)	3,80	
Share of GHG emissions	11,66	
Distribution of GHG emissions	**Gg Equivalent CO_2**	**%**
Energy	3915,8	41
Industries (Industrial processes)	378,9	3,9
Agriculture	2958	31,7
Wastes	2226	24

Source: IXeme Plan Senegal

1.2 Geo-Climatic Location

Senegal, within the peninsula of Cap Vert, is the westernmost part of Africa. It is located between 12 and 17° of latitude North and between 11° and 18° of longitude west. The country is bordered on the North and North East by Mauritania, in the South East by Mali and in the South by the Republic of Guinea and by Guinea Bissau.

The climate is one of droughts and tropical rain characterised by two seasons: dry and rainy . However the rainfall varies considerably in time and in space. Thus one can see big differences in the hydro climates between the south, which is humid (annual rainfall is above 1000 mm), and the North, which is dry (rainfall is less than 500 mm/year).

Differences in climate, hydrology and the types of soils, create many varieties of vegetation. In the North, the Sahelian zone consists of shrubby bush with thorny plantsas the dominant species. Woody bush, where wildlife is very important, is a characteristic of the Sudanian zone. Thick forest is in the sub-Guinea zone – which is located only in the low Casamance.

1.2 Socio-Economic Situation

The population of Senegal was estimated to be 9.04 million in 1998 with a growth rate of about 2.7%, that is higher than the growth rate of the economy. With this growth rate, the population will be 13.8 million by 2014. This growth is high due to many factors, among which is the decreasing death rate of children due to improvements in health conditions.

The majority of the population is young and female (over 52% female with 48.5% under 15 years old). Population distribution varies from 3,400 inhabitants/km^2 in Dakar to 6 inhabitants/km^2 in Tambacounda district. The continuous growth of the urban population, particularly in the city of Dakar is placing more and more demand on public utilities and is creating problems with sanitation and security.

1.3 Economic Situation

Since the beginning of the Sixth Development Plan, economic growth has increased to more than 5%. In 1998, the growth rate was higher than in 1997. The National Gross Domestic Production (NGDP) was 5.7 % in 1997 and rose to 6.1 % in 1998 with the secondary and tertiary sectors contributing most of the growth. Between 1997 and 1998, the share of the secondary sector in the GDP rose from 19.8 % to 20.6 % and that of the tertiary sector was raised from 19.8 % to 20.6 %. At the same time the primary sector share decreased from 19.0% to 17.8%.

The recent achievements of the secondary sector are due to the Building and Public Works (BPW) and to vegetable oil factories that have increased their shares respectively to 16% and 5%. However, the quarrying industries have seen a decrease in their share after 1997.

The tertiary sector slightly decreased in 1998 due to a reduction in transport and trade, which fell respectively from 10.5% and 7.4% in 1997 to 9% and 7.1% in 1998.

1.4 Attempts to Rationalise Environmental Policies

Senegal, like many others countries after the Rio Conference in June 1992, decided to adopt a more coherent programme for sustainable development. Indeed, the environmental problems that the country is facing are serious (depletion of the forests, degradation of air, water and soils, pollution, industrials risks etc.). Many conventions submitted to the international community before, during and after the Summit of Rio de Janeiro have since been signed and ratified.

A first 'Code of the Environment' was adopted in 1983 and subsequently reviewed to take into account all parameters and determinant factors of the environment. The National Assembly adopted the new code in December 1999 giving new perspectives for the year 2000.

1.5 National Action Plan for the Environment (NAPE)

Elaboration of the National Actions Plan for the Environment was a priority for the Higher Council of the Environment and Natural Resources (CONSERE). Elaboration of the NAPE started in 1995 under the guiding principle of 'people participation and decentralisation'. The NAPE document is designed to involve all sectoral departments, that deal with environmental issues in discussions on the functioning of the National Committee on Sustainable Development.

2.0 CLIMATE CHANGE ACTIVITIES

DECI (Direction of Environment and Classified Installations) is the UNFCCC focal point in Senegal but climate change issues are managed by the Ministry of Environment and Protection of Nature.

2.1 Bilateral Activities

The Netherlands undertook a study (1997-1999) entitled "Scenarios of climatic coastal zone and agricultural vulnerability", coordinated by DECI but involving other government Departments (e.g. geology, atmospheric physic, agronomy, geography), NGOs, universities and research institutes. The funding of the project was US$ 200,000. Studies focused on the future vulnerability (2020, 2050 and 2100) to climate changes impactsof coastal zones, agriculture, water resources, tourism and fisheries.

Recently, Canada provided assistance for the NCCCC to support the National Focal Point, in terms of organisation of meetings, follow up of the UNFCCC/Protocol of Kyoto activities and policy dialogue.

2.2 Multilateral Activities

2.21 Inventory of GHG

The first inventory of GHG was conducted in 1994 with 1991 as its reference year, using the IPCC methodology supported by GEF/UNDP (for a duration of six months at a cost of US$ 247,085). DECI coordinated the inventory with the technical collaboration of Departments interested in climate issues and GHG emissions (industry, energy, forestry, waste, CFCs and agriculture).

2.22 Initial National Communication

Activities to redress climate change problems were defined using the inventory results and other data collected for year 1994 as well as from studies related to climate change. These activities were funded by GEF/UNDP (69,000 $US).

2.23 Climate Change - TRAINING: GEF / UNDP / UNITAR (CC-TRAIN)

Senegal with two other African countries (Benin and Chad) was selected for Phase II of the Climate Change Training Program developed and co-ordinated by UNITAR held 1997-1999. The final report of this project, together with the National Implementation

Strategy (NIS) on climate change, was presented during the tripartite review in Bonn (UNDP – UNITAR). The NIS will, in the coming years, be the guide to climate change activities for reducing emissions and measures to mitigate and adapt to climate change.

The project established information centres, undertook training and capacity building activities and studied the vulnerability of tourism, water resources and fisheries to climate change. These studies complemented those undertaken by the Netherlands project on vulnerability.
Policy discussions with other stakeholders will now be held based upon the results of the NIS to ensure the implementation of appropriate measures in their areas of responsibility.

2.24 Economic Evaluation of Reducing GHG Strategies

Duration: 1 year (1998-1999).
Co-ordination: DECI
Fund: GEF US$ 50,000
Agencies: UNEP, UCEE, RISO/Denmark.

The (LEAP) project permits one to conduct a descriptive case study on an economic evaluation of GHG reductions based on scenarios (2020, 2050, 2100) in some industries: SONACOS, ICS, SENELEC.

2.25 Energy Efficiency in Buildings

Duration: 3 years
Fund: GEF US$ 350,000, shared between Senegal and Ivory Coast

Objectives: Reducing GHG electricity production by a more efficient conception of buildings i.e. by increasing lighting and thermal comfort: it gives an energy consumption reduction between 30 to 50%.

2.26 Energy Program World Bank

Component a:

- Sustainable management of natural forests for energy wood production.
- Co-ordination: Direction of water resources and forests.
- Objective: Increase sequestration capacity of carbon from 1,1 millions to 4,5 millions CO_2.

Component b:

- Demand Management and promoting Energy of substitution.
- Co-ordination: Direction of Energy.
- Supply fuel to populations in an efficient manner and reasonable cost and reducing GHG.

Duration: 7 years and Funded by: GEF - World Bank

2.3 National Activities

With the funds provided for climate change activities, a national team established under CC-TRAIN, is conducting the following activities:

- National inventories and communications studies;
- Institutional strengthening;
- Policy dialogue;
- First National communication (submitted in December 1997);
- Draft second national communication;
- National Implementation Strategy on Climate Change.

2.31 Committee on Climate Change (NCCC)

Since 1996, a National Team and a National Committee on CC have been set up in order to coordinate all activities that were previously handled by various agencies. The national team is more technical and has the mandate to participate in and conduct studies related to CC. Both are involved in the definition and implementation of activities, plans and the position of Senegal in advance of the Meetings and Conferences of the Parties to the UNFCCC (COP/MOP).

The NCCC deals with issues related to climate change, deliberates on each issue and examines decisions and positions to be taken before each UNFCCC session. The NCCC is composed of representatives from:

- Ministries of: Industry and Energy, Finance, Water Resources, Commerce, Tourism, Agriculture, Meteorology, Forestry Resources, Oceanography, fisheries, Marine, Transport, and Environment.
- Institute of Research: Department of Geology, Hydro-geology, Agronomy, Geography, Meteorology, Sciences, Environment, Laboratory of Physic and Atmosphere;
- NGOs: 3 members.
- Private sector: "Economic Grouping of Senegal", National Confederation of Employers, Chamber of Commerce of Dakar.

3.0 NATIONAL COMMUNICATION

The first national inventory of GHG was completed in 1994 with 1991 and 1994 as reference years. In 1997, Senegal presented its initial national communication during COP3 in Kyoto.

In Bonn, during COP5, the second draft national communication (reference years 1995-1996) was presented with a National Implementation Strategy on CC (NIS), elaborated through the Climate Change – Training project (GEF/UNDP/UNITAR).

Table One Synthesis of initial national communication 1997 (Data 1994)

Modules	Emissions Expressed in Gg					Gg equivalent	Emissions Out of Forests
	CO_2	CH_4	CO	N_2O	NO_x	ECO_2	%
Module 1 Energy							
From Energy : Production	3660	5,38	41,25	0,032	1,13		Out of forests
Petrol/Gas		0,27					
Total Module 1	3660	5,65	41,25	0,032	1,17	**3788,6**	**40,6 %**
Module 2- Processes							
Emission of processes	345,5						
Total Module 2	345,5					**345,5**	**3,7 %**
Mod 4- Agriculture							
Emission CH_4 Animals	-	137,98					
Bush fires		0,99	26	0,012	0,44		
Agricultural wastes		1,99	25	0,0234	1,06		
Total Module 3		142,16	51,00	0,046	1,69	**2957,6**	**31,7 %**
Module 5- Forests							
CO_2 Thinned Forests	19244,5						
Gas elements thinning		25,04	219,15	0,17	6,21		
Annual suppressed	-25824,7						
CO_2 exploited Forest							
Total Module 4	-6575,5	25,04	219,15	0,17	6,21	**-5997**	
Module 6- Wastes							
CH_4 public discharges		86,80					
CH_4 industrial sewage		19,21					
Total Module 5		106,01				**2226,2**	**24 %**
Total of all Emissions	**-2570**	**276,86**	**311,4**	**0,248**	**9,07**	**3321**	**100 %**
Potential of Global heating 100 years	1	21		310			
Equivalent CO_2	**-2570**	**5814**		**77**		**3321**	**100 %**

Table Two: Synthesis of second national communication 1999 (Data 1995)

Module	Emissions Expressed in Gg					Gg Equivalent	Emission Out Forests
	CO_2	CH_4	CO	N_2O	No_x	ECO_2	%
Module 1-Energy							
Source of Energy	3785	5,248	40,28	0,031	1,13		
Parafineoil/Gas		0,52					
Total Module 1	3785	5,77	40,28	0,031	1,13	3915,8	41 %
Module 2- Processes							
Processes Emission	345,5						
Total Module 2	345,5					378,9	3,9 %
Mod 4- Agricultural							
Emission CH_4 Animals	-	140,07					
Bush Fires		0,99	26	0,012	0,44		
Agricultural wastes		1,02	21,42	0,029	1,06		
Total Module 3		142,08	47,42	0,041	1,50	2996,4	31,4 %
Module 5- Forests							
CO_2 forests thinned	19244,5						
Gas Trace Thinning		25,04	219,15	0,17	6,21		
Annual suppressions	-25824,7						
CO_2 harvest Forests							
Total Module 4	-6580	25,04	219,15	0,17	6,21	-6001	

Module 6- Wastes							
CH_4 discharges Public		89,44					
CH4 Industrial sewage		19,21					
Total Module 5		108,65				**2281,6**	**24 %**
Cumuli Emissions	**-2450**	**281,54**	**306,85**	**0,242**	**8,84**	**3571,7**	**100 %**
Global Potential Heating 100 years	1	21		310			
Equivalent CO_2	**-2450**	**5912,3**		**75,02**		**3571,7**	**100 %**

3.1 Sectoral Distribution of Emissions

Analysis of the synthesis table of emissions (with all GHGs in CO_2 equivalents) combined with the appropriate degree of global warming potential over a period of 100 years gives the following indications:

The equivalent CO_2 emissions are widely diminished by the forests capacity to sequester. The residual capacity of forest sequestration being **6001 Gg ECO_2**, this compensates the emissions of other sectors which amount to **9539,3 Gg ECO_2** with a net outcome of emissions of **3538 Gg ECO_2**.

The synthesis table gives sectoral distribution as follows:

- Energy = 3,915.8 Gg ECO_2 = 41%
- Agricultural = 2,996.4 Gg ECO_2 = 31.3%
- Wastes = 2,281.6 Gg ECO_2 = 23.8%
- Industrials Processes = 345 Gg ECO_2 = 3.9%
- Forest = -6,001 Gg ECO_2

That leaves a sequestration capacity of about 63 % compared to emissions.

3.11 Analysis at the Energy sector level

Table Three: Emissions by Sector

	Emission of GHG					TOTAL	ECO_2
Sectors	CO_2	CH_4	CO	N_2O	NO_X	Gg	%
Industries	1.670	1 ,33	21	0,025	0,92	1.705,4	43,5%
Transportation	1.275					1.275	32,5%
Households And others	840	4,44	19,2	0,007	0,21	935,4	24%
TOTAL	3.785	5,77	40,2	0,031	1,13	3.915,8	100%

Emissions linked to energy sources account for 43,5% of emissions for industries, 32,5% for transportation and 24% for households and service sectors. Senegal benefited from early bilateral and multilateral help in examining climate change issues. This help has reinforced national focal points (institutional strengthening) and assisted in the execution of projects, programs and training courses.

Table Four: Comparing Emissions of 1994-1995

MODULE	1994 (Gg ECO_2)	1995 (Gg ECO_2)	Ecart (Gg ECO_2)
Energy	3788,6	3915,8	+127,2
Industrial Processes	345,5	378,9	+33,4
Agriculture	2957,6	2996,4	+38,8
Forests	-5997	-6001	-4
Wastes	2226,2	2281,6	+55,4
Net Cumuli	**3321**	**3572**	**+251**

Emissions have increased by about 251 Gg between 1994 and 1995 (a relative increase of 7,56 %). The increases came from energy (+ 127 Gg-50%), agriculture (+38,8 Gg – 15%) and wastes (55,4Gg –22%) and were due t :

- Energy: increase in the consumption of petroleum products which rose from 701 328 etp in 1994 to 1 065 176 etp in 1995 & from industrial processes (increase of cement production);
- Agriculture: increase of cattle (cows, sheep, goats). That explains the increase of emissions linked to the entero-methanization (+2,1 Gg CH4) or (44 Gg ECO2);
- Wastes: Increase of household wastes production which has gone from 1250 Gg to 1302Gg Giving therefore a rise of 2,64 Gg of CH4 that is to say 55,4 Gg ECO_2.

Sectoral emissions linked to the energy sector did not change. However one sees a significant rise of the transportation sector (from 31% to 32%) through an increase in urban transportation in the cities, mainly in Dakar.

Per capita emissions changed from 408,3 kg ECO_2/inhabit/year to 425,6 kg ECO_2/inhabit/year, or 1,12 kg/inhabit/day to 1,17 kg/inhabit/day.

4.0 CLIMATE CHANGE AND INDUSTRY

The policy of easing restrictions on trade (in place since 1986) is still in place. This policy is characterised by disengagement of the State from the direct productive sectors, promotion of the private sector, setting up of adequate reforms (legislation, work and common law), setting up an attractive and secure environment according to the rules of the marketplace.

In order to facilitate these initiatives, a council on industry, an industry 'observatory' body and a new strategy for industrial development ("Senegal 2000") have been created to improve conditions for national and foreign investment in Senegal.

Energy is a key-determining factor in industrial production and the necessity to preserve and protect the environment is a condition nowadays to promote sustainable industrial activities. That means that opportunities provided by the UNFCCC for this sector are extremely important for Senegal. Among these opportunities one can cite:

- Improving the competitiveness of industries by mastering energy;
- Acquisition of new, clean and efficient technologies;
- Reinforcement of Senegalese private sector capacities.

Moreover, the CDM gives a necessary supplementary motivation to carry out investments that would otherwise not be done by industrialists or government.

UNIDO, together with the Ministry of Industry, has developed an integrated program (IP) in Senegal that focuses on increasing the competitiveness of industrial products, enhancing the economy and improving quality (standards). The IP strategy is based on seven components: an industrial strategy; an information network; development of SMEs; industrial partnership development; metrology, standardisation and quality development; capacity building in textile and food industries.

At the environmental level, there is a "Recovery and recycling of CFCs, and demonstration project on methyl bromide phase-out" programme (Montreal Protocol). However, in the field of climate change no other activity has taken place within industrial sector. Industries have taken part in many national and international meetings related to climate change related to preparation of the inventories and national communications and for COP 4 in Buenos Aires. While there are industry members on the NCCC and National Team, the actual involvement of the sector so far has been insignificant.

A project on "Ecologically Sustainable Industrial Development" has however been elaborated together with UNIDO with pilot projects in some industries to demonstrate efficient utilisation of raw materials, recycling, and reduction and/or elimination of some wastes. The project, that includes capacity building, will be managed by the DECI and the Directorate of Industry. Funding may be sourced from the World Bank and other funding agencies. To increase the possibility of funding, this project can be set in the context of climate change by focusing on reducing GHG emissions.

When setting up a CDM mechanism, many activities need to be conducted in the industrial sector: for example energy efficiency programmes can be put together to reduce GHG emissions from industries such as SOCOCIM, SENELEC, SONACOS, ICS and CSS. The national inventories indicate the contribution that industry make to the net national emissions of GHG:

- Energy sector = 3,915.8 Gg ECO_2 = 41%, with 43.5% from industries
- Industrials Processes = 345 Gg ECO_2 = 3.9%

5.0 SUSTAINABLE DEVELOPMENT

Senegal clearly indicates in all its relevant action plans (Environment National Action Plan and National Plan of Economic and Social Development) that it intends to promote environmentally sound technology in the industrial sector and to ensure sustainable development. This is also reflected in Senegal's industrial policy.

A national Committee for Sustainable Development has been established, co-ordinated by DECI, with the mandate to elaborate and conduct activities mentioned in Agenda 21 (Rio 1992). The following areas have been considered in terms of sustainable development: environment, economy and society:

- **Environment Indicators**: quality of water, air and soil, levels of toxic wastes.

- **Economic Indicators**: employment, investment, productivity, income distribution, competitiveness, inflation, efficiency of the uses of material and energy.

- **Social Indicators**: poverty, education, health, government, military spending and international co-operation.

For sustainable industrial development objectives, the environmental and economic indicators should be taken into account. The social aspects are also important because industrial development and protection of the environment through the use of cleaner technologies help to reduce poverty.

6.0 CONSTRAINTS

Constraints to industrial development that are faced by Senegal are:

- Lack of a favourable environment for the development of the private sector.
- Low level of development of physical infrastructure and of industrial and economic activities (lack of diversity of the industrial network).
- Insufficiency of the institutional structures.
- Lack of adequate funding.
- Insufficient managerial resources.

Without consistent investment and new equipment flows, the objective of environmentally sound industrial development will not be achieved. Current practices lead to extensive GHG emissions as well as atmospheric pollution, with serious consequences for health and environment degradation.

So far, industry has not responded to invitations to be involved in climate change activities. Even though they are members of the National Team and NCCC their attendance is not frequent enough. Compared with the administrative sector, industries do not have the much interest, as their concerns are more immediate (productivity margins, inadequate and/or old equipment and materials, competitiveness problems, financing problems, etc). In order to generate the necessary level of interest in climate change issues, there needs to be a demonstration of the feasibility of projects, before they become involved.

Another critical problem is the lack of adequate and/or absence of support services as, in general, environmental issues are not considered by industry. The creation of such departments in industry would assist with the solution of problems that may arise. Also, decisions to invest are not made for environmental reasons, more from consideration of risk reduction and to increase the rate of returns.

CDM activities need to take these facts into account in order to attract the private sector. As the procedure for CDM are still being discussed, the industrial sector has an opportunity to voice their concerns in advance of the mechanisms being established.

In many African countries, government is more involved in climate change activities than industry even though it appears that the CDM offers possibilities to the industrial sector to benefit from the implementation of climate change activities.

To encourage industrial development, government should remove some of the barriers such as inappropriate duties and taxes as well as bureaucratic bottlenecks. But in the context of the CDM, both government and industry have to prepare a favourable environment for project implementation (i.e. the creation of co-ordinating units, updating knowledge, compiling basic data on the industrial sector in relation with climate change, developing a national strategy for implementing the CDM, definition of development priorities, information and awareness on recent activities).

7.0 STAKEHOLDERS

Individual contacts were made and a one-day forum was organised with potential stakeholders to the CDM (industrial sector, government, NGOs, associations of industries and employers, UNDP and academia) at which the UNIDO programme was presented.

The industrial forum facilitated the gathering of the main stakeholders and, following presentations (on the project objectives, the potential of the CDM, the national industrial policy and the GEF mechanism), the industrial sector expressed interest in the programme and their willingness to participate in the next stages.

An exchange of views helped to identify SENELEC (National Electricity Power Generation) and SONACOS (vegetal oil production from groundnuts) as industries to be selected for the implementation of the CDM projects. All other industry representatives agreed to this choice and they expressed their full collaboration.

8.0 INDUSTRIAL SECTOR

Six industries have been involved in the project. All agreed, after a long exchange of views, to the selection of SENELEC and SONACOS as the top priority due to their present high level of emissions.

Having accepted the UNIDO initiative to develop a concept for developing national capacity to implement CDM in 6 African countries, the other industries expressed their interest in future CDM projects. It will be useful to consider their needs in future activities.

8.1 Industries Selected

8.11 SENELEC

Introduction

'Société Nationale d'Electricité' (National Society of Electricity, SENELEC) is the main producer of electrical energy in Senegal. Some industries provide surplus energy to SENELEC, for distribution.

The total amount of electricity produced by SENELEC is 296.4 MW

- 251.4 MW in the Dakar region (189.5 MW in Cap de Biches and Rufisque and 61.9 MW in Bel Air).

- 37.7 MW in the other five regional power stations located in Saint Louis, Kaolack, Ziguinchor, Tambacounda et Ourossogui.

- 7.3 MW in 23 isolated power stations in the country.

Dakar, Saint-Louis and Kaolack are the main nodes of the national electrical grid. Other power plants constitute regional networks that are not connected to the grid and are hence called isolated power plants.

In order to satisfy rural electrificity demand, Senegal created an agency called (ASER), Agence Sénégalaise d'Electification Rurale. This Agency will assist private societies willing to invest in the electrification of rural zones.

SENELEC supplies three types of voltages:

- High voltage, which is used in the Industries Chimiques du Sénégal (ICS), SOCOCIM and the Senegalese Corporation of Phosphate of Taïba (CSPT). The total came to 171,4 Gwh in 1997.
- Medium voltage is utilised by all other industries. The total made up 375,5 Gwh in 1997.
- Low voltage to Small and Medium Enterprises and to households. The total came to 458,9 Gwh in 1997.

8.2 Redistributing Energy in Senegal

Development of a nationwide interconnected network will be influenced in the future by two fundamental government options, these are:

Option 1: Hydro-electric management in the Senegal river at Manantali; hydro-electric management in Felou and in Gouina (if economically viable).

Option 2: utilisation of natural gas of Diam Niadio and of new and renewable energy system.

8.21 Hydro-Electric Management in Senegal River

Manantali Option

Hydro-electric management forecasted by the OMVS program will have an electric plant of 200 MW at the Manantali site. In the initial step, the plant will supply around 306 Gwh per year on its interconnected network. According to the work plan of OMVS, the supply of electricity will begin the year 2001.

Felon and Gouina option

In previous studies, electricity plants were planned in Felon and in Gouina. If the case study shows that the two plants are economically viable, the two power plants will

supply 300 Gwh into the interconnected network of Senegal. This hydroelectric programme will be executed sometime after the year 2010.

8.22 Natural Gas Development

Presently three gas turbines have been installed at the C3 plant of Cap des Biches in Dakar. The discovery of an important natural gas site in Diam Nadio with an estimated capacity of 500 million m^3 gives the prospect of installing more gas turbines.

A new private plant using natural gas, which will produce 50MW, was installed in November 1999 with the help of the USA: the electricity produced will be sold to SENELEC.

8.23 Use of New and Renewable Energies

Because of the new energy policy (RENES) initiated by the government of Senegal in the 1980s, the following options are available:

- Urban electrification by national electric network;
- Rural electrification by renewable and other energies.

These options will be carried out by the new agency for rural electrification (ASER).

8.24 Electricity Sales Projection

Predictions on electricity demand in the long term (until year 2015) are based on the following hypothesis:

An increase of the low voltages sales: catch up, in the medium term, of demand for medium voltage.

The projected increase of the rate of sales is higher over the period 2000-2015 than that of the decade of 1980s (2,8 % from 1980 to 1990). It should be close to the increase of sales observed in the 1970s (7 %) as a mean between 1973 and 1979 and to increase of the GDP, which is actually close to 6 % average.

These two issues will make an economic improvement very imminent.

The Launch of the Energy II Program

Energy is an unavoidable element in boosting the economy. High taxation of this sector impedes investment and reduces production. Liberalisation of this sector will have a beneficial effect on investment.

The opening of the UEMOA Market

Even though countries like the Ivory Coast have enormous potential because of their geographic location in UEMOA, Senegal has advantages in mining resources, chemical (marble, cement, etc.) and harbour infrastructure. In this context, many industries in Senegal are thinking about increasing their production in the near future, for example:

- La SAR (African Society of Petroleum) is seeking to reinforce its refining capacity and to diversify its activities;
- La SOCOCIM is increasing its production and is installing more units for grinding and cooking;
- ICS is doubling its equipment at the site of Darou and is planning to increase its fertiliser production;
- SONACOS EID is extending its refining unit and the conditioning of oil;
- Some new industries are also being planned (soap making, vegetable oil in Rufisque) etc.

If we take into account all these scenarios, we find that the expected increase in electricity demand is between 3.6 % and 7.2 %

8.3 SONACOS

8.31 Activity Level of the Société Nationale de Commercialisation des Oléagineux du Sénégal (SONACOS)

The sector of oleaginous grinding is presently not functioning very well and that is affecting its energy consumption. During the past three years the production of groundnuts has fallen, particularly during 1996. This year SONACOS functioned below its grinding capacity.

The low harvest of groundnuts is due to:

- A variable rainfall, which is decreasing;
- Continuous diminution of seeds;
- Less arable and fertile lands;
- Lack of money for subsistence framers.

The SONACOS Group is composed of four industries installed in four regions of Senegal: Dakar (EID: Industrial Etablissement of Dakar), Kaolack (EIL: Industrial Etablissement of Lyndiane), Diourbel (EIB: Industrial Etablissement of Baol) and Ziginchor (EIC: Industrial Etablissement of Casamance).

SONACOS uses vegetable residues: ground nuts shells, rice straw, cotton shells, empty palm shells to supply its steam boilers in order to produce the energy which its needs. It has also boilers that work with heavy fuel, but these fuels do not cover the energy needs of the factories so the remaining energy required is supplied by SENELEC. According to the type of energy, it is used either in heating, to run machines or to empty equipment.

9.0 Conclusions and Recommendations

Many initiatives have been undertaken to invite industry to take part in CC activities, without success. It appears that industrialists have some basic knowledge on the issues but are often confused by the CDM. Many participants appreciate the initiative of UNIDO to elaborate a concept for developing national capacity to implement industrial CDM in Africa. Stakeholders have expressed interest in being involved in the CC activities with the aim of establishing CDM as soon as possible, or to extend the

Activities Implemented Jointly in the pilot phase. This methodology meets the concerns of industry. The concrete demonstration of CDM opportunities in Africa, in terms of institution strengthening, capacity building and environmentally sound technology transfer has given the first opportunity for industry to be assisted by all other stakeholders.

The first steps consisted of bringing industry into the process. Efforts must be oriented towards the successful implementation of the initial projects within the selected industries, keeping in mind the results expected from the activities.

The NCCC must manage to bring some cohesion to the activities and to get more industrial sectors and industrialists interested in climate change issues, in particular the CDM. In order to gain such interest, the programme must build capacity and meet industrial sector needs. Certain barriers that exist should be removed.

Industries that are affiliated to big international groups or that are subsidiaries of multinational companies are less concerned with policy issues as their headquarters follow the CDM more closely. The headquarters of these groups are ready to submit a variety of projects as soon as procedures and rules of CDM are adopted.

In addition, NGOs involved in climate change issues should provide information and awareness to the industrial sector and other stakeholders.

As clearly mentioned by African delegates and the G77 Group during COP 5, the transfer of environmentally sound technologies and the training of users should be taken into account in the implementation of projects under CDM.

Lastly, one should not wait until the processes of defining the rules of the CDM are completed to become involved. One should participate actively from the beginning.

Chapter Seven

Concept For Developing National Capacity To Implement Industrial Clean Development Mechanism Project In Africa

Zambia Case Study

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1.0 INTRODUCTION

1.1 National Circumstances

1.11 Physical Features

Zambia is a landlocked country which shares borders with eight countries: Congo Democratic Republic and Tanzania in the north; Malawi in the east; Mozambique, Zimbabwe, Botswana and Namibia in the south; and Angola in the west. It lies between latitudes 8° and 18° south and longitudes 22° and 34° east and has a land area of 752,600 sq. km.

The country is situated on Central African plateau and generally has a flat topography with the exception of isolated hills and hill ranges in western Nyika plateau in the east and around the Mbala region in the north. The country's altitude ranges from 900m in the southwest to 1400m in northeast. However, the Luangwa valley falls to 340m at the confluence of the Luangwa and Zambezi rivers. This flat terrain has led to the existence of extensive swampy areas characterised by the Bangweulu and Lukanga swamps.

The country is drained by four major river systems: Luangwa in the east, Luapula/Chambeshi in the north, Zambezi in the west and Kafue in central Zambia.

Although the country lies within the tropics, its temperature is modified by the altitude. Average temperatures range from a mean monthly minimum of 10°C in June/July to a mean monthly maximum of 30°C in October/November. There are three distinct seasons: the cool dry season (April - August), the hot season (August – November), and the hot wet season (November – April). The rainfall is concentrated between November and April, varying from 1200mm in the north to 800mm in the south.

The county's vegetation is classified in three distinct categories. These are closed forests, woodland and grassland. Closed forests are limited in extent, covering a mere 6.5% of the country. The most extensive of the these is the cryptosepalum evergreen forests which occur on the Kalahari sand in western Zambia, where there is all-year accessible ground water supply. The second most extensive is the deciduous Baikiaea forest which is also found on the Kalahari sand in Southwest Zambia.

The savannah woodlands are the dominant vegetation of the country and account for 71% of the country. There are four types of woodlands: The most extensive being the *Miombo* woodlands, which covers 47% of the country. The second most extensive is the Kalahari woodlands, which occurs on the Kalahari sands of western Zambia. The third and fourth are the *Mopane* and M*unga* woodlands which grow in the dry valleys of the country.

Grasslands range from pure grasslands to grassland with scattered trees. These occur in poorly drained dambos, flood plains or swamps.

It's estimated that 55% of the 46 million hectares of country's land total is covered by forests. Of these 14% are designated as national or local forests. Both national and local forests are designated as production forests to supply timber and wood and non-wood forest products or as protection forests to protect important physical features, water catchment areas, national monuments and bio-diversity.

A further 18% of the forests are designated as Game Parks and Game Management areas (GMAs) to protect fauna and biodiversity. The remainder of the forests are classified as open forests or non-gazetted forests. The largest proportion of these occurs on traditional land while much smaller proportions of them occur on state land within municipalities. These open forests serve as production and protection forests.

In addition, the country has developed an industrial estate of plantations of exotic tree species of mainly pine and eucalyptus. There are 55,000 hectares of these all of them situated in the Copperbelt Province. These are supplemented by a further 10,000 hectares of local supply plantations of the same species, which are located in the rest of the provinces to meet local demands of softwood timber and wood products.

1.12 Demographic Features and Trends

Zambia's population has risen rapidly over time, from 3.5 million in 1963 to an estimated 9.5 million in 1996, representing an increase of 171% over 33 years. The projected population for 1997 was 9.78 million. The estimated population growth rate of 3.1% is one of the highest in the world and implies that approximately a 23-year doubling time of the population.

One of the main reasons for the persistent high growth of population is the persistence, despite a declining trend, of a high level of fertility. A variety of social-cultural factors contribute to the high fertility: low mean age at marriage, low education especially among females, low contraceptive use, high levels of infant and child mortality, and low socio-economic status especially that of women.

Owing to the high population growth, the population density has steadily increased over the years but nevertheless remains very low. The number of persons per square kilometre increased from 5.3 in 1969 to 7.5 in 1980, to 9.8 in 1990 and to an estimated 12.6 in 1996.

Zambia remains one of the most urbanised countries in sub-Saharan Africa although the percentage of urban population has steadily gone down in the nineties-from 45.5% in 1991 to 38.8% in 1993 to 36.9% in 1996.

1.13 Economic Situation

The Zambian economy is dominated by the mining sector with copper being the major export product, contributing over 90% of the country's foreign exchange earnings. It is also supposed to be the major source of Government revenue. As of 1990, manufacturing was the first most important sector followed by mining and agriculture. Contribution to gross domestic product in 1990 in 1985 constant figures were mining (22.3%), manufacturing (22.5%) and agriculture (12.5%).

In 1991 a number of far reaching structural reforms were implemented, these include:

- Decontrol of interest rates
- Removal of exchange controls and floating of the local currency
- Liberalisation of the banking sector,

The Zambian economy has faced fluctuating rates of growth. Negative growth in 1991 and 1992, was followed by positive growth in 1993, followed again by negative growth in 1994 and 1995 followed by positive growth in 1996 and 1997. A negative growth was again forecast for 1998. The overall growth rate has been a meagre 1% during the last seven years. Per capita real GDP growth has been mostly negative between 1990 an 1995 and was slightly positive only in 1996 and 1997. This means that the overall per capita growth in the last seven years has been negative.

The major contributing factor to this overall decline in GDP has been attributed to adverse weather conditions and sharp decline in copper production and export. As a result of the above, coupled with the weakening of the financial sector, real GDP contracted by an estimated 2.0% in 1998. The manufacturing sector has continued to perform unfavourably with contribution to real GDP declining form 28% in 1991 to about 24.0% in 1997. The poor performance of the sector is attributed to the liberalisation of the economy, the high tight monetary policy and high inflation. Opening up of the borders has exposed local manufacturing companies to unfair competition.

Despite these negative scenarios, the Government's macro-economic objectives for the period 1999-2001 are to achieve economic growth of 5.0% a year. This is hoped will be achieved through privatisation of the copper mine, whose production has gradually dropped over the years.

1.14 Energy

The country is well endowed with indigenous resources, mainly coal, hydropower and wood fuel. Petroleum products are the major energy import. Nationally wood fuel contributes the largest share of final energy consumption, which was over 60% in 1995.

Zambia's hydropower potential stands at 4000MW and has developed over 1630MW. The country has an electricity generation capacity of 1795 MW, which includes thermal and gas turbines, diesel sets (8MW) and mini-hydro power station 50MW.

Of the 1795 MW electricity capacity, 1670MW is hydro-electricity, 80MW is from gas turbines, 40MW from waste heat, and 5MW from diesel generators supplying isolated systems in North-Western Province. The hydro-electricity scheme is interconnected. In addition, the Zambian power system is interconnected at high voltage with neighbouring Zimbabwe and Congo D. R. and at lower voltage to northern Botswana and Namibia. The structure of energy consumption in Zambia is largely influenced by the mining sector. Mining accounts for 27.0% of total consumption, followed by transport (12.05%), and industry 11.0%.

1.15 Industrial Activities and Performance in Zambia

The industrial base in Zambia is characterised by activities in mining, manufacturing, and energy transportation and processing. Copper mining is still the backbone of Zambia's economy. Copper mining involves mining of ores from both underground and open pits, concentration, smelting and refining into 99% pure copper. Mining and processing of copper involves use of electricity, and combustion of fuels (such as coal, fuel oil, wood and charcoal) mostly in furnaces.

The manufacturing sector although comparatively small is fairly diversified with activities in:

- Cement and Lime
- Glass
- Textiles
- Food and beverages
- Pulp and paper products
- Wood and forestry
- Iron and steel foundries
- Chemicals (pharmaceuticals) soaps and detergents, etc.

The industries that are in processing mainly use electricity for motive power. Electricity is also a major source in refrigeration and cooling in food and beverage production. The other major fuel source is coal and fuel oil. These are mainly used in boilers (for steam process production) and furnaces.

Energy transportation and processing involves activities in transportation of crude/spiked oil from Dar-Es-Salaam to Ndola through a 1700km pipeline. The pipeline has seven pumping stations and use combination of diesel and spiked oil for combustion in the prime movers. The crude/spiked oil is then processed in a refinery. Energy production in the form of electricity, despite Zambia's relatively reasonable potential in hydro-based electricity generation, it is still provided by diesel generating sets estimated at 8MW. This being the case due to remoteness of some districts in the country and associated high transmission costs.

The copper industry still provides about half of the Government revenue at 85% of the country's export earnings. Over the recent past, however, there has been a decrease in the production of copper. For example, in 1997, Zambia produced 320, 446 tonnes of copper, as compared to 640,000 tonnes of copper in 1975.

In an attempt to revitalise the mining industry, the Zambian government is in the process of privatising the Mines. Once privatised, it is expected more investment flows will be forthcoming to increase production, which has been falling over the years.

Significant progress has been made in the privatisation of the manufacturing industry, with about 282 companies privatised by 1998. With this change in economic structure, the privatised companies are putting in a lot of effort to put more life into production through re-investment with the aim of making them more competitive.

1.2 Africa's Position on the Clean Development Mechanism (CDM)

CDM has in the recent past become a topical and sometimes controversial issue in various debates on climate change. CDM has received mixed reactions, although it is generally agreed that CDM can be a means of assuring that interests of all parties from industrialised countries and all developing countries are equally developed. From the developed countries' perspective, CDM is seen as "a cost effective way of mitigating global greenhouse emissions through creation and sharing of credits".

In other words a means of business as usual and a world of money.

On the other, whilst developing countries, particularly Africa agrees that CDM can contribute to sustained growth, poverty eradication, technology transfer and capacity building, there are areas of concern that need to be addressed.

- CDM should address sustainable development and technology transfer.
- There should be equity in terms of benefits and access to CDM.
- Governance issues should be addressed particularly the structure and design of CDM.
- Operational and methodological issues, (including certification and verification criteria of CDM projects and activities should be addressed).
- As a funding mechanism, CDM should not replace Official Development Assistance (ODA).
- There should be increased support and need for capacity building in climate change areas.
- Issues of transparency should be addressed.

At another forum, the following issues on CDM were raised:

- CDM projects: Participants were of the opinion that all CDM projects should satisfy the purpose of establishing as stated in the protocol. However, participants expressed their desire to include sustained economic growth, poverty reduction, transfer of technology and capacity building as part of the sustainable development objectives of CDM projects.
- Capacity building requirements for CDM: A range of capacity building requirements were mentioned in order to prepare African Countries to participate in the CDM. These included; raising awareness about CDM and climate change in governments, the private sector and the general public, building capacity in baseline calculation, monitoring, verification and certification; research and development of technology and the creations of institutions at the national, sub-regional and regional levels to channel climate change activities.

At a recent workshop, issues of concern, during the process of defining and operationalising CDM (in particular criteria to be used in appraising CDM projects), were elaborated as follows:

- CDM projects selected should contribute to sustainable development. For sustainable developments to have a meaningful impact, it is essential that projects designed under CDM are assessed based on the following indicators (financial, economic, environmental, technological and social sustainability.
- To have a meaningful participation in CDM, Africa should be assisted to develop human and institutional capacity for identifying, planning, appraising, implementing and monitoring CDM projects.

From the various discussions and deliberations, three major issues of concern emerge

- Kyoto Mechanisms (CDM, etc) and transfer of technology.
- Attainment of sustainable development.
- Transfer of environmentally sound technologies

The UNIDO project programme on "Concept for Developing National Capacity to Implement Industrial Clean Development Mechanism Projects in a selected number of countries in Africa" no doubt goes a long way in attempting to addressing some of the current issues and concerns on CDM from the African countries' perspective.

In particular, the terms of reference of the UNIDO Programme relating to strengthening institutional and infrastructure capacity among other issues to develop project documents will assist Africa in achieving sustainable development and becoming effective partners in the climate change process. This initiative will in addition go a long way in increasing public awareness about linkages between technology co-operation, sustainable development, both at macro and micro levels and climate.

2.0 CLIMATE CHANGE RELATED ACTIVITIES

2.1 Background

Zambia, like many other countries, made a commitment at the Rio Summit of June 1992 aimed at contributing to the global reduction of the green house gas emissions as a way of promoting sustainable development.

This commitment to United Nations Framework Convention on Climate Change (UNFCCC) entailed undertaking studies on inventories, mitigation and vulnerability and adaptation.

In the last five years, the following climate change related studies and activities have taken place:

- Measures to implement the UNFCCC: Zambia country study on climate change: Inventories and mitigation.
- Climate change mitigation in Southern Africa: Phase I.
- Activities on GHG emissions inventory vulnerability, mitigation and adaptation.
- Climate change mitigation in Southern Africa: Zambia country study

- Zambia Enabling Activity for the preparation of initial communication.
- Sugar-cane resources for Sustainable Development: A case study in Luena.

In addition, other studies related to climate change have also been undertaken. Of relevance to this programme is a study on:

- Survey of industrial boilers in Zambia. Power Rehabilitation Project: Industry Energy Conservation Sub-Project.

2.2 Brief Description of Climate Change Related Activities

2.21 Measures to Implement UNFCCC: Zambia Country Study on Climate Change: Inventories and Mitigation

A multi-disciplinary team under the auspices of the Centre for Energy, Environment and Engineering Ltd. (CEEEZ) undertook the work on the Zambia country study on climate change.

The project was funded by GTZ to enable Zambia fulfil its commitment to the UNFCCC. In the study, emission inventories were compiled. The study further identified a number of climate change mitigation options under two broad categories:

(i) Supply-side options.
(ii) Demands-side options.

Results of the study are summarised below:

2.22 Inventories

In 1990, Zambia contributed 3.2 million tonnes of CO_2 to the atmosphere or about 1% of Africa's total emission. Approximately 88% emissions were attributed to energy use. Industrial processes mainly cement and lime production and use accounted for 12% of CO_2 emissions. In the energy sector, transportation contributed 29.5% of total CO_2 emissions followed by mining with 15.8%.

Results of the study reveal CO_2 emissions from the industrial sectors as given in Table 1.

Table 1: CO_2 Emissions from Industrial Sector for the Year 1990 (Tonnes).

SECTOR	COMPANIES	CO_2 FROM ENERGY	CO_2 FROM INDUSTRIAL PROCESSES
Mining	ZCCM	505, 980	120,239*
Manufacturing Industries	Chilanga Cement National Breweries Zambia Breweries ROP	221,620 20,740 20,900 16,830	210,438

	Premium Oil Industries Dunlop Zambia Sugar Others	14,430 13,940 12,100 26,840	
TOTAL		853,380	330,678

* From Lime Production

2.23 Mitigation analysis

The climate change mitigation options were identified by selecting energy and industrial options. The options were assessed for green house gas reduction potential. The cost of the options was compared to the reference option, which would be the most likely path to be followed by Zambia in its development activities. The following is a list of the options related to industrial activities, which were analysed:

(i) Substitution of diesel and heavy fuel oil boilers with electric boilers.
(ii) Converting cement production from wet to dry process.
(iii) Extension of the national grid to serve areas currently supplied with diesel generators.
(iv) Replacement of four diesel pumping stations with electric motors at TAZAMA Pipeline

2.3 Climate Change Mitigation in Southern Africa: Phase I

The UNEP Collaborating Centre on Energy and Environment (UCCEE) undertook the study, in collaboration with Centres and Ministries in southern Africa. These comprised of:

- Botswana (Ministry of Mineral Resources and Water Affairs and EECG Consultants).
- Tanzania (Ministry of Energy, Minerals and Water Affairs and the Centre for Energy, Environment and Sciences and Technology (CEEST)
- Zambia (Ministry of Energy and Water Development and Centre for Energy, Environment and Engineering (Z) Ltd., (CEEEZ).

The work was supported by the Danish International Development Agency (DANIDA) through UCCEE. The study focused on the following:

- Overview of the institutional set up for national planning related to environment.
- Organisation overview of the existing climate change activities.
- Review of existing studies and plans on climate change.
- Energy supply and demand environmental issues in major sectors of the economy and mitigation options.

2.31 Activities on GHG Emissions, Inventory, Vulnerability, Mitigation and Adaptation

The study was carried out under the auspices of the Environmental Council of Zambia (ECZ) with financial support from the United States Country Studies Programme (USCSP).

The study undertook some activities on a GHG emissions inventory, vulnerability assessment and adaptation options. A series of models for predicting adaptation and vulnerability scenarios were adopted.

The results of the emissions inventory were critically reviewed and fully harmonised in a comprehensive GHG inventory under the Zambia Enabling activities for the preparation of initial communication based on the results of the USCSP and GTZ studies, and updated to 1994.

Similar efforts are continuing on harmonising and improving estimates on vulnerability, adaptation and mitigation studies under the Zambia Enabling Activities for the preparation of Initial Communication.

2.32 Climate Change Mitigation in Southern Africa

The Zambia Country Study was carried out by the Centre for Energy, Environment and Engineering (Z) Ltd with financial support from DANIDA and backstopping from UCCEE. The study was a continuation of a preliminary study and aimed at methodological development, national mitigation analysis and institutional capacity building in Zambia. The study comprised the following five elements:

- Comprehensive evaluation of national social and economic development framework for climate change.
- Baseline scenario(s) projection(s)
- Mitigation scenario(s) projection(s)
- Macro economic assessment
- Implementation issues.

2.321 Baseline Scenario Development

One of the main objectives of the study was to develop baseline scenarios in energy and forestry sectors. The main elements considered under baseline scenarios in the energy sector were energy demand and CO_2 emission projections. To determine these parameters, the following assumptions were taken into consideration: population and household energy; household energy mix; economic activities measured in GDP; energy intensity, energy policy and; fuel prices. Together with these assumptions, energy demand and CO_2 emissions projections were calculated using the Long-Range energy Alternatives Planning (LEAP) system. Another model used in the study is the Greenhouse Gas Abatement Costing Model (GACMO) which was specifically used to determine the cost of implementation of mitigation options on an individual basis.

Results from the energy consumption projections by sector under baseline are shown in Table 2.

Table 2: Energy Consumption Projections by Sector under Baseline (PJ)

YEAR	House-Hold	Industrial/ Commerce	Govt. Service	Agriculture	Mining	Transport	Total
1995	131.25	21.51	3.99	5.21	23.23	13.1	198.29
2010	195.2	47.15	7.49	9.01	43.01	20.75	322.61
2030	330.8	147.21	18.9	18.71	97.81	40.39	653.1

The total energy demand under baseline is expected to increase from 198.29 million GJ to 322.61 million GJ by 2010 and 653.10 million GJ by 2030. The largest contribution came from household (50.70%) followed by industry/commerce (22.50) and mining 14.98.

Results for emissions projections from energy, industrial processes, and land-use change activities are shown on Table 3.

Table 3: Emission Projections from Energy, Industrial Processes and Land-Use Change Activities (tonnes CO_2) (baseline)

SECTOR	**1995**	**2010**	**2030**
Energy	2,133,190	4,190,550	10,502,190
Industrial Processes	297,636	535,745	1,174,472
Land-use Activities			
(i) On-site burning	53,829,140	94,624,370	200,792,360
(ii) Off-site burning	14,892,140	20,013,800	36,147,150
(iii) On-site decay	5,486,670	8,501,110	15,954,500

It should be noted that CO_2 emissions arise from both energy (combustion in boilers and furnaces under manufacturing and mining) and industrial activities.

Mitigation analysis under the mitigation scenario in the energy sector, considers five economic sectors namely:

- Household
- Mining
- Industry
- Transport
- Government service

Under the industrial sector, options of partial replacement of coal, diesel and fuel based boilers with electric ones and, cement production were considered and analysed for potential emission reduction and cost of reduction. Results of emission reduction and cost of reduction of industrial based sector options, together with other options under household, transport and government service are given in Table 4.

Table 4. Emissions Reduction and Cost of Reduction

OPTION	EMISSION REDUCTION (TONNES CO_2)		COST OF REDUCTION US$/TONNE CO_2
1. Improved Motor vehicle maintenance			
(i) Petrol	8,400	20,000	-1,126.55
(ii) Diesel	5,400	10,000	-473,79
2. Ethanol blend	71,240	120,000	- 97.04
3 Use of improved charcoal stove	460,000	760,000	-29.11
4. Use of coal briquette stove	40,000	60,000	-11.97
5. Use of electric stove	1,850,000	4,810,00	-10.55
6. Replacement of boiler with electric ones			
(i) Fuel oil	220,000	110,000	-3.87
(ii) Diesel	100,000	50,000	-12.16
(iii) Coal boiler	80,000	40,000	-14.74
7. Cement production	50,000	110,000	9.74
TOTAL	2,885,040	6,090,000	

The total emission reduction for all the options amounted to 2.89 million tonnes in 2010 and 6.1 million tonnes in 2030. It is evident from the results that most of the options in the Zambian scenario have negative costs with an exception of cement production and replacement of coal boilers. This scenario puts Zambia in a well-placed position to positively contribute to abatement of CO_2 emissions through implementation of relatively lower cost options.

2.4 Sugar Cane Resources for Sustainable Development: A Case Study in Luena Zambia

A study on exploitation of sugar cane resources for sustainable development has recently been completed. The overall objective of the study was to assess alternative uses of sugar cane resources in Luena and identify investment alternatives that are most advantageous for sustainable development from societal perspective. Specifically the study developed and compared different scenarios and configurations (from financial, economic, environmental and social perspectives) for production, sale and consumption of sugar, ethanol and electricity.

Based on a flexible production configuration consisting of sugar factory, an annexed distillery and advanced co-generation technologies, sugar, ethanol and surplus electricity are produced in sufficient quantities to make three promising options financially, economically and environmentally viable. The Three options are given in Table 5.

Table 5: Financially Promising Options

Technical Configuration	Initial Investment (Million US$)	Net Present Value (Million US$)	Internal Rate of Return	Pay Back (Years)
Sugar factory, Annexed Distillery using 'A' molasses & CEST	159	83	18.4%	4
Sugar Factory and Annexed Distillery 'B' molasses & CEST	130	55	16.6%	5
Sugar Factory Annexed Distillery using 'A' molasses & BIG/STIG	235	67	14.8%	5

Positive socio-economic and environmental impacts include:

- Employment generation
- Reliability and stability derived from better utilisation of a domestically available resource.
- Rural Development in Luena region
- Creation of sustainable livelihoods through linkages to small businesses.
- Sustainable Energy System based on renewables
- Diversification of Zambia Energy Resource Base and Electricity system
- Health benefits of unleaded gasoline (ethanol as octane enhancer)
- Carbon dioxide savings (internal climate goals)
- Savings in Foreign Exchange

The positive results of this study can be used in existing sugar estates and factory such as Nakambala Sugar. Nakambala produces sugar and molasses, and uses traditional co-generation technologies for internal electricity generation. Opportunities do exist for Nakambala to produce ethanol from molasses and invest in advanced co-generation technologies to produce sufficient electricity for its own consumption and export to the national grid.

2.5 Survey of Industrial Boilers in Zambia

The study on the Survey Industry Boilers in Zambia was undertaken by CEEEZ under the auspices of World Bank Supported Power Rehabilitation Project: Industrial Energy Conservation Sub-Project. The objective of the study was:

- To gather data on actual fuel consumption of Industrial Boilers

- Establish the extent of energy efficiency and conservation in selected manufacturing industries.

Findings and recommendations of the study are given below as follows:

- Potential for energy conservation and efficiency exists but requires awareness creation at the top and middle management and operative levels
- Monitoring and Instrumentation is largely inadequate and non-existent in the majority of the industries surveyed. Therefore, the data on energy consumption may not be accurate and there is no knowledge of efficiency.
- Most of the boiler operators and their supervisors and some plant managers do not seem to appreciate the need for efficient operation of boiler plants. Boiler operators generally have on-job experience and hence have no theoretical understanding of boiler operation.
- Record keeping with respect to boiler logbooks is uncommon and absent in most of the industries surveyed.
- Although automatic water treatment facilities are available in some of the surveyed industries, the level of sophistication of water treatment practices are inadequate in the many cases and the manual treatment facilities are generally unsystematic. This deficiency requires serious attention and urgent correction.
- Energy conservation policy is largely non-existent in the surveyed industries.
- Steam condensate is not properly utilised and in about half the plants surveyed condensate recovery systems are non-existent.
- Technical status with regard to insulation, steam leaks and housekeeping was found to be substandard in most of the industries surveyed.
- Although as many as 84% of the industries indicated that they do carry out planned and preventive maintenance, very few companies out of all the surveyed actually do systematic plant maintenance.
- There is lack of specialised private sector support services to industry in Zambia in form of consultancy and specialised services such as cleaning and test instrumentation and water treatment facilities.

2.51 Recommendations

❑ Training

Training programmes should be instituted in selected industries with potential for energy conservation and efficiency measures to succeed aimed at the following:

(i) There will be need for training to be initially targeted at middle managers in order to strengthen management support and the capability to establish an organised monitoring and targeting programme. The middle managers should be given training in the following topics: •

- Improved housekeeping, maintenance and operation of boilers
- Improved combustion efficiency in boilers
- Boiler tuning with the help of electronic combustion analysers
- Use of monitoring and instrumentation equipment for improved combustion efficiency

- Water quality and boiler 'blow down control'
- Energy cost reduction measures

ii The boiler operators will be targeted for practical training once the middle managers have been trained and the management support sufficiently strengthened for all practical purposes.

iii Training of IOB staff on accurate data collection on boilers and its interpretation.

- **Awareness**

Institute an awareness programme in selected industries aimed at:

(i) Inculcating to all levels of management on the need for energy conservation, efficiency policies, programmes and practices.

(ii) Informing management on the need for monitoring and instrumentation and the benefits that accrue.

(iii) Informing management on the economic reasons for the need to conserve energy and the need to develop uniform record keeping, reporting and accounting system.

- **Energy Conservation and Efficiency Measures**

Implementation, with the assistance of a revolving fund[1] to be created, of low cost energy conservation and efficiency measures in selected industries such as:

(i) Metering and/or flue gas analysis to improve combustion efficiency.

(ii) Flue gas analysis for CO, CO_2 and O_2 to determine combustion efficiency and air-fuel ratio.

(iii) Insulation of steam distribution piping aimed at reducing heat losses.

(iv) Improve steam distribution efficiency and condensate recovery to increase the efficiency of steam utilisation.

(v) Installation of improved water treatment facilities and test equipment for determining boiler and feed water quality.

- **Support Services**

Introduction of specialised support services in energy audit and analysis, cleaning services and test equipment and water treatment facilities.

In view of the need to improve on competitiveness in industry in terms of priority, training and awareness are important measures to implement followed by energy conservation and efficiency measures.

[1] The Revolving Fund could be established and then administered by a Committee through a financial institution (ie, a Bank). It is estimated that the fund would require an initial capital of US$500,000. The amount would be sufficient to allow industries operating boilers to tap from the fund in order to institute low cost measures.

There is need for more companies to promote boiler water treatment in order to strengthen service capabilities.

2.6 AIJ Experience in Zambia

As part of a regional study on AIJ, a study was undertaken in Zambia to ascertain the level of awareness and extent of AIJ activities. The study revealed that lack of participation in AIJ projects in Zambia, just as the rest of Africa was due to lack of awareness and it was suggested that awareness creation for policy-makers, scientists and private sector be initiated. Despite this lack of awareness, it was generally agreed that AIJ had potential in fostering sustained economic and social growth.

3.0 ZAMBIA ENABLING ACTIVITIES FOR THE PREPARATION OF INITIAL COMMUNICATION UNDER THE AUSPICES OF (ECZ)

The main objective of the activity is to enable the country fulfil its commitments and obligations as required by articles 4.1 and 12.1 of the Convention, especially the preparation of its initial communication as required by article 12.1 (a), (b) and (c) of the UNFCCC based on the recommended COP2 guidelines and format for non-annex I parties.

Some of the objectives of the activity include:

(i) To harmonise the various climate change programmes undertaken in Zambia and develop a plan of action based on the past and existing activities.
(ii) To enable Zambia to compile a comprehensive GHG inventory, taking account of previous studies.
(iii) To enable Zambia to undertake mitigation, vulnerability and adaptation assessments, so as to choose appropriate technologies for mitigation and adaptation.

The activity has three major study elements:

- Inventories
- Mitigation
- Vulnerability and adaptation

So far the study on inventories of anthropogenic greenhouse gas emissions and removals in Zambia has been completed. The Centre for Energy Environment and Engineering (Z) Ltd (CEEEZ) undertook the study.

Results of total emissions of greenhouse gas are given in Table 6 for the year 1994.

Table 6: Total Emissions of Greenhouse Gases 1994 (Gg)

Greenhouse Gas Source	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Total National emissions	2,595.35	735.98	6314	1197.84	10,787.82	79.03	6.42
1. All Energy (Fuel combustion and fugitive)							
A. Fuel Combustion							
1. Oil Refinery							
2. Household				0.0012	0.00187	0.0124	0.0186
3. Agriculture & Fisheries	57.046	56.811	39.333	920.176	828.587	63.227	2.6319
4. Mining	1.231	1.947	1.342	31.50	28.274	2.408	0.1035
5. Industry & commerce	657.329	0.045	0.1160	1.569	4.384	0.7536	0.8726
6. Government Service	319.488	5.207	3.586	85.660	78.89	6.404	2.1358
7. Transport	48.238	0.0054	0.0077	0.4747	2.130	0.031	0.1937
Sub total	1211.553	0.1626	0.0177	13.427	2.130	10.651	0.3786
H. Fugitive Fuel Emissions	2,294.885	64.178	44.40	1052.807	993.830	77.451	6.335
1. Coal mining							
Sub total	-	0.0137	-	-	-	-	-
INDUSTRIAL PROCESSES	-	0.137	-	-	-	-	-
2. Cement production							
3. Lime production	139.340	-	-	-	-	-	-
4. Ammonia production	153.61	-	-	-	0.0393	-	-
5. Glass manufacture							
6. Nitric acid production	7.464	-	-	-	-	0.0224	0.00014
7. Road paving	-	-	-	-	-		9
8. Sub total						0.0423	-
AGRICULTURE	-	-	-	-	-	-	-
Enteric Fementation	-	-	0.084	0.0881	-	-	-
Animal wastes	300.465	-	-	-			-
Rice cultivation			0.084	0.0881	0.0393	1,5747	
Savannah burning							0.08314
Agricultural waste							9
Burning		76.48	0	0	0		
Agricultural soils		3.04	0.0003	0	0		
Sub totals		0.72	0	0	-0		
		297.29	3.68	132.98	7803.84		
			0.02	0.73	10.64		
Land-use Change and Forestry5.		0.51	14.62	0	0		
		378.04	18.34	133.71	7814.48		
Waste							
		226.23	0.311	11.24	1,979	47	
		67.39					

From the results, it is evident that under the energy sector for the year 1994, CO_2 emissions from the industrial sector, comprising of mining and manufacturing accounted for 43.0% of total emissions. Mining alone contributed 28.6% and manufacturing 13.9% of total emissions. Under manufacturing, major contribution comes from cement and lime production.

Mitigation and vulnerability studies are still being undertaken.

Under mitigation analysis, the options related to industrial activities being considered are:

- Use of energy efficient furnaces
- Electrification of surface and underground vehicles and locomotives
- Replacement of fuel based furnaces with electric ones
- Converting coal fire boilers to electric boilers
- Extension of national grid to Lundazi and Chama from Malawi
- Construction of mini-hydro power stations in North-Western Province.

Given on Table 7 is a summary of the status of activities undertaken in Zambia

Table 7: Summary of Status of Climate Change Related Activities

Activity	Support	Component	Institution	Year completed	Collaborating institutions
1. Activities on GHG Emissions, Inventory, Vulnerability, Adaptation and Mitigation	USCSP	• Inventory • V&A • Mitigation • Public awareness	ECZ	Partially completed	• NCSR •Meteorological Dept • Forestry Dept • ECZ staff
2. Measures to implement the UNFCC	GTZ	• Inventories • Mitigation.	CEEEZ	1996	• University • ZESCO • DOE
3. Climate Change mitigation in Southern Africa: Zambia Country Study	DANIDA	• Methodological Development • Mitigation analysis • Macro-economic assessment • Implementation issues.	CEEEZ	1998	• DOE
4. Enabling Activity for Preparation of Initial Communication	UNDP/ UNEP	• Inventories • Mitigation • V&A • Public awareness	CEEEZ ECZ ECZ ECZ	1999 On going On going Ongoing	• DOE • ZESCO • NSCR • Met. Dept
5. Energy Efficiency and Conservation: Survey of Industrial	World Bank	• Energy Efficiency • Barrier identification	CEEEZ	1997	• DOE

Boilers					
• Feasibility study: Sugar Cane Resources for Sustainable Developme nt : A Case Study in Luena	SIDA	• Financial/Economic analysis • Environmental analysis • Social impact assessment • Possible candidate for CDM	CEEEZ	1999	• DOE • SEI • ZACCI • ZAM • Min. of Finance • Min. of Transport, Comm.
7. AIJ experience in Africa	Southern Centre	Assessment	CEEEZ	1995	

The methodological approach used in undertaking the studies emerged as follows:

(i) An independent centre is given the responsibility for the execution of the analysis on behalf of Government, with staff from other Ministries, Universities, industry and NGO participating in the work of the centre.

(ii) A Government Agency is given the responsibility for the execution of the analysis and uses its staff and staff from other institutions to undertake the work.

(iii) In most of the areas stakeholders from Ministries, selected private sectors, Universities and NGOs were involved either at the beginning and/or end of the activity to contributing to the results of a given study.

4.0 CLIMATE CHANGE AND INDUSTRY

4.1 Possible CDM Activities for Implementation Under the Industrial Sector

Choice of CDM industrial based projects will largely be influenced by the level of emissions generated in a particular situation. Preliminary results of some work undertaken so far indicate possible CDM opportunities do exist in the following industrial sectors:

- Copper mining industry.
- Manufacturing industry in particular cement and lime, food and beverages, leather and textiles.
- On the supply side, Nakambala sugar Company has the potential to produce ethanol and surplus electricity to serve to the national grid through use of advanced cogeneration technologies.

Given in Table 8 are the possible CDM measures and/or technologies per identified industrial sector.

Table 8: Possible Measure and/or Technology per Identified Industrial Sector

Industrial Sector	Measure/Technology	Estimated CO_2 avoidance (T)
1. Copper mining (ZCCM)	• Energy efficiency in furnaces • Use of electric furnaces • Electrification of surface and underground vehicles and locomotives	500,000 - 700,000
2. Manufacturing (i) Food and beverages (ii) Textiles and leather (iii) Cement and Lime	• Energy efficiency in boilers and furnaces • Process • Improvement in cement and lime industry	400,000 - 600,000
3. Nakambala Sugar Company	• Use of advanced cogeneration technologies	

4.2 Review of Energy Intensive Industries

Of the industries in Zambia, copper mining and food and beverages industries constitute some of the leading energy intensive industries in Zambia. Copper, which involves mining concentration, smelting and refining, is well integrated in terms of its production strategies. All the mines namely Nchanga, Roan, Nkana, Mufulira, Chibuluma and Chambishi and Konkola have mining and concentration facilities. Nkana and Mufulira in addition to mining and concentration have smelting and refining facilities for its own use and for other companies like Roan, Nchanga, Chambishi, Konkola and Chibuluma who do not have their own internal facilities for this purpose.

Fuels such as coal, heavy fuel oil, diesel and paraffin are used extensively in the concentrates (for drying the concentrates), smelters, conversion and smelting), acid plants (for conversion). For this purpose, Nkana and Mufulira Mines were selected for further Claboration as CO_2 emissions were concerned.

Among the Food and Beverages companies, National Breweries was chosen in view of its extensive network of plants in the country making opaque beer and also the nature of technology used in the process.

National Breweries has breweries scattered in most parts of Zambia namely:

- Kitwe
- Lusaka
- Chililabombwe
- Mufulira
- Mazabuka
- Choma
- Livingstone
- Ndola
- Chipata

Coal is mainly used in boilers to provide process steam.

To determine CO_2 emissions from the selected industries, IPCC/1996 methodology was used and is given below as follows:

CO_2 = Fuel consumed X Energy conversion factor X Carbon Factor X Carbon Oxidised X 44/12

Given in Table 9 are the amounts of fuel consumed in the selected industries.

Table 9: Amount for Fuel consumed in selected industries – for the 1998/99 Financial Year (tonnes)

INDUSTRY	COAL	HFO	DIESEL	PARAFFIN
Nkana Mufulira Sub-total	53083	42,315	347	8,204
		9,785		
	53,083	52,100	347	8,204
National Breweries	11,000			
TOTAL	**64,083**	**52,100**	**347**	**8,204**

Based on the above, fuel consumption and taking the following input data in Table 10, CO_2 emissions are calculated.

Table 10: Input Data for CO_2 Calculations

Fuel	Energy Converion Factor GJ/Tonne	Emission Factor (KgC/GJ
Coal	27.21	25.0
HFO	40.82	2.1
Diesel	42.75	20.2
Kerosene	43.34	19.6

The amount of CO_2 emitted in the year 1998/99 financial year and ratio of CO_2 in relation to total for Zambia is given in Table 11.

Table 11: CO_2 Emitted (tonnes) and Ratio with Total 1998/99 Financial Year

Industry	Amount Emitted (tonnes)	Total Estimated (tonnes)	Ratio of Total
Nkana	293,958	3,000,000	10.0%
Mufulira	30,593	3,000,000	1.1
Sub-total	324,551	3,000,000	10.8%
National Breweries	**28,031**	**3,000,000**	**1.0%**

Nkana is the largest contributor in the mining sector with 10.0% of the total emissions for the year 1998/99. This being the case in view of high utilisation of fuels for process

execution at Nkana, as compared to Mufulira with 1.0% due to heavy reliance on electric furnaces for the reverbatory furnaces. National Breweries contribution was only 1.0%.

5.0 INDUSTRIAL SUSTAINABLE DEVELOPMENT

5.1 Indicators of Sustainable Development

One of the objectives of CDM under active consideration during negotiations on mechanisms pursuant to articles of the Kyoto Protocol is to assist non-Annex I parties in achieving Sustainable Development.

Attempts are currently underway to develop and build a consensus on criteria and indicators to be applied to the definition of sustainable development. Broadly sustainable development has been defined as attainment of economic growth, equity and environmental considerations. For sustainable development to have a meaningful impact, it is essential that projects and programmes be assessed based on the following proposed indicators:

- Financial Sustainability
- Economic Sustainability
- Environmental Sustainability
- Technological Sustainability
- Social Sustainability

i Financial Sustainability: If the private sector is to be encouraged in CDM projects and programmes, the bottom line will be that of attainment of financial sustainability of usual standard indicators.

- Profit and loss
- Balance sheet
- Cash flow requirement
- Financial indicators

(a) Internal Path of Return (IPR)
(b) Net present value (NPV)
(c) Pay back period

ii Economic Sustainability: Implementation of projects and programmes through increased energy efficiency and application of renewable technologies resulting in reducing the burden on imports of energy on a macro-level, and contributing to competitiveness of a micro-level like industry.

iii Environmental Sustainability: Two aspects are of interest here namely global and local environmental analysis and assessment: Global environmental measures should result in the reduction of greenhouse gases (CO_2, CH_4, N_2O) as per convention). Local environmental efforts should result in reduction of local impacting local emissions (pollutants: SO_4, NO_x, CO, VOC).

iv Technological Sustainability: Requires an increase in energy productivity through reduction of energy intensity at a micro-level, and increasing share in the contribution of renewable energy to the energy supply mix of a macro-level.

v Social Sustainability: Requires implementation of projects and programmes resulting in increased local employment and more equitable distribution of resources.

5.2 At Country Level

At country level, it is essential that sustainable development and its indicators be integrated both at the national level planning and as part of total management system at the enterprise level. In this direction, it is useful to assess to what extent sustainable development has been and can be integrated from the industrial point of view. It would also be interesting to note whether the application of sustainable development has been as a result of intervention explicitly or implicitly from the viewpoint of the Convention on climate change.

For example in Zambia, the Ministry of Commerce, trade and Industry is in the process of implementing the National Action Programme for Private Sector Support (NAPPSS).

NAPPSS is a programme concretising what action is needed by Government to pursue the objective of promoting and facilitating sustainable growth and development of the private sector, in general, and the industrial, commercial and trade sectors in particular.

The main focuses of NAPPSS are threefold:

- The assessment of economic potentials of various economic sectors and industries.
- The evaluation of their recent performance and competitiveness.
- The identification of prevailing business constraints.

Priority areas of NAPPSS have been identified as follows:

- Macro-economic stability and predictability of policy environment.
- Competitiveness, market development and access.
- Incentives, taxation and duties.
- Infrastructure and utility cost.
- Availability and cost of factor inputs.
- Regulatory environment and transaction cost.

Although the programme has no direct linkage with the Convention on climate change and sustainable development in particular, it does contain some aspects and attributes of sustainable development such as economic growth through encouragement of attainment of competitiveness, and environmental through insistence on a regulatory environment.

For example, in the area of environmental standards and compliance, the Government through its agency, the Environmental Council of Zambia (ECZ) has established strict environmental standards and guidelines to be followed by all companies doing business in Zambia. Under the Environmental Protection and Pollution Control Statutory

instrument, it is a requirement to have a full Environmental Impact Assessment (EIA) done before and after a project has been established. There is no specific standard for emissions and effluent control, but general standards guidelines and statutory instruments exists on:

- Waste management
- Air pollution from stationary sources
- Pesticide and non-toxic substance regulation.

Such an arrangement above goes a long way in addressing local environmental concerns as required by the Convention on climate change.

6.0 EXPERIENCE AND LESSONS, AND BARRIERS

6.1 Experience

Climate change awareness, debate and activities started in 1994. Since 1994, two institutions namely, ECZ (Environmental Council of Zambia and CEEEZ (Centre for Energy, Environment and Engineering (Z) Ltd, have so far been involved in climate change related work and analysis.

ECZ was created by an Act of Parliament in 1990 with the overall responsibility to protect the environment and control pollution, so as to provide for the health and welfare of persons, animals, plants and the environment as a whole. The Ministry of Environment and Natural Resources has designated the ECZ to undertake climate change related activities. With support from USCSP and UNDP/UNEP, the ECZ has undertaken the following:

- Activities on GHG emissions, inventory, vulnerability, adaptation and mitigation
- Enabling activity for the preparation of initial communication

CEEEZ founded in 1993 is a Non Governmental Organisation, whose main focus is to undertake studies, research and development, consultancy and training in the area of energy, environment and engineering applications for sustainable development. Since 1994, CEEEZ has undertaken the following studies:

- Measures to implement The UNFCCC. Zambia Country Study on Climate Change, Inventories and Mitigation Analysis.
- Climate change Mitigation in southern Africa Phase I
- Climate Change Mitigation in Southern Africa. Zambia Country Study. Phase II
- Participated in the Enabling Activity for the preparation of Initial Communication.
- Energy and Environment challenges in Southern Africa: The Case of Zambia.
- Feasibility study on Sugar Cane Resources for Sustainable Development: A Case Study in Luena.
- Survey of industrial boilers in Zambia.

6.2 Lessons

Some capacity has been built at independent research centres, Universites, Government and selected private sectors in the area of

(i) Understanding and implementing UNFCCC mechanisms (national communication, Kyoto protocol, and related instruments).
(ii) Compilation and/or analysis of inventories, mitigation options and vulnerability and adaptation of the climate system.
(iii) Undertaking financial/economic, environmental and social analysis of environmentally sound technologies in the context of sustainable development.

- Only limited public awareness has taken place on the need and benefits of climate change mechanisms including the Kyoto Protocol, transfer of technology, etc.
- At industry level, there is lack of awareness of profitable potentials and benefits of Energy Efficiency measures and technologies, and their linkage to CDM.
- To some extent, there has been duplication of efforts in the implementation of UNFCCC mechanisms due to lack of a strong and well-linked institutional structure.
- Poor technical information base hindered the capacity for effective sourcing and selecting of environmentally friendly technologies.

6.3 Barriers

6.31 Barriers Related to Previous Work and Studies

Barriers related to previous work and studies on energy efficiency, which can also be relevant and applicable to the present work, have been identified as follows:

- Lack of information (most companies are frequently unaware of practices and technologies available to conserve energy).
- Financial barriers (most companies will not make investment in energy efficiency because they lack capital to buy new efficient equipment or make the required retrofit in their installation. Sometimes capital may not be the restraining factor but energy efficiency is not their priority).
- Technological barriers (several opportunities to produce or to conserve energy depend on new technologies which might not be available in the country).
- Energy prices (electric tariffs in some cases may be a barrier in attracting a company to invest in energy efficiency due to subsidised tariffs).

6.32 Barriers Arising From Interaction With stakeholders

To implement the project "Concept for developing national capacity to implement industrial Clean Development Mechanism" requires a well co-ordinated environment of stakeholders from Government, Association of Commerce and Industry and the private sector in industrial undertakings.

In addition to ensure that stakeholders understand and appreciate the potential for industrial, economic, and development benefits from UNFCCC and related Kyoto Protocol mechanisms, especially the Clean Development Mechanisms, a forum with representatives from Government, Associations of Commerce and Industry, and Private and Parastatal Sectors, was convened on 13th December, 1999, at the Pamodzi Hotel.

In addition to introductory keynote address on CDM and benefits to accrue from it, the participants were requested to fill the set questionnaires. The results and analysis of the questionnaires were arranged in three groups as follows:

(i) Government and its agencies representing the Ministry of Commerce, Trade and Industry, Ministry of Energy and Water Development and Environmental Council of Zambia (ECZ) responded as follows:

- Barriers (Lack of awareness among consumers on efficient devices and wasting behaviour, lack of information on cost-effective opportunities and savings, high initial cost of equipment and risk awareness).
- Capacity needs (Ability to conduct energy audits in different industrial sectors, ability to conduct and review technology assessments and implement new energy-efficient and clean manufacturing processes and devices).
- Capacity building and policy measures (information exchange, extension and education through conferences, workshops, clearing houses and awareness campaigns, innovative finance arrangements including loans, grants, tax credits etc.).
- Capacity needed to be strengthened (development of emission factors and guidelines, promoting national dialogue, public awareness campaigns, CDM and its criteria of assessment to include validation, verification and monitoring, integration of CDM into national development plan and strategies).

(v) Associations of Chamber and Commerce and Industry representing Zambia Association of Chambers of Commerce and Industry (ZACCI) and Zambia Association of Manufacturers (ZAM) responded as follows:

- Barriers (In addition to what has been identified in (i) above, the following additional barriers were identified: lack of diagnostic and measuring technology for energy audits, lack of adequate financial services especially for small enterprises.)
- Capacity needs (ability to conduct and review technology assessments and implement energy efficient and clean manufacturing processes and devices, ability to develop and market training products on energy conservation and clean technology).
- Capacity building and policy measures (information exchange, extension and education, energy and environmental audit programmes performed by trained in-house employees or outside consultancy e.g. ESCOs, establishment of research programmes, training of skilled personnel at Centres of Excellence, and establishment of industry support services).
- Capacity needed to be strengthened (data acquisition, development of baselines, data sharing and dissemination, exchange programmes, leasing,

networking, investment promotion, energy and emission audits, training on methodological issues).

(v) Private and parastatal companies representing food and beverages and mining industries responded as follows:

- Barriers (in addition to those identified in (i) and (ii) include multiple roles and needs served by an existing technology that may not be met with by a new one, split responsibility between technology and user,).
- Capacity needs (in addition to what has been identified in (ii) include ability to conduct energy audits, ability to review management systems and process, monitoring and ability to provide non-technical support services).
- Capacity building and policy measures (in addition to what has been identified in (ii) include innovative finance arrangements).
- Capacity needs to be strengthened (in addition to what has been identified in (ii) include creation of internal environment units, identification of potential partners, CDM project identification and formulation, tax incentives, information on national and international investment laws).

7.0 CONCLUSIONS AND RECOMMENDATIONS

An elaborate attempt has been made in this report to discuss multilateral and bilateral activities, which have taken place in the area of climate change since 1992. In particular, the reports highlights industrial related CO_2 emissions arising from the various studies cited. Zambia is in the process of preparing its initial National Communication, parts of these results have been discussed in this report.

Industrial set up in Zambia is a major contributor of CO_2 emissions to total CO_2 emissions from the country. Copper mining, which is the backbone of Zambia's economy, carries out a major contribution of emissions due to its complex nature of processes used and type of technologies applied. Because of its concentration, objectives of developing capacity for identification of CDM projects will be relatively easier. In fact, Nkana Mine is in the process of carrying out a Cleaner Production Technology Project, which has some bearing on the Climate Change Convention and CDM.

The food and beverages industry also has some contributing influence on CO_2 emissions. Again the structure of Food and Beverages Industry is well situated foe possible CDM projects and this will again make it easier to cover this sector.

Some experience and lessons, in capacity building and institutional strengthening from past and on going climate change related activities, have been learnt. These can be used as a base to foster the way forward with particular reference to the proposed UNIDO CDM Programme and assistance required undertaking the following:

- Methodological aspects of project identification, design and implementation under CDM Umbrella.
- Transfer of environmentally sound technologies
- Development of technical capacity

- Development of an information base.

The question of institutional set up is crucial in ensuring successful implementation of the programme. The proposed triangular approach consisting of a private based sector resource based focal point, on one hand and strong linkage with Government, and the private sector including Chambers of Commerce and Trade on the other, forms a good basis to ensure that output of the programme is realised.

The way forward in effective implementation of CDM activities in Zambia involves the following steps:

- Creation of a small and effective National Task Force involving government, (Ministries of Trade, commerce and Industry, Finance and Economic Development, Energy and Water Development, and Environment and Natural Resources), Private sector (Chamber of Commerce and Industry (ZACCI), Zambia Association of Manufacturers (ZAM), Banks' Association and University/NGO - aimed at:

    (i) Defining and developing national industrial based CDM goals
    (ii) Overseeing and spearheading the implementation of industrial based CDM projects
    (iii) Attracting and mobilising financial resources for implementation of promising industrial based CDM projects.

- Creation of an independent based national focal point aimed at:

    (i) Serving as secretariat to the National Task Force.
    (ii) Undertaking trained and public awareness to industrial based stakeholders or profitable potentials and benefits for CDM projects.
    (iii) CDM project identification, formulation, design and implementation of promising CDM projects in conjunction with industrial based stakeholders.
    (iv) Development of baseline and criteria for assessment of sustainable development with particular reference to industry.
    (v) Analysing financial/economic environmental and social indicators of selected promising CDM projects.
    (vi) Monitoring, verification, auditing and certification of industrial based CDM projects.
    (vii) Enhancement of technology, transfer and its implementation.

- Provide additional capacity building to the national focal point in:

    (i) Project identification, formulation, design and implementation of industrial based CDM projects.
    (ii) Baseline development and development of criteria for sustainable development with assistance with appropriate tools and methods.
    (iii) Financial/economic technological, environmental assessment with the assistance of appropriate tools and methods.
    (iv) Monitoring, verification, auditing and certification assessment.

- Creation of a technical information base at the national focal point for effective sourcing and selecting of environmentally sound technologies to enable access to global information.
- Setting up CDM project web-site.

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Chapter Eight

Concept For Developing National Capacity To Implement Industrial Clean Development Mechanism Project In Africa

Zimbabwe Case Study

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1.0 Introduction

The ultimate objective of the UNFCCC is to stabilise atmospheric concentrations of greenhouse gases and Zimbabwe, as a Party to the Convention, has an obligation to submit regularly a national inventory of greenhouse gas emissions by sources and removals by sinks and to participate in the global effort to mitigate the emission of greenhouse gases under the principle of "common but differentiated responsibility".

In this light, Zimbabwe has taken very active steps both to assess its inventory of greenhouse gases, assess its options for greenhouse gas mitigation and to gain a practical appreciation of such climate change mitigation support instruments as the Global Environmental Facility, Activities Implemented Jointly and CDM.

Zimbabwe was the eighth country of the non-Annex I Parties to submit its Initial National Communication. The Initial National Communication not only allowed Zimbabwe to place its inventory of greenhouse gas emissions against the global picture of emissions but also assisted in guiding the country to focus on more climate sensitive developmental goals and formulate informed mitigation policies.

The Zimbabwean assessment of greenhouse gas emissions employed the Intergovernmental Panel on Climate Change (IPCC) Guidelines (1996) and these conform to the international agreement to standardise the methodology for estimating emissions. Although the IPCC method might not fully reflect the situation in Zimbabwe, it assists in those cases where no scientific methods have been developed for Zimbabwe and it represents the best scientifically derived methodology available to date. However, uncertainties and discrepancies still exist and, hopefully, these will be dealt with in the not too distant future.

2.0 CLIMATE CHANGE ACTIVITIES

2.1 Multilateral and Bilateral Activities

RISO/Southern Centre for Energy and Environment Studies

In 1992 and 1993, UNEP through its RISO Centre conducted studies on various climate change abatement options in Zimbabwe through a local non-governmental organisation, the Southern Centre for Energy and Environment.

2.2 United States Country Studies

In 1995/96, the United States Country Studies were conducted in Zimbabwe under the auspices of the Ministry of Mines, Environment and Tourism. These studies were more comprehensive than all the earlier studies because local consultants were trained on methodologies on impact studies. This training covered sectors on forestry, water, energy, and agriculture resources.

2.3 UNDP Capacity Building Project

In 1996, with the assistance of UNDP (GEF), Zimbabwe participated in a two-year regional four-country Capacity Building Project. The main objective of this project was to enable the four countries (Mali, Ghana, Kenya, and Zimbabwe) to meet their obligations under the UNFCCC. In Zimbabwe, the newly formed Climate Change Office in the Ministry of Mines, Environment, and Tourism executed this project. The methodology for project execution was through national and provincial workshops throughout the country as well as focused studies on mitigation options particularly in the energy sector. The greenhouse gas inventory was also revisited using 1994 as a baseline year. The project also attempted to examine climate change policies in the four participating countries. The studies were completed in 1998. These attempts were successful in the sense that the level of climate change awareness is now relatively high in Zimbabwe. Furthermore, the basis for future policies and measures was also laid through participation in this project.

2.4 Initial National Communication

In 1997, Zimbabwe started working on its Initial National Communication under the UNEP/GEF Enabling Activity Program. The Climate Change Office also executed this project. Under the general framework of the Zimbabwe Initial National Communication Project, greenhouse gas inventories were further improved through expanded areas of sources of emissions as well as improved quality of data. This exercise was facilitated by the presence of a reasonable number of previous studies (particularly the greenhouse gas and impact studies generated under the United States Country Studies and the UNDP Capacity Building Project) as mentioned before in this section. The final product - the Initial National Communication was submitted to the UNFCCC Secretariat in May 1998.

2.5 World Bank National Strategy Study on Activities Implemented Jointly and Clean Development Mechanism

Currently (since December 1998) Zimbabwe is conducting a National Strategy Study for Activities Implemented Jointly (AIJ) and Clean Development Mechanism (CDM) to enable/prepare policy makers to make informed decisions with respect to AIJ and CDM. This is a short ten-month World Bank program financed through a trust fund arrangement - Switzerland being the Donor. Only two African countries are involved in this study i.e. Zimbabwe and South Africa. Similar studies have been conducted in Eastern Europe.

From the foregoing studies, it is clear that the major obstacle for Zimbabwe to implement UNFCCC obligations lies in identification of barriers for the adoption of recommended technologies (mitigation options) by industry in Zimbabwe.

3.0 THE NATIONAL COMMUNICATION

3.1 GHG Emissions as Per Initial National Communication

Data for preparing the greenhouse gas inventory is usually available in formats that suit Government planning and inappropriate for IPCC reporting. Some information may not be normally recorded or statistics may be out dated. Thus in many sectors, it is vital to ensure the existence of reliable data banks feeding the IPCC/UNFCCC data requirements.

In the exercise of preparing the inventory, a number of assumptions had to be made in all cases where information was difficult to access. Examples include the neglecting of carbon stored in fuel combustion resulting in over-estimated emissions. Methods of estimating emissions from industrial processes are the least developed. Although information on industry was eventually collected, there were difficulties as companies concealed vital information fearing exposure to competitors among other reasons. Information on bunkers was not included in the inventory.

Although the Zimbabwean study adopted the IPCC methods, there were instances when local factors were incorporated into the overall IPCC methodology. This was the case where certain processes were well known and local experts had confidence in the science of the process. In most cases, IPCC default emission factors and conversion coefficients were used.

The level of confidence of data for the commercial use of energy is over 95% while between 80% and 90% accuracy is valid for agriculture, industrial processes, land–use, forestry and waste management. However, most of Zimbabwe's emissions come from energy. Assessments in this document represent the best available data. Table 1 shows the inventories in the respective sectors using 1994 as a baseline year.

The Zimbabwean energy mix is dominated by carbon-based fuels. Over 96% of the total supply is from such fuels. The only non-carbon energy source is hydro-electricity and some renewables (which represent a negligible portion of the total energy supply). Even then this source contributes yet undetermined amounts of CH_4 through reservoirs supplying energy for hydro electricity generation. The electricity supply is mainly from coal-based thermal fuels.

Figure 1 shows the distribution of coal usage in Zimbabwe. In calculating emissions from fuel combustion, the IPCC Detailed Fuel approach was used.

The methodology is silent on equipment efficiency. This is often considered unnecessary because the emissions factors are based on the energy content of fuels and not the useful energy gained from the combustion process. The IPCC guidelines state that emissions from use of fossil fuels are independent for technology. This assumption is valid if the energy data is based on the energy supply figures. If the data is based on energy use figures such as in electrical energy consumption then it would be important to include efficiency figures in determining the emissions per unit of energy used. The assumption

also makes it more difficult to identify interventions as the emission levels will not readily show the linkage with efficiency.

More than 48% of the Greenhouse gases emissions emanate from power generation. Industry is another significant contributor to Greenhouse gases emissions at 14.97%, agriculture (11.34%), transport (11.82%), commercial (9.59%) and the rest, including mining and households contribute 4.18% as shown in Figure 2. The transport sector consumes about 60% of liquid fuels in Zimbabwe, and grew at about 24% between 1985 and 1990 and about 37% from 1990 to 1993.

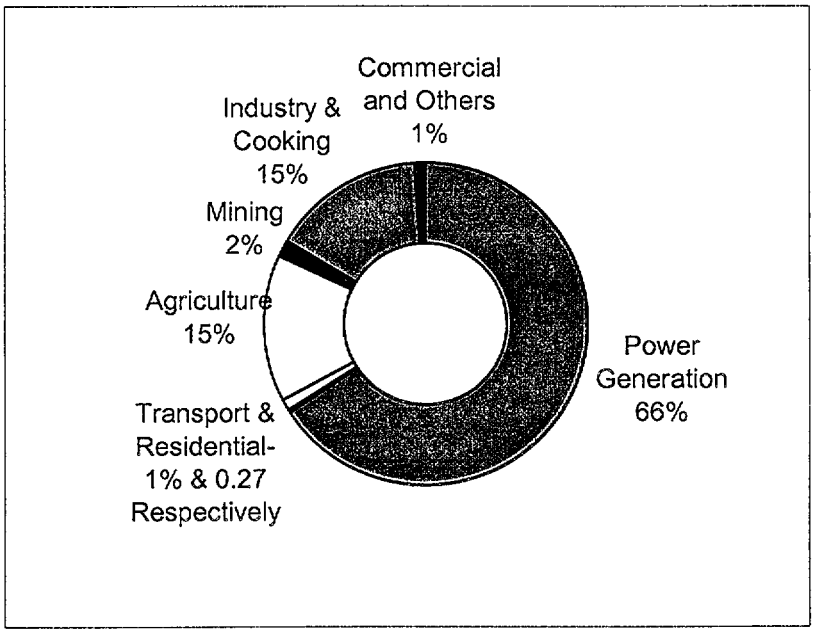
Table 1: Summary of national GHG emissions/Gg (1994)

Greenhouse Gas Source and Sink Categories Global Warming Potential	CO_2 1.00	CH_4 24.50	N_2O 320.0	NO_x 40.00	CO 3.00	CO_2 Equivalent
1: ALL ENERGY (Fuel Combustion and Fugitive)	**14,772.13**	**77.19**	**1.18**	**10.08**	**544.46**	**19,056.68**
A: Fuel Combustion	14,772.13	63.95	1.18	10.08	544.46	18,752.36
Power Generator	6,803.17	0.01	0.01			6,806.73
Residential	151.22	0.00	0.00			151.28
Transport	1,851.40	0.98	0.56			2,054.20
Agriculture	1,814.96	0.04	0,03			1,825.95
Mining	224.46	0.01	0.01			227.48
Industry	2.397.25	0.05	0.03			2,409.35
Commercial & Others	1,529.57	0.17	0.11			1,568.00
Biomass burned for energy		62.69	0.43	10.08	544.46	3,709.36
B: Fugitive Fuel Emissions	0.00	13.24	0.00	0.00	0.00	324.32
Coal mining		11.78				288.65
Post coal mining		1.46				35.67
2: Industrial Processes	**2,316.35**	**19.08**	**6.05**	**0.21**	**1.38**	**4,732.20**
Mining Industries	23,70		6.05			1,959.70
Metallurgical & Mineral Processing	1,844.00	19.08		0.04	1.38	2,317.25
Beer Wine & Manufacture	0.00					0.00
Sugar manufacturing	0.00					0.00
Cement Production	448.65					44865
Fertilizer manufacture			0.17			6.60
3: Agriculture	**0.00**	**236.84**	**2.39**	**66.91**	**1,381.81**	**13,388.96**
A. Agricultural Waste	0.00	0.93	0.03	1.10	19.81	135.82
B. Enteric Fermentation		179.82				4,405.54
C. Manure Management		7.09				173.71
D. Savanna Burning		49.00	2.36	65.81	1,362.00	8,673.90
4: Land Use Change & Forestry	**-62269.00**	**1.26**	**0.01**	**0.20**	**18.44**	**-62171.75**
A. Forest & Grassland Conversion	2,500.28	1.26	0.01	0.20	18.44	2,597.54
B. Changes in Forest & Other Woody Biomass	16,234.20					16,234.20
Stocks						
C. Managed forests	-81003.49					-81003.49

D. Abandonment of Managed Lands	Not Estimated					
5: Waste	0.00	25.15	0.00	0.00	0.00	616.06
A. Landfills		24.31				595.60
B. Wastewater		0.84				20.46
TOTAL	-45180.52	359.52	9.63	77.40	1,946.08	-24357.85

Note: Some totals do not all up exactly due to rounding off of decimals
Source: Zimbabwe Initial National Communication (1998), Energy Combustion

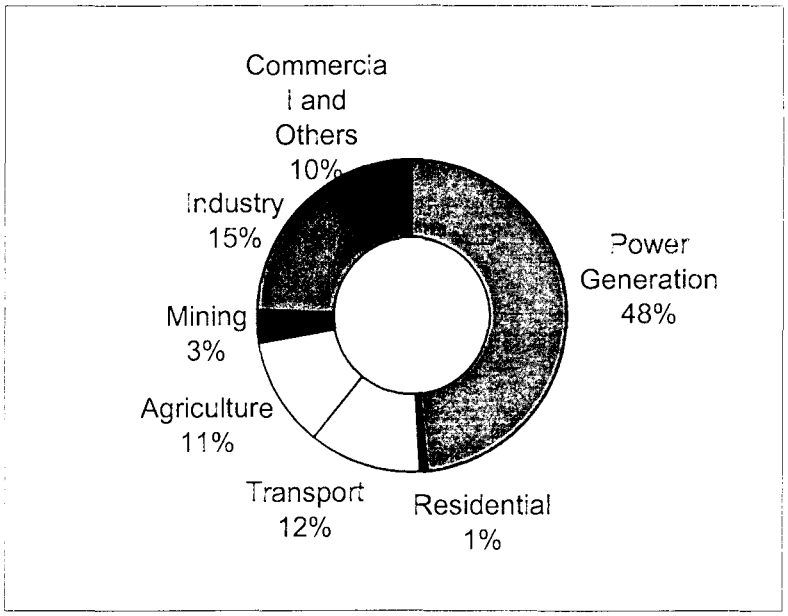
Figure 1: Distribution of Coal usage in Zimbabwe



3.2 Energy Consumption and Demand Forecast

Energy use in production can be related to the GDP contribution of each sector to the economy. Energy efficiency in the activity can therefore, be measured in terms of monetary GDP units produced per unit of energy consumed.

Figure 2: Sectoral distribution of GHG Emissions from commercial fuels.



The assumptions used in this approach are that there is an inherent improvement in productivity as economies modernise. Old equipment is replaced by newer and more efficient fixed equipment, and production methods themselves become more refined. Even though there may be deliberate effort to improve energy efficiency, there should still be an efficiency improvement due to the advancement of technology. This indirect gain in energy efficiency is termed, ''Autonomous Energy Efficiency Improvement (AEEI)''. The AEEI figure in each sector is related to technology and can be estimated crudely. This approach does not rule out more drastic changes in production methods due to discovery of new technology but is related to the difference between available technology and that, which exists in Zimbabwe.

3.3 Energy Demand Forecast

Given GDP projections, it is possible to project energy demand and CO_2 emissions by each sector for the respective forecast years (Table 2 and Table 3) The forecast is obtained by multiplying the energy intensity for each sector by the AEEI of that sector. Since each sector includes various forms of energy it is not possible to split the energy used by fuel type for each sector. The goal is, therefore, to find the total energy demand and then split it by fuel using the energy supply figures. This computation obviously has an error due to the exclusion of energy switching options in each sector.

It is however, assumed that Zimbabwe has limited energy sources such that energy switching is not a major option for most activities. As an example, industry cannot switch from thermal energy based on coal to natural gas as in many North American and European countries, since the latter fuel source is not available in a large-scale commercial basis in Zimbabwe.

Table 2: Energy demand forecast/TJ

		1994	2010	2030	2050
Coal	41.7%	132 436	229 112	348 492	496 916
Ethanol	0.1%	329	1 402	2 133	3 043
Jet AI	1.2%	3 779	6 266	9 531	13 590
Gasoline	3.9%	12 273	16 920	25 738	36 699
Diesel	9.4%	29 976	38 529	58 606	83 566
AvGas	0.05%	54	242	368	25
Wood	43.7%	138 777	188 799	287 173	409 482
Coal	41.7%	132 436	229 112	348 492	496 916
Total		317 724	481 273	732 042	1 043 822

NB: The decimal in the totals have been rounded
Source: Zimbabwe Initial National Communication (1998)

Table 3: CO_2 emission projections for Zimbabwe/'000Gg

Emissions	1994	2010	2030	2050
Coal	14.041	21.77	33.11	47.21
Ethanol	0.00	0.00	0.00	0.00
Jet AI	0.264	0.45	0.69	0.98
Gasoline	0.895	1.24	1.88	2.68
Diesel	2.179	2.85	4.34	6.18
AvGas	0.012	0.018	0.027	0.038
Wood	0.00	0.00	0.00	0.00
Total	17. 391	26.32	40.04	57.09

NB: The decimal in the totals have been rounded
Source: Zimbabwe Initial National Communication (1998)

4.0 CLIMATE CHANGE AND INDUSTRY

4.1 Emissions Associated with Industrial Processes

Zimbabwe's industrial sector comprises mainly of mining and agro-based primary extractive operations. Zimbabwe's industries have been classified into the following major categories:

- Mining industry explosives.
- Metallurgical process.
- Beer, wine and spirit manufacture.
- Sugar manufacturing.
- Cement production.
- Fertiliser manufacture.

Data used in the greenhouse gas assessment for these categories was obtained from industrial operations identified as major emitters of greenhouse gases and from records of the Central Statistical Office (CSO). Most of the emissions therefore, were determined using balanced chemical equations of the resources transformation processes.

The use of these equations, which are not standard IPCC methodology, is justified because most of the industrial processes assessed in the communication are not included in the IPCC methodological guidelines. Locally derived methods were, therefore, used except for cement, which is provided for in the IPCC guidelines. In the case of nitric acid, actual plant monitoring provided reliable measurements for emissions. The following section gives the detailed greenhouse gas emissions for industrial processing.

4.2 Mining And Mineral Processing Industry

Mining operations involve ore digging and stockpiling, while mineral processing involves industrial production of mineral-based final products.

Mining operations use explosives containing mainly ammonium nitrate base that produces nitrous oxide (N_2O). There are no IPCC guidelines to estimate emissions from explosives used in mining operations. Emissions were then estimated based on balanced chemical equations of the processes. This approach was also used for all other processes for which the IPCC has no methodology. In 1994, 6.05Gg of N_2O were released from explosives. Greenhouse gas emissions were also estimated from lime production. These amounted to 23.70Gg of CO_2.

Metal production involves primary production of ferroalloys and iron and steel making. Tier Ib of IPCC guidelines was used in estimating emissions from this sector on known products. Emissions from ferroalloys amounted to 404 Gg of CO_2 and emissions from iron-and-steel production were estimated to be 1440Gg of CO_2, 0.04Gg of NO_x and 1.38Gg of CO_2.

4.3 Sugar Manufacturing and Beer Brewing

In sugar manufacturing, and molasses fermentation during the distillation process is an important source of carbon dioxide. Greenhouse gas emissions are also produced during the microbial fermentation process in the production of beer, wines and spirits. However, these two activities are assumed to give zero net CO_2 emissions since the emitted gases are assumed to be reabsorbed during crop growth.

4.4 Cement Manufacturing

Carbon dioxide is also produced during the production of clinker, an intermediate product from which cement is made. It should be noted that when concrete mixture is cooling, some CO_2 is reabsorbed by the concrete from the atmosphere.

This CO_2 reabsorption is, however, believed to be only a small fraction of the CO_2 emission resulting from cement production and is therefore usually ignored in emission calculations.

Because CO_2 is emitted during clinker production (rather than cement production itself) emission estimates should be based on lime content and the production of clinker.

However, clinker statistics were not readily available in Zimbabwe and, as a result, cement production statistics were used.

If information on clinker is not available, emissions are based on cement production instead and IPCC emissions factors based on the average CaO content of cement can be used. This does not compromise the accuracy of the emission estimates since there is direct relationship between cement and clinker produced. A total of 0.4985 tonnes of CO_2 are released per tonne of cement produced. This is an IPCC default based on average lime content of cement. Studies in most countries have indicated that the difference in emission estimates using clinker or cement data is very small. The errors in lime content assumption are also very small compared to the assumption in the cement production figures. This translates into 448.65 Gg of CO_2.

4.5 Fertiliser Manufacturing

Fertilizer manufacturing is another industrial process, which emits greenhouse gases. Sable Chemicals, a fertilizer manufacturing facility operating two nitric acid plants, advised that 0.165Gg of NO_x was released into the atmosphere in 1994. These emissions were based on actual measurements at the plant.

4.6 Emission Projections for Industrial Processes

Projecting emissions from industrial processes was rather difficult. The reason for this was mainly because there was no information on baseline trends in technologies used in the industries of concern. Nor was it possible to reasonably assume demand for the various products associated with the industrial sources of greenhouse gases. Under these circumstances, we assumed that emissions from these sectors will maintain the present linkage factors with GDP. This is a weak assumption given that even trends in GDP will change with technological transitions. But it is the best assumption we have at present. Table 4 presents these assumed projections.

Table 4: Projections of Emissions from Industrial Processes /Gg

GAS	1994	2010	2050
CO_2			
Cement production	448.65	759.13	2 503.50
Metals and mineral	23.70	23.70	132.25
Processing	1 844	3 120.11	10 289.7
CH_4			
Metals and mineral processing	19.08	32.28	106.47
N2O			
Metal and mineral	6.05	10.24	33.76
NO_x			
Fertilizer production	0.17	0.28	0.92
CO			
Metal and minerals	1.38	2.34	7.70
Processing			
Total (in CO_2 equivalent)	4 732.15	8 006.95	26 405.74

N.B: the decimal in the totals have been rounded
Source: Zimbabwe Initial National Communication (1998)

4.7 Energy - Intensive Industrial Sectors

One measure of areas of high-energy consumption and potential for intervention is to identify those sectors, which consume disproportionately high amounts of energy in production relative to their international counterparts. This way we may be able to benchmark Zimbabwe's performance and seek to achieve higher levels of performance based on selected benchmarks.

4.8. Conclusion

Studies conducted in Zimbabwe have shown that significant emission reduction gains in Zimbabwe can be achieved through demand side options. However, some equipment particularly in the textiles sub-sector is quite old – offering a good opportunity for the introduction of cleaner technologies in a timely replacement investment, which may involve CDM partnerships.

The introduction of these options may also include broad based technology improvement programmes such as boiler efficiency improvement across a wide spectrum of the manufacturing sector or they may include a strategic selection of a few large scale industries such as fertilizer producers and smelters which are indeed the largest single consumers of energy. The selection of an approach would require more time to assess the benefits and resource demands of each approach.

The present efficiency of coal fired boilers made in Zimbabwe and used in industry is 74%. In some cases poor operation practices efficiencies decrease to 50%. It is possible to improve efficiency to 79% by introducing the use of soot blowers to clear steam pipe surfaces and thus increase heat transfer, introducing boiler jacket insulation and improving operating practices. Insulation would reduce boiler skin temperature from the present average 40°C to 30°C, much closer to ambient temperature in factory settings.

Some five large-scale industries stand out as the key determinants of electricity consumption in the country. These are mainly smelting and fertilizer production.

5.0 SUSTAINABLE DEVELOPMENT AND SUSTAINABLE INDUSTRIAL DEVELOPMENT INDICATORS

There are no sustainable development indicators formally agreed in Zimbabwe. However, there is a high consciousness on the importance of ensuring sustainable development. This has resulted in various national activities to ensure practices, which are supportive of this objective. These activities include the production of a National Conservation Strategy in 1987, the National Consultation Report on the Rio Earth Summit in 1992, wide ranging activities on environmental law reform and the national Guidelines to Environmental Impact Assessment – being the culmination perhaps of all the earlier processes. The guidelines give at least a national sentiment as to what are the appropriate measures of sustainable development. Based on this assumption, we have extracted a

number of recommended items for inclusion in an EIA as presented in the guidelines. These show the basic principles or objectives, which an EIA must be guided by, environmental or sustainable development indicators at the construction stage of a plant, considerations to be made from a social point of view and those to be made from an economic perspective.

5.1 EIA Guidelines Which May Indicate Preferred Sustainable Development Indicators

5.11 EIA principles

- Sustainability for future generations is the cornerstone of environmental management.
- Our dependency on a complex and diverse ecosystem requires management approaches, which integrate economic, social, cultural and natural environments.
- EIA, must enhance development by contributing to its environmental sustainability, not inhibit it.
- Project impacts must be monitored and managed throughout the life of the development.

5.12 Construction Stage

Physical / Biological factors to consider:

- Loss and modifications of soil profile;
- Damage to cultural resources and sites;
- Visual intrusions from mine equipment and infrastructure;
- Soil erosion from disturbed areas;
- Degradation of surface water bodies by increase in suspended particulates
- Disruption of groundwater aquifers;
- Ground fractures;
- Contamination of groundwater or surface water;
- Soil contamination.

Social Factors to consider:

- Disturbance of both humans and wildlife;
- Competition with local cultures, traditions and life-styles;
- Increased demands on services and facilities in local communities;
- Social and cultural conflicts affect community stability;
- Secondary population growth;
- Displacement of local communities;
- Health problems associated with dust;
- Development of schools, hospitals and recreational facilities;
- Standard of living gains for local communities.

Economic Factors to consider:

- Land use conflicts particularly with traditional or popular applications;
- Induced development of other economic sectors;
- Availability of a ready market for products;
- Increased employment opportunities for local population;
- Employment and income;
- Effects on balance of payment.

6.0 CONSTRAINTS

Zimbabwe is conducting an in-depth assessment of barriers to energy efficiency in industry under a GEF/UNDP enabling activities programme. Prior to this major study, various other assessments had been conducted on the same topic but these were much less focussed and had narrower coverage. These studies and the discussions held with management in the electric motor and brick making industry have amply confirmed that the main barriers to energy efficiency in Zimbabwe can be reduced to five which if fully addressed would also fully respond to most of the barriers in a very long list of barriers which one can draw.

These five key barriers are poor government umbrella support for energy efficiency; poor and sometime misguiding macro-economic policy signals; limited financial support for energy efficiency investment; lack of energy services providers and limited information on options and opportunities for energy efficiency improvement.

These barriers which afflict energy efficiency improvement also have a strong bearing on the successful implementation of CDM initiatives among industry. At this point in time, an immediate but easily surmountable barrier is information to industry about CDM and its benefits to them. Most industry associations have poorly serviced secretariats with little knowledge on CDM and poor capacity to facilitate new initiatives such as CDM.

7.0 STAKEHOLDERS

7.1 Analytical Background

There are various stakeholders depending on the industrial segment we are focusing on. In Zimbabwe, four groups are important to consider. The most obvious is the large-scale formal industry. This is the level represented by the Confederation of Zimbabwe industries and represents the mainstream of manufacturing activities in the country. The second level comprises small to medium scale industries. This sector is important in that it appears to be the future pattern of industrial expansion in the country and holds significant potential for employment creation. Government policy and support will give it high priority. Then there is the informal sector. This is an important form of employment but it is difficult to administer or to plan for particularly for CDM. The fourth category comprises of rural industries. These range from agro-industries such as tea factories and sugar factories and such small informal activities as beer brewing and brick making.

The small to medium scale industries have a formal association, which represents their interests, as is the case with the formal manufacturing sector. The policy and political importance of this small-scale sector is enhanced by that it is seen as a conduit for local development of industrial entrepreneurship as opposed to the formal manufacturing sector that is heavily biased toward international ownership. We cannot dwell too long on this analysis but it is intended to show that there are policy preferences, which must coincide with CDM preferences. The need for policy assistance may be less for established foreign owned companies than it is for small nascent local industries. CDM by nature has a large foreign component and investors in CDM prefer large single projects. This situation calls for creative policy in order to bring in the necessary policy coincidence with CDM preferences. The list drawn below is based on such consideration.

7.2 Needed or target holders and institutional requisites and gaps

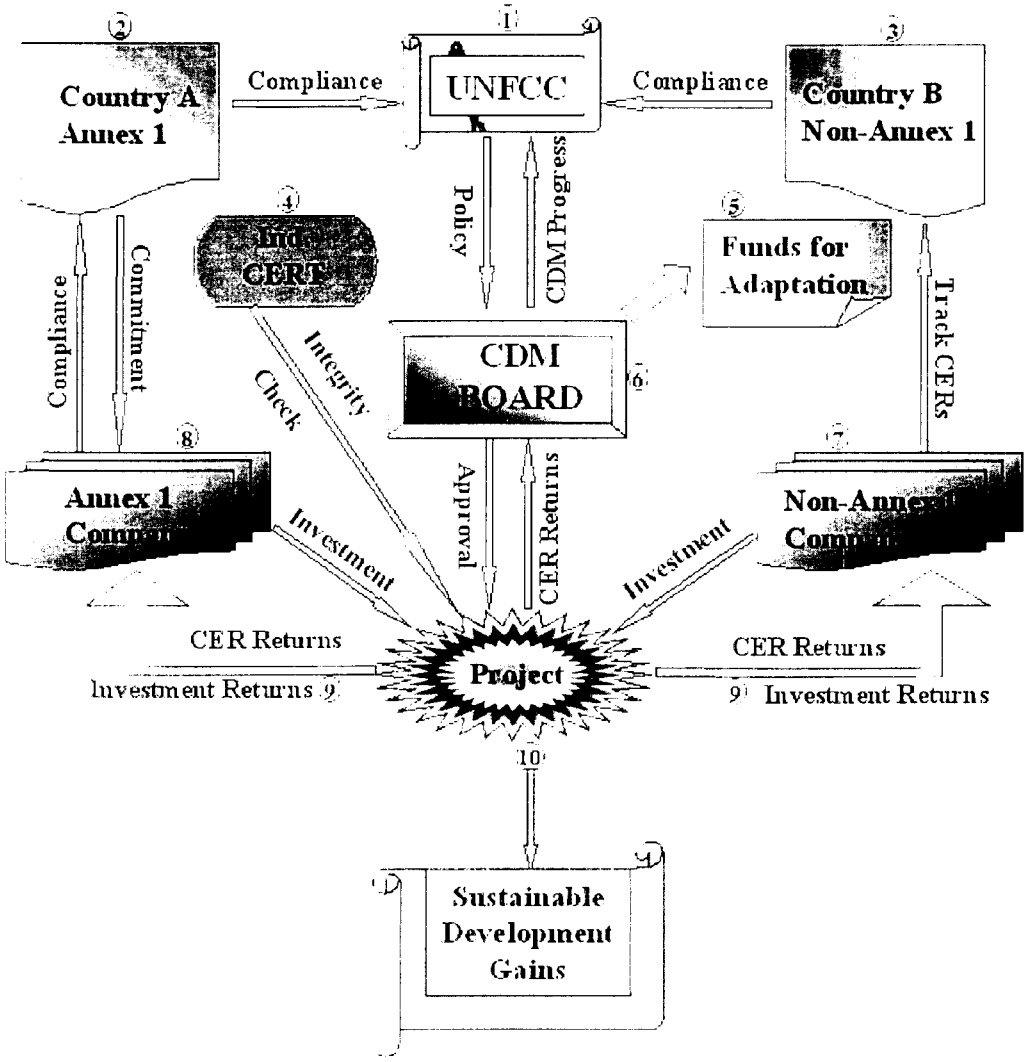
We see three important technical and institutional steps to be completed in a CDM project. The first is the international CDM implementation format, which is presented graphically in Figure 3. The second is a national CDM mechanism or management framework and the third is an internal CDM management set up for the participating company. These functions are indeed the bottom line of a CDM engagement and they are the prime concern of a private company entering into CDM. We must assess therefore, technological and institutional capacities to enable all the three steps to be completed.

7.3 International CDM Support

Key points for national institutional support to CDM at this level are at the CDM board level and at the convention process. While this level of participation is beyond this project, it is important to set up a credible and robust umbrella capability at these levels so that any CDM engagements are serviceable. National skills also have to apply at the various verification and assessment levels in order to build confidence in the local participating bodies and to give credibility with the international system. This applies as well to the CER assessment functions of the CDM process. Present institutional capacity to support this is weak. It would not have been expected that such a capability would exist. This would have to be built as the process develops. However, there is a national climate change committee, which has a wide range of experts who can serve in the interim to support the international CDM institutional requirements.

The current committee comprises the Confederation of Zimbabwe Industries, the National Planning Commission, and the National Chamber of Commerce. These are key institutions, which have good back up support and can serve to strengthen the national committee.

Figure 3: International CDM Structure



7.4 National CDM Support Structure

We present below are the ideal national structures to administer and promote CDM. This structure is not in place but it represents what has been discussed already in the country. What has not been suggested has not been put in place but institutions currently in place are sufficient to support CDM projects with some capacity boosting. Institutions in place are:

The Ministry of Environment and Tourism is the custodian of the UNFCCC and is responsible for environmental legislation. This ministry has established a Climate Change Office, which coordinates climate change projects in the country. In the initial phase of CDM projects, this office would facilitate projects. Foreign investment has to comply

with the investment guidelines of the Zimbabwe Investment Centre. So the two institutions (the Climate Change Office and the Investment Centre) would be the main official organs to contact. The investment centre is a one stop foreign investment support body which has been in place for over ten years and whose operations are now streamlined and tested. The Climate Change office is thinly manned and is new. It would only save as an interim body pending the setting up of a more effective structure.

The sustainable development gains from CDM would be the concern of the National Economic Planning Commission. They have not adopted this role formally but they have participated on the national climate change committee and are aware of the importance of their role in this regard. Their capacity to conduct the requisite assessment however is not determined yet. There are various economic consultants who can provide advice to industry on investment and CDM decision-making. What may be important is to conduct training workshops to provide orientation.

The internal CDM management set up should entail the establishment of a CDM project manager for a CDM project. Again an orientation exercise for company financial managers and executives would be required. A survey conducted on the ability of industrial companies to assess energy efficiency projects indicated that most of the companies are aware of energy efficiency, but little has been done to improve energy efficiency. This result could be used to guide capacity or other enabling activities to improve assessment capabilities in industry.

Another important aspect of national institutional CDM support involves strengthening baseline investment capacity for local partners in CDM. This function is currently being served by commercial banks. These and other financial markets such as the stock exchange and venture capital companies are well developed. Presently, however, the capital market is heavily constrained with interest rates exceeding 50% and foreign currency supplies heavily depleted. Local investors would have to seek offshore support and the World Bank for example has to provide baseline investment funding. This is an important area of the CDM proposition since local companies must get international support for baseline or equity investment where local financial institutions cannot provide support.

Table 5 gives an example of a possible CDM type auditing exercise, in which a company should be able to define its baseline conditions including technology, emissions, and cost of investment. This has to be done for either a reference (existing) plant or for a baseline (planned) plant. The cost of deviation to an emissions reduction plant are also calculated here and the financial and other investment costs are also assessed here. The question, therefore, is whether the company can carry out the assessments and make a reasonable decision in terms of engaging with a foreign partner.

As it stands the skills to conduct such an assessment in Zimbabwe are available. A number of individuals and organizations have been involved in conducting mitigation cost assessment under various projects which have been reported in this document. What is not available is the knowledge of state of the art mitigation options or technologies including their relative cost. This skill will require information support from outside and UNIDO is well positioned to provide such information.

An important capability in this regard is technology assessment. This is generally a weak area in Zimbabwe as may be the case in most developing countries. However, the Government has set up an industrial research and development centre, this will eventually be in a position to support industry with technology assessments. Capacity could be built at this centre to perform such functions. The Zimbabwe investment centre assesses and approves projects for investment in the country. It has limited technology assessment skills but these too can be improved to support technology assessment needs of industry under CDM. This and access to technology information are the two major limitations which cannot be satisfactorily completed in country.

7.5 Results of National Meetings

The joint national forum has yet to be held. However, three meetings have been held, one with the National Climate Change Office, one with the Department of Energy and another with the Confederation of Zimbabwe Industries. Several meetings were held with the two selected industries one in the brick sector and the other in the electric motor sector. The meeting with CZI was the most critical in that it provided an umbrella view of the potential and limits to industry's participation in CDM.

Overall, however, the conclusions and views can be drawn from the various meetings. Some of these were procedural and others were more fundamental. The list under Section 9.0 presents the results in no specific order of importance.

8.0 INDUSTRIAL SECTORS

8.1 CDM Opportunities in Two Industrial Sectors

8.11 Brick Burning Using Urban Waste Fuel Option

The factory currently uses a natural process of drying, which is not only slow but also inefficient in reducing the moisture therefore resulting in more coal usage in the burning process.

The majority (~90%) of bricks are burnt in a clamp operation where bricks are packed with coal and burnt at a temperature of ~1100 degrees Celsius. This operation uses 1600 tonnes of coal per month and the thermal efficiency according to the South African C.S.I.R. is below 35%.

If the bricks can be packed onto a car which passes through a dryer followed by a kiln heated by a bio-gas converted burner utilizing Harare's household waste as fuel, the following benefits will accrue:

Table 5: Company Level Skills and Operations

ABATEMENT COST MODEL:BOILER EFFICIENCY

Costs in	Reduction 0Option	Reference Option	Increase (Red.-Ref.)
Total investment	200000		
Project life	35		
Lev. investment	5714	0	5714
Lev. inv. in power plant			
Annual O&M	22000	10000	12000
Levelized fuelcost	0	0	0
Total annual cost	27714	10000	17714

Annual emissions:	Tons	Tons	Reduction
Fuel CO2 emission	660.9	1044.3	383.3
Fuel N2O emission	0.000	0.000	0.000
Fuel CH4 emission	0.000	0.000	0.000
Total CO2 equiv.	660.9	1044.3	383.3
Z$/ton CO2 equivalent			46.21

Notes:
The typical boiler is approx. 2 ton of steam per hour.
The boiler operates 12 h/d in 300 days/year.
The boiler is insulated and a sootblower is installed.
An average boiler with an efficiency of 74% uses
200 kg coal/h = 23.2 GJ/h.
A boiler without sootblower and insulation in the field operates
at 50% eff., the improved boiler operates at 79%eff.

General inputs:

1 Ton CH4 =	Tons	Ton CO2
1 Ton N2O =	660.9417722	Ton CO2
1 US$ =	8.2	0
Discount rate	0%	
Fuel CO2 emis. factor	35	kgCO2/GJ coal
Fuel CH4 emis. factor	0	kgCH4/GJ coal
Fuel N2O emis. factor	0	kgN2O/GJ coal
Calorific value of coal	28	GJ/ton
Consumption in 2 ton boiler	5.6	GJ/h of coal
at an efficiency of:	74%	

Reduction option:

O&M	1.0% of investment
Activity	1 boiler
Investment	200000 Z$
Operating time	3600 hrs
Boiler efficiency	79%
Annual coal consumption	18884 GJ

Reference option:

O&M	0.5% of investment
Activity	1 boiler
Original inv. in boiler	2000000 Z$
Operating time	3600 hrs
Boiler efficiency	50%
Annual coal consumption	29837 GJ

- Harare's waste problems would be minimized therefore becoming more environmentally friendly;
- Landfill methane emissions will be reduced;
- Local pollution in Mount Hampden caused by the manufacture of bricks would be reduced drastically;
- The clay pits resulting from brick manufacture over the past 50 years could be filled in by non-combustible waste in order to reclaim land for industrial and housing purposes;
- The cost of production would decrease substantially due to the reduction of coal use.

The only disadvantage is the fact that the capital development is of such a magnitude that this company cannot afford to pursue this project alone. Further a more detailed analysis of net emissions from the improvement needs to be carried out.

8.12 Improved Electric Motor Efficiency

A Harare based Electric Motor Manufacturing Company manufactures electric motors under a GEC license. The design efficiency for the motors is 85%. However, it is difficult to guarantee this level of efficiency because of various factors. These include:

- **Manufacturing Factors:**

The casting of rotors may not be accurate. To determine accuracy, one needs x-ray testing equipment. This is not available and therefore no testing is carried out. The efficiency reduction effect of this constraint is indeterminate. There is need to balance the motor shaft which if out of balance would lead to efficiency reduction. This balancing is contracted out and the resulting accuracy again cannot be determined internally. This reduces the supplier's confidence with the efficiency actually dispatched to the end user. There are other forms of testing conducted internally, but the testing equipment is old and its accuracy could be limited.

The supplier has a number of steps during which errors could occur that might reduce efficiency. These are:

- **Casting of Rotors:**

Wrong casting will lead to wrong motor speeds and efficiency reduction

- **Lamination Configuration:**

If the configuration is wrong, efficiency is reduced. The company is having problems with lamination materials – usually this is silicon steel imported from Japan. Sometimes other sources are used and problems of quality arise. If these are not detected, the product passes onto the end user with poor efficiencies. The machining of the rotor also leads to efficiency losses if this is not done properly. Currently machining equipment is very old and its accuracy could be flawed. The rotor testing equipment is serviceable but the old machining floor equipment pauses problems.

Ordinarily these are bought to specification but on some occasions poor quality bearings are supplied. If these were passed to the end-user, efficiencies would be affected.

In addition to the supplier's error points, there are also end-use points, which could lead to reduced efficiency. These include bad wiring, miss alignment, wrong sizing, poor fitting environments and poor protection from the atmosphere, which lead to leakage.

We have discussed these points with the supplier. Our conclusion is that there is significant potential for losses but this potential or actual loss is not yet determined. An in-depth audit has to be conducted to establish the correct picture. The potential for savings is quite high and this is increased by the size of the market, which includes Zimbabwe, Zambia, Malawi, and Namibia.

A social audit would also be needed to determine end-use practices and end user educational needs to improve efficiency through better application management. Imported motors are not tested and there is a possibility of dumping substandard motors onto the market. This too has to be investigated.

9.0 Conclusions and Recommendations

CDM has not been introduced into practice in Zimbabwe as in many other parties to the convention. Industries, therefore, have no example or experience to go by. The breadth of the electric motor industry in terms of companies to benefit from electric motor improvements will widen exposure and interest. The brick industry chosen is small. However, gains made in this small initiative should have major implications for the whole of the Southern African region with the twin benefits of urban waste management leading to land fill methane emissions reduction and provision of cleaner energy for brick burning.

We have discussed the CDM options with industry and the relevant official organs and an approach on the way forward has been agreed. This includes the following steps:

- Table the two projects with UNIDO.
- Confirm that CDM is real and practical for industry and indicate the approach to be followed under the UNIDO program on CDM.
- Indicate preferred roles of local industry and areas of support for them to play this role.
- Introduce the two selected projects as pilots.
- Use learning experience to build local institutional requirements and prepare industry for an effective role.
- Confirm that this development of national capacity can be done under the proposed project to be tabled for the GEF or other funding.
- Indicate policy measures to ensure broader and effective industrial participation.

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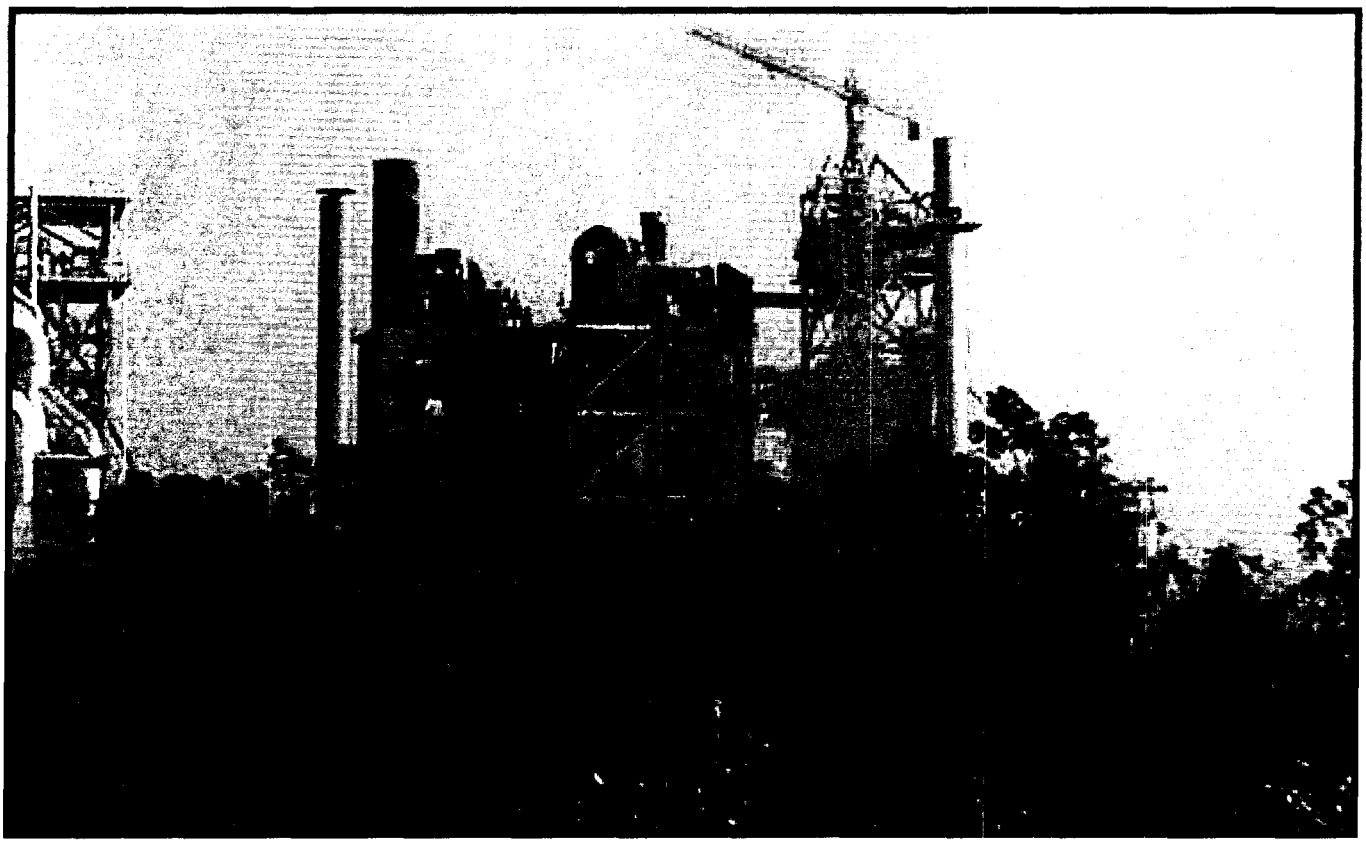

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