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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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FINAL REPORT ON UNIDO PROJECT YA/RAF/01/405

CN, 2001/057

cc: Registry
Ms Pluff

"DEVELOPING NATIONAL CAPACITY TO IMPLEMENT INDUSTRIAL CLEAN DEVELOPMENT MECHANISM (CDM) PROJECT IN A SELECTED NUMBER OF COUNTRIES IN AFRICA: PREPARATORY ASSISTANCE"

SUBMITTED BY:
ENVIRONMENTAL PROTECTION AGENCY,
P. O. BOX MB326
ACCRA
GHANA

Tel: **+233 21-664697/8**
Fax: **+233 21 662690**

E-mail: epaed@africanonline.com.gh **OR** wbonsu@epaghana.org

NOVEMBER 2001

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SUMMARY

Concerns have been expressed about the emission of greenhouse gases (GHG) because of their effects on climate change. Sources of such emissions are therefore being given much attention despite the never-ending challenge and the need to sustain the development of human society.

How does one attain maximum efficiency in the use of energy, with zero waste for disposal from each process?

The need to utilize energy more efficiently has necessitated the effort to assess the operations of the iron and steel and primary aluminium industries in Ghana.

These industries are energy-intensive. Electricity consumption per unit output in the iron and steel industry, which uses the Electric Arc furnace (EAF) for its ferrous scrap melting operations, ranges between 627 kwh/tonne of steel to 927 kwh/tonne of steel.

The project objective would be to reduce this requirement to the range of 320kwh/tonne of steel and 400 kwh/tonne of steel. In addition, heavy fuel oil used is about 74 litres/tonne of steel product.

A recycling of hot waste gases to preheat ferrous scraps for melting, and ingots for rolling would result in a significant reduction of energy wastage.

Energy consumption for primary aluminium production is :

i. 15,840 kwh/tonne (1992)
ii. 17, 425 kwh/tonne (1999)
iii. 17, 030 kwh/tonne (2000).

These values may be compared to a standard value of 16,200 kwh/tonne (at 86.5% current efficiency).

Improvements in energy utilization in primary aluminium production may be obtained by improving the following aspects of the cell design, namely:

i. control techniques
ii. anode quality
iii. cathode quality
iv. alumina quality
v. improvements in the electrolyte.

To address the demand of the Clean Development Mechanism (CDM) would necessitate improvements in industrial processes to make them more environmentally friendly. Recognising what improvements could be done to ensure compliance with increasingly stringent environmental standards has invariably resulted in the highlighting of issues relating to technology transfer, information technology etc.

What are the barriers to technology transfer? How can these identified barriers be removed? Sustainable measures need to be put in place to ensure that objectives can be achieved. The overriding issue then is capacity building.

A sustained programme of capacity building will be a major and important component of the Phase III of this programme.

INTRODUCTION

The concern about greenhouse gas (GHG) emissions has given rise to the CDM concept.

Industries are being targeted to reduce emissions; and also to use energy more efficiently. Why? This is because certain energy sources result in emissions which are considered deleterious, and add up to the emissions which are considered as contributing to adverse climatic changes in the world.

An attempt has been made to assess the operations of the iron and steel, and aluminium industries.

The three iron and steel companies in Tema, and the aluminium smelter, also in Tema, are energy intensive industries. How can they minimize emissions, or reduce the energy consumption per unit output of product?

It has been recognised that in order to achieve these objectives the following issues need to be resolved:

i. how to remove barriers to technology transfer;

ii. how to sustain capacity needs and capacity building to enable the country keep pace with changing technological trends.

This report is an effort to highlight the consensus of opinions which may be considered in tackling obstacles to the attainment of the objectives.

Industries ought to be forward looking and consider the importance of capacity building; policies and regulatory framework need to be constantly updated to keep pace with increasing changes in technology.

LIST OF ABBREVIATIONS

1.	CDM	-	Clean Development Mechanism
2.	COMESA	-	Common Market for Eastern and Southern Africa
3.	COP 7	-	7th Conference of Parties
4.	CSIR	-	Council for Scientific & Industrial Research
5.	DFID	-	Department for International Development(United Kingdom)
6.	EAF	-	Electric Arc Furnace
7.	ECOWAS	-	Economic Community of West African States
8.	EPA	-	Environmental Protection Agency
9.	FID	-	Factory Inspectorate Department
10.	GHG	-	Green House Gas(es)
11.	IIR	-	Institute of Industrial Research
12.	KITE	-	Kumasi Institute of Technology & Environment
13.	NGO	-	Non Governmental Organisation
14.	OHS	-	Occupational Health & Safety
15.	O & M	-	Operate and Manage
16.	Tonne	-	Metric Ton
17.	TOR	-	Terms of Reference
18.	UNIDO	-	United Nations Industrial Development Organisation
19.	UNFCCC	-	United Nations Framework Convention on Climate Change
20.	VALCO	-	Volta Aluminium Company

CHAPTER 1

BACKGROUND OF PROJECT

1.1 Project objective

African countries' industrial establishments do not have the full complement of human and institutional/infrastructure capacities to take full advantage of the potential opportunities for project development and implementation, technology transfer and foreign direct investment under the Clean Development Mechanism (CDM) of the Kyoto Protocol. To offset this problem, African industrial establishments and other relevant stakeholders need to develop a joint approach to project/investment sponsors.

This project which is a preparatory assistance program and a continuation of UNIDO –AFRICAN CDM Phase I, seeks to:

- Identify and remove barriers to the transfer of climate-friendly industrial technologies by improving the infrastructure and policy environment for industrial projects and activities under the CDM.
- Prepare a regional "thematic" programme consisting of six national components (Ghana, Kenya, Nigeria, Senegal, Zambia and Zimbabwe) and one regional component involving COMESA and ECOWAS.

1.2 Project structure

As a strategy, the project has established:

- ♦ A team of national experts.
- ♦ A national stakeholders core group identified in the Phase I programme, comprising the national support systems, namely the Industry Partners, Policy, Legislative/Regulatory, Technology, Investment, and Information/Awareness support group.
- ♦ A wider national stakeholders group.

The national experts will provide national stakeholders with technical advice on industry and the CDM. The national experts in consultation with the national core group are to facilitate the identification of barriers and preparation of barrier removal strategies and to prepare a programme that will facilitate capacity building and technology transfer (the core team of national experts will be responsible for the main activities to be carried out. They will consult with the stakeholders and will use them as resources).

The Ghanaian component of this project has identified two main energy-intensive industrial sub-sectors. These are:

- Iron and steel manufacturing
- Primary aluminum production

There are three companies in Ghana which produce iron and steel bars/rods. All three were invited to participate. Ferro Fabrik Limited has been elected to serve on the national expert team. The others who participated in the Phase I would be encouraged to take active part in the project.

The Volta Aluminum Company (VALCO), the primary aluminum producing company has been actively involved in the project.

CHAPTER 2

EXPERTS/STAKEHOLDERS MEETING

First experts meeting

After accepting the Terms of Reference (TOR) for the project, the Environmental Protection Agency (EPA) arranged the first core group meeting. The first core group meeting held on 30 March, 2001 was attended by the following:

1	Dr. P. C Acquah	Environmental Protection Agency
2.	Mr William K. Agyemang-Bonsu	Environmental Protection Agency
3.	Mr. Philip Acquah	Environmental Protection Agency
4.	Mr. Peter Pemleton	UNIDO Project Manager
5.	Dr. Pim Kieskamp	ETC Energy, Chief Technical Advisor
6.	Dr. Henry Mensah	Kumasi Institute of Environmental Development
7.	Dr. Joseph K. Annan	Ferro Fabrik Limited
8.	Mr. Emmanuel Ahiable	VALCO
9.	Mr. Edmund Mc-Addy	Environmental Protection Agency
10.	Mr. Larsey-Mensah	Environmental Protection Agency

2.1.1 Purpose/Outcome

The meeting, which was chaired by Dr. P. C Acquah, Executive Director, EPA, started at 1400hours instead of 0900hours. This was due to the delay of the scheduled flight of the UNIDO Project Manager and the ETC Project Consultant.

Dr. Acquah welcomed the participants (especially Mr. Peter Pembleton and Dr. Pim Kieskamp).

The first core group meeting sought to:

- Re-establish the core group (members were selected from the Phase I project)
- Introduce the project to core group members
- Assign responsibilities by way of handing over sub-contract/TOR to the core group members.

After the welcome address, Mr. Peter Pembleton introduced the project and explained to core group members the objectives and expected timeframe.

Mr. Pembleton informed the core group members of the implementation plan for the UNIDO CDM Project as comprising the following four phases.

Phase I:	National Capacity Building to facilitate the implementation of CDM projects.
Phase II:	Program Development
Phase III:	Implementation of Programs (Pilot Project)
Phase IV:	CDM project

Mr. Pembleton gave an overview of the achievements of the Phase I, and emphasized that funds were made available to carry out the current phase due to the success of Phase I. He indicated that the Phase II (Program development) should address the following activities:

- setting of core group
- identification of barriers to technology transfer to industry
- organization of multi-shareholder workshops
- development of strategies for barrier removals
- preparation of draft program
- participation in regional workshop
- participation in side event at COP 7 in Morocco in November 2001

Mr. Pembleton introduced the core group to the UNIDO Web Board, which should serve as a forum for conferencing among the six participating countries.

Core group members were encouraged to visit and participate in the discussion/conference on the Web Board.

To achieve this, he stated that each member, through the project coordinator, should submit his/her e-mail address.

Dr. Pim Kieskamp, in his presentation discussed the details of the framework among which the thematic components of the program and the several phases and their activities to be carried out. One of the themes was on decision tools that will be utilized in the development of the draft program as scheduled in the phase I project activities. These tools included COMFAR III EXPERT, IDENTIFY and LEAP 2000

He reiterated that these tools would be particularly useful in the evaluation of investment opportunities, cost of investment, BOOT/BOT issues, financial schemes/analysis, risk, insurance and security.

Mr. Philip Acquah, who coordinated the Phase I activity for Ghana also presented the output of the Phase I and discussed the presentation made during the UNIDO side-event organized at SBSTA 13 in Lyon, France.

Mr. Acquah emphasized the need for the two identified industries to seriously participate in this program and also indicated the benefits thereof if Ghana becomes a Party to the Protocol.

In his closing remarks Dr. P. C Acquah thanked the presenters and pleaded with the core group members to regard their involvement and input into this program as a service to Ghana, and should consider the money given them as an honorarium instead of as a consulting fee.

2.1.2 Contract composition/national experts

For smooth running of the project Ghana has the following contract composition (core group members)

- Project Coordination:
  - Dr. P. C Acquah
  - Mr. William K. Agyemang-Bonsu
- Investment/Financial analysis
  - Dr. Henry Mensah-Brown
- Energy Use in Industry
  - Mr. E. K. A Dickson
  - Mr. Charles N. Anderson
- Technology Transfer
  - Dr. Joseph K. D. Annan
  - Mr. Emmanuel Ahiable
- Information Systems
  - Mr. Edmund Mc-Addy
- Legal/Policy/Institutional Arrangements
  - Mrs. Margaret Ahiadeke

2.1.3 Scope of contact

2.1.3.1 General scope/indicative activities

Generally, the various national expert groups will carry out the following in their respective areas of expertise.

(a) Update the relevant data and information gathered in Phase I as appropriate to their areas of expertise. This will enable the preparation of an updated version of the identified projects in accordance with a UNIDO format circulated by James New of UNIDO, Vienna. (Reference format on webboard)

(b) Undertake identification of potential barriers and barrier removal strategies relevant to their areas of responsibilities. This shall be done in consultation with the relevant national stakeholders to ensure a stakeholders approach. This is consistent with their mandate to facilitate the identification by the stakeholders.

(c) Presentation of findings in knowledge sharing and knowledge transfer in stakeholders core group meetings to discuss findings and develop Draft strategy document,

(d) Presentation and dissemination of the draft strategy document to a wider national stakeholders conference and facilitation of the preparation of the final document on barriers and barrier removal strategy for technology transfer

(e) Preparation of capacity building programme to assist in implementing the strategy (d) above.

2.1.3.2 Project co-ordination

The project coordination is the responsibility of the Environmental Protection Agency (the contracting Agency with UNIDO).

The project coordinator is to see to the implementation of the program activities as outlined in the UNIDO TOR, particularly the execution of the contracts, the organization and the various meetings for the dissemination and the development of a country document on Barriers and Barrier removal strategy.

2.1.3.3 Energy use in industry

The TOR for this subgroup includes:

- The identification of barriers to energy efficiency improvement/clean technology deployment in industries in general and the sector specific industries in particular.

- Assessment of existing capacity, and capacity building needs in industry and energy services, particularly in the selected industrial sectors.

- Improve upon data collection in the three steel industries and VALCO. Data on all greenhouse gas sources in the areas that the CDM project is intended to improve should be considered. The data shall include the following:

    - Historical energy and emissions data (5 years baseline – 1995-2000),
    - Business-as-usual/reference case scenario (i.e. projected plant energy and emissions performance without CDM project over the entire CDM project life)

- Project case scenario (i.e. projected plant energy efficiency enhancement with the implementation of the selected efficient technology [energy and process]. The technology would have to be determined by the Energy and the Technology Transfer Team).

All projections should be for the expected CDM project life. The data set shall be consistent with UNIDO DATA Format.

The data set will include:

- General Data Sector/ Product types/unit of measure/project life

- Baseline Information
  - Specific energy consumption /energy intensities of End-use energy by product, and the intermediaries for each product line
  - Energy mix (hydro, IPP diesel-powered, and Light Crude Oil-LCO-powered) and fuel oil) and quantities/ equivalents assuming the supply of each independently
  - Carbon intensities of the electricity from IPP, and LCO-powered electricity
  - Generation efficiencies of the IPP and LCO-powered electricity
  - Carbon intensities of fuel for the thermal generation
  - Carbon intensities and fuel combustion efficiency on the plant
  - Benchmarks of energy consumption in EAF-Scrap melting operations
  - Benchmarks of energy consumption in aluminium smelting

2.1.3.4 Technology transfer

The Technology Transfer team would also carry out the following among others:

- Description of the existing plant operations and their operational efficiencies using plant performance indicators.

- Identification of technology options, and selection of the specific energy efficient and/or process technology option to reduce the energy consumption or/and direct process emissions of greenhouse gases from fuel combustion on the plant in consultation with the Energy Use-in–Industry team.

- Description of the specific energy efficiency and/or process technology options selected to reduce the energy consumption and/or direct process emissions of greenhouse gases from fuel combustion on the plant in consultation with the Energy Use-in–Industry team.

- Indication of the cost of capital, O & M, variable cost of O & M of the greenhouse gas emissions reduction project technology selected over the anticipated project life in consultation with the Finance and Investment Team. Additionally, the cost of capital, O& M, variable cost of O & M of the existing plant and intended efficiency projects/renovations on the existing plant that may be carried out without the CDM project must also be established to help in the additional financial estimation of the project. This is to enable approximate estimates of the GHG reduction opportunity per ton of CO2.

- Identify existing capacities in the Steel Companies and VALCO to implement the potential GHG reduction technology option selected, and assess any training and capacity development needs that will be required to implement the project at the respective plants.

- Identify potential risks that might not make the project attain the projected operating performance technically and organizationally to meet the projected emissions reduction target, and discuss remedies to lessen such risks.

- Needs Assessment: Identify existing capacities in the relevant country institutions for technology assessment, technology selection, and application in the energy and process industry; and assess the capacity needs (Institutions should include Association of Consultants, Private Energy and Technology consultants, Institute of Industrial Research (IIR)/CSIR,).

- Clean Technology Transfer Considerations:

The factors to be considered should include the following:

- Demonstrating technical, economic and environmental feasibility
- Ensuring environmental compliance (determine this in consultation with the Team Leader/EPA)
- Ensuring international occupational health and safety, OHS, standards (determine from Factory Inspectorate Department, FID)
- Adequate certification and warranty approvals from the equipment manufacturers (Equipment supplier quotation and supply conditions)
- Life cycle cost
- Ease of integration of new system with the existing

processes/compatibility with existing system
- Programs to get worker acceptance
- Obtaining capital approvals from the plant management

2.1.3 5 Finance /Investment contract

The areas of consideration should include the following:

- The feasibility of the existing plant WITHOUT the CDM project and WITH the CDM Project over the project life.
- The contribution of the revenue from Certified Emissions reduction (5-10 \$/ton CO2 reduction) to the feasibility of the project (environmental additionality of the project).
- Potential of the CDM project to attract investors based on the project indicators compared to the BAU (existing without CDM) where the sale of CERUS will not be adequate to pay for the total project cost.
- How the CDM project would enhance the competitiveness of the companies in the domestic and the international market considering energy efficiency improvement and associated cost reduction, and revenues from CERUS.
- In the case of the steel sector, the potential effect of liberalization of steel imports and scrap market in the sub-region on the sustainability of EAF operations would need to be discussed and policy options addressed.
- Determine the contribution of the project to sustainable development goals of the country regarding conservation of resources (e g, energy).
- The financial sector awareness, existing capacity and needs assessment for CDM project evaluation should be assessed.

2.1.3.6 Legal/Policy/Institutional arrangements and assessments

The team should be guided by the UNFCCC capacity building and technology transfers document as well as the UNIDO phase of the recent ENDA capacity assessment project and I Project Report.

The stakeholders selected for the capacity needs assessment should include all relevant institutions to reflect policy and legislation of industrial, energy, and environmental sectors in general, and the steel and the aluminum sectors in particular. The potential stakeholders should include the national support system identified during the Phase I (Reference: PHASE I report).

2.1.3.7 Information systems contract

Database management and relevant information support from UNIDO Web Board, relevant data on technology options.
Assist core group members and stakeholders to identify the use and application of softwares for the project COMFAR III EXPERT, IDENTIFY and LEAP 2000.

2.2 Project inception / first stakeholder meeting

The meeting was chaired by Mr Dan Amlalo, Director of Operations, EPA. (Ref: Appendix I)

Peter Pembleton gave the overview of the UNIDO Initiative in building capacity of African countries to actively participate in the emerging CDM. The various phases of the program was also outlined. The ultimate outcome of the project is bankable country or regional project that can attract foreign direct investment under CDM.

The major emphasis for the Phase II activities was

- That the mobilization of stakeholders must necessarily involve the National Climate Change Focal Points, private sector, relevant public sector institutions, and NGOs
- That Phase II will principally focus on identification of barriers and barrier removal strategies, and this process must be facilitated by the national experts
- That there is the need to ensure private sector interest and project ownership by the participating industry partners and government, and that UNIDO is only catalyzing the process with limited funding at this stage to ensure uptake and continuation by Donor Funds.

Dr. Pim Kieskamp again highlighted the project linkages, the tools, and the international support for the program.

Mr. Philip Acquah presented the summary of Phase I activities and highlighted the outcomes of the National stakeholders forum, the identification of the national support systems, the awareness created on the emerging financial mechanisms of the Kyoto Protocol and potential benefits to the private sector, national government, and the global climate.

The potential energy efficiency improvements that can be achieved in the selected energy-intensive industries were highlighted. The corresponding potential greenhouse gas emissions reduction from energy savings, its implication for energy security, employment, competitiveness of the iron and steel sector, and general sustainability of the two sectors were highlighted.

Mr. Philip Acquah finally presented a paper on CDM, the purpose and characteristics and indicators for a good CDM project. This was to guide national experts to specific areas that barriers and barrier removal strategies should also address, particularly with respect to CDM stakeholders outcomes.

In a discussion that ensued, the question of rates being paid to the national experts came up. The members were of the consensus that the rates indicated in the contracts were not appropriate and that it contravened the policy of the Ghana Institution of Engineers. It was therefore decided that the appropriate rates should be applied, but there should be a distinction between what UNIDO can afford and the real cost of the expert input. The individuals should then record the difference as a contribution and for that matter the country contribution to the project implementation.

In a closing remark the UNIDO coordinator emphasized the need for the ownership of the Project by the industry partners in particularly, and that UNIDO is facilitating the process out of its own resources.

2.3 Second stakeholder meeting

The second stakeholder meeting (Ref: Appendix II) was held on Wednesday, 16 May 2001 at the EPA's Conference Room. The meeting, which started at about 0930 hours was chaired by Mr. D. S. Amlalo. Mr. Amlalo after a brief welcome statement, apologized for Dr. P. C. Acquah for his inability to be with the group and explained that Dr. Acquah had been called to attend to another assignment.

The main purpose of this meeting was to further raise the awareness of stakeholders on the implication of CDM for industry and development and introduce stakeholders to the concepts of CDM particularly the criteria for CDM project screening and selection.

The other aim of the meeting was to assess the progress of work and to enable core group members to present work done so far in identifying capacity needs and planned activities for the future.

2.3.1 Participants

Under listed were the members that were presented at the meeting.

1	Mr. D. S. Amlalo	Environmental Protection Agency
2.	Mr William K. Agyemang-Bonsu	Environmental Protection Agency
3.	Mr. Charles N. Anderson	Energy Commission
4.	Mr. G. D. O. Asiamah	Energy Commission
5.	Mr. E. K. A Dickson	Delcon Engineering Compan Ltd.
6.	Dr. Henry Mensah-Brown	Kumasi Institute of Environmental Development
7.	Dr. Joseph K. Annan	Ferro Fabrik Limited
8.	Mr. Emmanuel Ahiable	Volta Aluminum Company Ltd.
9.	Mr. Edmund Mc-Addy	Environmental Protection Agency
10.	Mrs. Margaret Ahiadeke	Environmental Protection Agency
11	Mr. Ben Treveh	National Development Planning Commission
12	Mr. Issah Nikabs	Ministry of Trade and Industry
13	Mr. Emmanuel Mensah	Ministry of Energy
14	Mr. B Agyare	Ministry of Energy

2.3.2 CDM project screening and selection

Mr. William K. Agyemang-Bonsu led the discussion on the implication of CDM for industry and development and introduction of stakeholders to the concepts of CDM particularly the criteria for CDM project screening and selection (Ref: Appendix III). The presentation deliberated on the technical, financial, environmental, socio-economic criteria with the idea of sustainable development as the principal theme. Participants were also informed of the need to screen projects against government development priorities. The paper also highlighted the lack of capacities in-country to undertake monitoring, verification and certification of potential CDM projects. The complete paper will be made available at the Web Board under Ghana Conference.

2.3.3 Energy use in industry

Mr. Charles N. Anderson presented a paper (Ref: Appendix IV) on energy use in industry which gave an overview of past efficiency initiatives in Ghana. The purpose of this paper was to apply lessons learnt in those projects to the identification and removal of barriers for technology transfer and assist the technology transfer group to identify possible areas for CDM project development. The paper which offers some useful lessons will be posted at the Web Board under the Ghana Conference.

2.3.4 Financial and investment analysis

Dr. Henry Mensah-Brown discussed the financial and investment component of the project along the following lines:

- data collection on potential energy savings by the adoption of best practices by VALCO and Ferro Fabrik Ltd
- carbon analysis to estimate CO_2 emissions reductions and revenue from certified emissions reduction
- estimation of the cost of procurement/installation and operation of the best practices or new technology option
- cost of training to implement GHG reduction technology
- estimation of project feasibility without CDM
- estimation of project feasibility with CDM
- assessment of the impact of liberalization of steel imports and scrap market on sustainability of EAF project operation (legal and policy implications)

2.4 Synergies between ongoing country programmes

2.4.1 UNEP/RISØ CDM capacity building programme

This programme has the aim of building capacity in-country to assist Ghana take advantage of the CDM. The principal objective is to develop 2-4 bankable CDM projects. While the UNIDO-Africa CDM programme is focusing on building capacities within the industrial sectors in Africa, this project, however, is focusing on all sectors.

The project which was expected to come to a close by the end of April 2001 has identified three major projects which are still undergoing fine-tuning. These projects are:

- Conversion of a single cycle thermal plant to a combined cycle using natural gas as the feed,
- Cogeneration of energy and heat from wood waste, and
- Development of urban rail network.

2.4.2 Moving towards emission neutral development

The programme is being hosted by Kumasi Institute of Technology and Environment (KITE) a non-governmental organization and is being funded by DFID. The objective of the project is also to identify and develop CDM projects that are intended to address poverty alleviation. This project is therefore targeting small-scale rural CDM qualifying projects. The project is still ongoing.

2.5 Scope of activities and work plan

The table below shows the scope of activities and work plan for the execution of the project.

ACTIVITY	MONTH (2001)							
	Apr	May	June	July	Aug	Sept	Oct	Nov
1. Re-establishment of core group and identification of relevant stakeholders. Project inception workshops (for core group and stakeholders)								
2.National CDM Concept Workshop and identification of capacity building needs								
3. Preparation and review of first progress report								
4. Assessment and identification of barriers to technology transfer by core group members.								
4.Development of barrier removal strategies by core group members								
5. Stakeholder workshop for harmonization, prioritization and adoption of identified barriers and their removal strategies								
6.Preparation and review of second progress report								
7. Identification of potential CDM projects for steel and aluminum sectors								
8. Technology identification including investment requirements for identified potential CDM projects and opportunities								
9. Preliminary baseline calculations for identified potential CDM projects								

10. Prepare and review draft of national programme								
11. Participate in regional workshop								
12. Finalisation of national integrated programmes								
13. Participate in side event at COP7								
14. Project conclusion and debriefing								

CHAPTER 3

BARRIERS IDENTIFICATION AND REMOVAL STRATEGIES

3.1 Introduction

At its third (Ref: Appendix VI) stakeholders' meeting held on the 27th June, the team identified a host of barriers and their removal strategies. These barriers were harmonized along ten main themes; viz:

- Inadequate human resources and institutional capabilities
- Access to technology
- Economic regime
- Sourcing of funds and interest rates
- Inadequate baseline information
- Inadequate legislation
- Rapid pace of technological advancement
- Estimation of project cost, procurement and feasibility with and without CDM
- Marketing
- Inadequate information

During the fourth (Ref. Appendix VII) stakeholders' meeting which took place on the 1st August, 2001, there were some further developments and re-arrangements of the barriers that were identified at the previous meeting. The ten barriers were merged into three major themes.

- Capacity Building Needs
- Access to technology
- Economic Regime.

For the purpose of highlighting the needs under Capacity Building, the team assessed the following aspects:- Human Resources Development Needs and Institutional Capacity Needs. The corresponding removal strategies were therefore developed along the current prioritised barriers.

Further discussions of the barriers and their removal strategies were carried out at the fifth stakeholders' meeting held on 26th September, 2001(Ref. Appendix VIII).

3.2 Prioritised barriers and barriers removal strategy matrix

Table 1 gives the Matrix for prioritised barriers and their removal strategies that are relevant to investment and technology transfer in the metal finishing industry, under the clean development mechanism.

Dr. Annan presented a paper on "Identification and strategy for removal of barriers" in the steel and aluminium sectors (Ref. Appendix IX)

Table 1: Matrix for prioritised barriers and barriers removal strategies for industry CDM projects

PRIORITISED BARRIERS	REMOVAL STRATEGIES
1. Inadequate human resources in: • Greenhouse gas mitigation cost analysis • Emission baseline estimation • Climate change issues • Identification of CDM eligible projects • Negotiating for FDI under CDM • Development and implementation of CDM projects. • Modern project management skills. • Greenhouse gas emission monitoring, validation, verification and certification. • Database development	• capacity building through training workshops and international attachments • retraining and capacity mobilization for the purposes of re-orientation to understand CDM programme, especially in area of greenhouse gas (GHG) mitigation cost analysis, emission baseline estimation and identification of eligible CDM projects • capacity, building for CDM project development, implementation and management. • Awareness creation for management of industries in climate change and CDM issues • Capacity building for the acquisition of negotiation skills. • Capacity, building for GHG emission monitoring, validation, verification and certification. • Capacity, building for database development and management.
2. Inadequate Institutional Capacity in the Areas of: • greenhouse gas emission monitoring and database management (records and achieving) • greenhouse gas emission data quality control and quality control assurance systems. • greenhouse gas emission monitoring systems • rigid cooperate policies and management hierarchy • inefficient institutional networking • unnecessary competition • lack of assess to useful (but confidential)business information.	• institutional structures for monitoring of GHG emissions and data archiving strengthened and/or established. • Institutional structures for GHG emissions data quality control and assurance put in place. • Industries should be encourage to change their organisational structure and corporate policy to accommodate relevant skills (eg appointment of environmental managers) and to reflect the dynamics of global environmental agreements • Existing institutions with some capacity to undertake pollutant monitoring should be strengthened to take up greenhouse gas emission monitoring. • Networking between relevant institutions be established and/or strengthened • industries should be encouraged to share expertise and information that will enhance their environmental performance. • Industries should be taught how to

	communicate or package confidential business information to relevant stakeholders but yet maintain the integrity off the information
3. Accessing Technology • lack of assess to relevant information on technology • inability to keep pace with rapid technological advancement. • lack of systematic research in technology development, adoption and adaptation.	• Establish and/or strengthen technology information centres that ensure that information on state-of-the-art technology are made available to stakeholders • Retraining of personnel for the adoption and adaptation of technology to ensure that industry keeps pace with rapid technological changes. • Encourage the setting up of R&D departments in industry.
4. Unfavourable Economic Regime/ Enabling Environment • Lack of infrastructure (e.g. communication) • High initial financial resources to acquire technology • High interest rates • Infective regulatory framework on competitive policies in terms of trade and standards • Access to market • Estimation of project cost of procurement and feasibility with or without CDM • Intermittent power failure • High cost of production that makes local manufactures not competitive on domestic and global markets • Lack off incentives and tax holidays	• Enhance and facilitate access to information technology infrastructure • Government and the private sector should create the necessary conditions to attract donor funding and private investment and encourage commercial and development banks to finance industrial projects. • Government/investment banks to be sensitised and lobbied to ensure a sustainable low interest rates for borrowers for industrial development. • Industries to adopt and stick to international standards (as appropriate) on general quality • government to create necessary environment and ensure access to international markets through appropriate trade polices. • Capacity building for the estimation of project cost of procurement and feasibility with and without CDM be carried out in industry • Alternative power supply systems put in place • Government to create incentives and tax holidays for industries that can prove reasonable investment in technology that improves their environmental performance and ensures environmental integrity.

At the fifth stakeholders meeting, Mr. C. N. Anderson (on behalf of the core group for project development) discussed the potential project areas within the metal finishing industries. The two project areas discussed included:

- Energy efficiency improvement
- Carbon dioxide emission reduction through fuel switching and or process technology change.

He indicated that there should be an investment in the existing plant technology through the under listed basic steps:

- Energy accounting/audit
- Energy management systems improvement through adaptation of motor driving systems
- Heat recovery processes
- Establishment of motor rewinding shops
- Fuel switching to LPG
- Assessment of production cost per ton of the two metal finishing industries under the condition with/without CDM compared to imported items.
- Assessment of carbon dioxide emissions to get a fair idea of what to expect on efficiency.

CHAPTER 4

OBJECTIVES, OUTPUTS AND ACTIVITIES FOR PHASE III

During the implementation of this programme, Phase II of CDM Capacity Building – Implement Industrial Clean Development Mechanism (CDM) Project in a Selected Number of Countries in Africa. "Preparatory Assistance", it was realized that several capacity building activities need to be carried out if industry is to participate effectively in the project implementation phase under the CDM.

Whilst some of these needed capacity building activities are human in nature, others are purely institutional. A clear combination of both institutional and human capacity development is very relevant if this industry capacity building initiatives are to make any meaningful impact.

Apart from the private industrial institutional and human resource development needs, it was also recognized that government departments/agencies including the academia, research institutions, and above all financial institutions need to be strengthened. The NGO community, no doubt needs some awareness creation and capacity building.

Currently, the Environmental Protection Agency, the country's agency for climate change activities, is developing plans to establish a national commission on climate change. It is envisaged under this plan that with the enactment of a legal framework to support the commission, a CDM unit would be created to address CDM transactions in the country.

The Phase III of this programme is thus expected to fulfill some of these identified capacity needs and above all address barriers which will hinder the smooth running of the country CDM programmes.

Table 2 summaries the objectives, outputs and activities that will ensure the effective implementation of some of the portfolio projects identified in Chapter 5.

Table 2 Objectives, Outputs and Activities for Phase III

Code	Objective	Output	Activity	Suggested start	Duration	Number	No. Participants/item
Objective 1	To improve awareness						
Output 1.1		Trained industry, government and NGO representatives					
Activity 1.1.1			Hold national and zonal workshops	Month 3	2 years	5	150
Output 1.2		Established information and a national communication system					
Activity 1.2.1			Develop and publish quarterly newsletters	Month 6	4 years	16	500
Output 1.3		Documentary on climate change, impacts adaptation and mitigation options					
Activity 1.3.1			Engage experts in the development of a documentary	Month 12	1 year	1	1
Output 1.4		Establish networks among stakeholders					
Activity 1.4.1			Develop a national web page on CDM	Month 12	6 months	1	1
Activity 1.4.2			Link relevant stakeholders to an information network	Month 12	6 months	1	10
Objective 2	To mobilize stakeholders						
Output 2.1	Industry, government and NGOs participate in CDM process						
Activity 2.1.1			Attend COPs	Month 1	4 years	4	6
Objective 3	To train stakeholders in						

	greenhouse gas mitigation cost analysis						
Output 3.1		Trained stakeholders in greenhouse gas mitigation cost analysis					
Activity 3.1.1			Send some stakeholders for international attachments	Month 8	1 month	1	2
Activity 3.2.1			Hold trainer of trainers workshop	Month 10	1 week	3	60
Objective 4	To estimate emission baselines						
Output 4.1		Trained industry government, NGOs and academicians in baseline development					
Activity 4.1.1			Hold national workshops	Month 10	1 week	3	60
Objective 5	To build capacity in CDM project identification, development and management						
Output 5.1		Improved CDM project development skills					
Activity 5.1.1			Train stakeholders in project identification development and management	14 month	1 week	3	60
Activity 5.12			Build stakeholders negotiation skills through training workshops	14 month	1 week	3	60
Objective 6	To develop a legal framework for the operationalisation of CDM						
Output		National legislation on CDM					
Activity 6.1.1			Develop a CDM legal framework	Month 14	1 year	1	20/1

Objective 7	To develop a CDM investment package						
Output 7.1		Investment package that ensures favourable environment for CDM projects implementation					
Activity 7.1.1			Review national investment package and enhance its attractiveness for technology transfer under CDM	Month 14	1 year	1 20/1	
Objective 8	To evaluate the state-of-the-art GHG mitigation technologies applicable to steel and aluminuim production						
Output 8.1		Catalogue of GHG mitigation technologies for the two metal finishing industries					
Activity 8.1.1			Undertake technology needs assessment for the steel aluminium industries	12 month	2 month	1	30
Objective 9	To strengthen national institutions (both private and public) to undertake GHG emission monitoring						
Output 9.1		Enhance capacity of national institutions to monitor GHG emissions					
Activity 9.1.1			Train technicians to undertake GHG monitoring	14 month	2 weeks	4	20
Activity 9.12			Equip selected national laboratories for GHG	12 month	2 months	1	4

			monitoring				
Activity 9.1.3			Enhance database development and management sills of selected laboratories	14 month	2 weeks	4	20
Activity 9.1.4			To establish and strengthen GHG emission data quality control and assurance systems	15 month	2 weeks	4	20
Objective 10	Strengthen and seek accreditation for national institution(s) to undertake CDM project validation, verification and certification						
Output 10.1		National institution(s) strengthened for CDM project validation, verification, certification and monitoring					
Activity 10.1.1			Send national experts on international attachments	18 month	1 month	1	3
Activity 10.1.2			Organised training workshop for selected laboratories for GHG monitoring and reporting	20 month	1 week	1	20
Activity 10.1.3			Seek accreditation for some of the selected national laboritories	12 month	1 year	1	1

CHAPTER 5

5.0 PORTFOLIO OF POTENTIAL PROJECTS

5.1 Iron and steel scrap melting in Ghana

5.1.1 Project background

There are three iron and steel melting and rolling mills in Ghana all sited in the heavy industrial area of Tema. They have a combined production potential of 110,000 tonnes per annum of rolled steel products of various sizes. However, production and management problems being faced by one of the steel mills has affected it's production significantly, and is on the verge of collapse.

In the 1990's the industry witnessed a significant upsurge in production as a result of the country's economic recovery programme, with two of the three steel mills commissioning new melting plants. However, soaring energy tariffs, since 1998, has resulted in either the companies reducing the extent of their melting operations or stopping the melting operations (for a while). Production output of the rolling mill operations is being maintained with imported steel ingots.

5.1.2 Project description

The proposed project would involve energy efficiency improvements of between **38%** to **58%** that would restore the economic viability of the melting operations of the three steel mills. The energy efficiency improvements envisaged includes the possible recycling of hot waste gases.

5.1.3 Contribution to sustainable industrial development

Improving the energy efficiency of the ferrous scrap melting plants would result in full utilisation and enable competitiveness with imports. 1,300 direct jobs would then be secured, as well as the informal income generating opportunities provided for thousands working for ferrous scrap and refractory bricks suppliers. The operations of the ferrous scrap suppliers have contributed to improvements in environmental sanitation in the cities and outlying areas throughout the country. Large tracts of land have now been reclaimed for development. These operations also contribute to some saving of national foreign exchange.

5.1.4 Greenhouse-gas emissions abatement

5.1.4.1 Project baseline

Estimates of current emissions are:
Electricity consumption is approximately between 627-927 kwh/tonne of steel;
Fuel consumption is estimated at 74 litres/tonne of steel.

5.1.4.2 Emission reduction projections

Estimated potential electricity saving:
From 627-927 kwh/tonne of steel produced to 390 kwh/tonne of steel produced.

This will also lead to potential fuel oil savings.
Carbon dioxide emissions will reduce as a result of a reduction of energy wastage, dust emissions will be decreased; and both dust and slag will be reused.

5.1.5 Project summary

The following Table presents a summary of key project data.

Proposed mitigation measures	**CO_2 abatement: Fuel switching and energy conservation**: Energy efficiency improvements.
Project baseline	**Business as usual scenario**: Continued use of existing equipment...
Crediting period	**Twenty-one years**: The project seeks Certified Emission Reductions (CERs) for three 7-year "renewal" periods depending on baseline development.
Estimated CO_2 reduction	Anticipated Annual Emission reductions (ERs)
Sources of ERs	Only CO_2. ERs will be achieved through (1) reduced fuel oil consumption on site, and (2) reduced fossil-based electricity consumption.
Sustainable development impact	• Improved industrial competitiveness. • Secured direct employment and indirect income generation. • Reduced Forex from steel imports.
Anticipated sources of revenue	• Reduced production costs. • Sale of CO_2 emission reductions (ERs). • Sale of re-melted iron and steel.

5.2 Volta Aluminium Company (VALCO) Aluminium Smelting, Tema, Ghana

5.2.1 Project background

The VALCO Aluminium Smelting plant in Tema, Ghana is a key industry in the national economy of Ghana. The company manufactures aluminium, and has a design capacity of about 200,000 tonnes per year. Most of the company's products are exported. The company currently employs directly about 1,280 workers and contributes enormously to the country's foreign exchange earnings and local taxes. The plant also provides aluminium to the only aluminium rolling plant in the country (Aluworks Ltd) and some aluminium as raw material to local fabrication plants.

Aluworks, which is an aluminium rolling plant, in turn supports all the national industries engaged in the production of aluminium roofing sheets, utensils, and extrusion products.

The VALCO smelting plant is also the largest electricity consumer in the economy. All electricity consumed at the plant is supplied from the national grid.

5.2.2 Project description

The proposed project involves both process and energy efficiency improvements. Process improvements would include improvements in: control techniques; anode quality; cathode quality; and alumina quality. The energy efficiency measures envisioned involve improvements to the design of electrolytic cells.

5.2.3 Contribution to sustainable industrial development

Reducing the electricity demand from the VALCO Aluminium plant would reduce production costs, thereby improving its competitiveness. In addition, it would relieve pressure to expand supply capacity in the energy supply system, which is already unable to meet the demands of other sectors of the economy. Reducing the need to increase supply capacity would indirectly reduce the environmental degradation that arises from new energy supply projects.

5.2.4 Greenhouse-gas emissions abatement

5.2.4.1 Project baseline

Benchmarks of energy consumption for Aluminium production in Ghana are:

i. 15,840 kwh/metric ton in 1992;
ii. 17,425 kwh/metric ton in 1999;
iii. 17,030 kwh/metric ton in 2000.

This may be compared to the standard consumption, at 86.5% current efficiency, of 16,200 **kwh/metric ton of output.**

5.2.4.2 Emission reduction projections

With process improvements it is estimated that the carbon-intensity of production can be reduced by 71 $kgCO_2$/tonne aluminum.[1] At full production this would represent 13,000 tonnes CO_2 avoided per year. At full production levels, the total savings would be at minimum 360,000 MWh/yr. Accounting for generation, transmission and distribution losses, this is equivalent to 1.6 million MWh/yr of thermal generation, which is greater than the electricity produced by the 30MW thermal power generating plant established to supply emergency power to the industries in the locality during the 1998 power crisis. Assuming the national average emissions for electricity production, savings can be estimated (in tonnes CO_2/yr). The combined savings from the two sets of mitigation measures can also be estimated (in tonnes CO_2/yr).

1. The savings estimate here is based on a baseline figure of 1651 kg CO2/tonne aluminium (the average for the period 1990 through 1996) and a target of 1580 kg CO2/tonne aluminium achievable through mitigation measures.

5.2.5 Project Summary

The following Table presents a summary of key project data.

Proposed mitigation measures	**CO_2 abatement: Fuel switching and energy conservation**: The project involves process and energy efficiency improvements.
Project baseline	**Business as usual scenario**: Housekeeping measures and some modifications of existing equipment, but no major retrofits or replacements.
Crediting period	**Twenty-one years**: The project seeks Certified Emission Reductions (CERs) for three 7-year "renewal" periods depending on baseline development.
Estimated CO_2 reduction	Anticipated Annual Emission reductions (ERs) Order of magnitude estimate:
Sources of ERs	Only CO_2 ERs will be achieved through (1) reduced CO2 emissions, and (2) reduced fossil-based electricity consumption.
Sustainable development impact	• Improved industrial competitiveness. • Reduced pressure for expansion of national electricity supply.
Anticipated sources of revenue	• Reduced production costs. • Sale of CO_2 emission reductions (ERs).

APPENDIX I

MINUTES OF INCEPTION MEETING OF THE UNIDO/EPA CDM PHASE II MEETING HELD ON FRIDAY, 30TH MARCH, 2001 AT THE EPA CONFERENCE ROOM

1.0 Present

i. Dr. P. C Acquah
ii. W. K Agyemang-Bonsu
iii. Philip Acquah
iv. Dr. Henry Mensah-Brown
v. Dr. Joseph K. D Annan
vi. Edmund Mc-Addy
vii. Dr Pim Kieshamp
viii. Peter Pembleton
ix. Karsten Kryger

2.0 Opening

The meeting opened at 2:00 p.m.

Mr. Philip Acquah welcomed members and said the Executive Director would not be able to attend the meeting because he was engaged elsewhere but extended his regards.

He said the meeting is to initiate the Phase II of the UNIDO Programme and discuss the Contract. He said that the Phase I of the Project had been completed and because it was well done, UNIDO approved the Phase II of the project.

3.0 Main issues discussed at the meeting

Mr. Krasten Kryger elaborated on some of the current UNIDO programmes.

3.1 Activities

Mr. Krasten Kryger indicated UNIDO's keen interest in the use of mercury and it's associated environmental, safety, and health impacts from **small-scale mining**.

The Executive Director later joined the meeting and apologized for coming in late. He asked members to introduce themselves.

After the introduction one of the members gave the background of the CDM Phase II project. He said there should be a framework for meaningful and effective actions e.g. Article 4.5 (Technology Transfer).

He said UNIDO is involved in all the three (3) Phases, and that Phase I has been completed.

He went on to say that the team members came from different countries and there is therefore the need for teamwork. He also outlined the activities in the Phase I and the events taking place this year. He also said that they had the 2nd Phase ready in 1999.

Some of the events are:

i. Surveys
ii. National multi-stakeholders workshop
iii. Development of strategy and programme
iv. Regional workshops
v. Side event at COP 2000. He gave the project website to members in order to keep them abreast with what is going on.

He stated that he would only need their e-mail addresses so that he could communicate with them and that the framework is a guide for six countries.

The Executive Director thanked the presenters and encouraged everyone to seek clarification on every issue relating to the Project. He also introduced Mr. D.S Amlalo to the members.

4.0 Any Other Business

Dr. Annan said that the money allocated to the project had been underestimated. Peter Pembleton said that this was just a preparatory phase of the project and these payments were to be considered as honororium. He said that there is a bigger project pending which would involve about 10 (ten) million United States Dollars.

He said the first report should be presented at the end of April (2001) with the schedule of each member of the core group. The second report, which is the surveys and identification of barriers made, should be presented around June (2001), and the third report was to be presented at the end of July (2001). The last report should be presented by the end of September (2001) because Regional workshops would be held in September before COP7. He stated also that the project should be completed before the end of the year to avoid any defaults with payments.

One of the members stated that the barriers and strategies to address the Climate Change should be identified.

5.0 Closing

The Executive Director ended the meeting by saying he appreciated the fact that Ghana is involved in the regional group and thanked the presenters for coming.

APPENDIX II

SECOND MEETING ON THE IMPLEMENTATION OF THE UNIDO-EPA CDM PROJECT ON "DEVELOPING NATIONAL CAPACITIES TO IMPLEMENT CDM IN SELECTED NUMBER OF COUNTRIES IN AFRICA: PREPARATORY ASSISTANCE".
WEDNESDAY 16 MAY 2001

The third stakeholders meeting on the above-mentioned project took place on Wednesday 16 May 2001 at the EPA Conference Room.

1.0 Present

1.	Mr. D.S Amlalo	In chair
2.	Mr. E. Mc-Addy	Member
3.	Mr. Emmanuel K. A. Dickson	"
4.	Mrs. M Ahiadeke	"
5.	Dr. H. Mensah Brown	"
6.	Dr. Joseph Annan	"
7.	Mrs. Patience Damptey	"
8.	Mr. Emmanuel Mensah	"
9.	Mr. Isaah Nikabs	"
10.	Mr. Ben Treveh	"
11.	Mr. Emmanuel Ahiable	"
12.	Mr. William Agyemang-Bonsu	"
13.	Mr. G. D. O Asiamah	
14.	Humie Annie-Seini	
15.	Mrs. Afia S. Asare-Botwe	

2.0 Absent

1. Dr. P. C Acquah

3.0 Opening

The meeting commenced at 0900 hours and was chaired by Mr. D. S Amlalo.

Mr. William K. Agyemang-Bonsu took participants through the concepts of the clean development mechanism to enable new members be aware of what was expected from them. He said the CDM concept was important because it would ensure that developed countries (i.e. annex 1 countries) that emit above their quota reduced their emissions.

Purpose of CDM

- To assist non Annex 1 countries to achieve sustainable development
- Contribute to the ultimate objective of the Convention
- Stabilize GHG emission
- Assist parties included in annex 1 to achieve compliance with (QELRCs)

Benefits of CDM

- Non annex 1 parties would gain from it
- Annex 1 parties would also gain because they would be able to meet their commitments to the UNFCCC.

CDM Government

- Subject to the authority and guidance of the COP/MOP protocol
- Supervised by the Executive Board
- Emission reductions result from each project activities shall be certified by operational entities; viz,
    - i. Validation
    - ii. Registration
    - iii. Monitoring
    - iv. Verification
    - v. Certification.

He said that all the signatories can take advantage of the CDM, i.e. both Non Annex 1 and an Annex 1 countries. However, countries listed under the same annex cannot, i.e., it is the investor who looses if the project fails.

Participation

Mr. Agyemang-Bonsu said that an annex 1 country party cannot force a non annex 1 country to take on a project and vice versa. It should be by mutual agreement for the benefit of both parties.

Mr. Charles Anderson discussed issues relating to energy use in industry. In his presentation, he discussed previous experiences with industrial energy audits, energy efficiency and improvement programmes being implemented.

Dr. J. Annan led the discussion on technology transfer and presented data on Ferro Fabrik Limited and VALCO (Ref. Appendix V).

Dr. H. Mensah-Brown presented a paper on investment financing.
Mrs. M. Ahiadeke addressed issues on policy and legislation. Her presentation hinged principally on the laws and policies that have relevance to the implementation of the CDM in Ghana.

Mr. E. Mc-Addy also presented to the group issues on information systems, indicating how stakeholders could access the UNIDO-CDM Web Board and what software the project will be using.

Using the TOR submitted to the Agency, Mr. Agyemang-Bonsu led the discussion on the way forward, towards achieving the objectives of the project.

Core group members were encouraged to look at the TOR and prepare on issues such as technology transfer, barrier identification and removals, which are expected to be the main output according to the TOR for next stakeholder meeting.

The group agreed tentatively to have the next meeting on the Wednesday 27 June 2001 at EPA.

The meeting ended at 12:30 hrs.

APPENDIX III

"CDM Concepts and Potential CDM Project:- Screening and Selection "

Paper Presented at the Second Stakeholders' Meeting Under the UNIDO Project YA/RAF/01/405 – "Developing National Capacity to Implement Clean Development Mechanism Projects in a Selected Number of Countries in Africa: Preparatory Assistance", 16 May, 2001, EPA Conference Room, Accra Ghana

By

William Kojo Agyemang-Bonsu
Senior Program Officer
Energy Resources and Climate Change Unit
Environmental Protection Agency,
Accra, Ghana

CDM - The Origin
The Brazilian Proposal
Polluter Pays
CDM - The current form as agreed upon by COP in Kyoto (1997) at the COP3 Art. 12 of the Kyoto Protocol
Other Flexible Mechanisms
Joint Implementation (JI), Art. 6 of KP
Emission Trading (ET), Art. 17 of KP

The Purpose of CDM
To assist countries not included in Annex I in achieving sustainable development
Contribute to the ultimate objective of the Convention
Stabilization of GHG emissions
To assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments (QELRCs)

CDM Benefits
Non-Annex I Parties will benefit from project activities resulting in certified emission reductions (CERs)

Annex I Parties may use CERs accruing from such project activities to contribute to compliance with part of their QELRCs.

CDM - Governance
Subject to the authority and guidance of the COP/MOP to the Protocol, and
Supervised by the Executive Board (EB)
Accreditation Body
Emission reductions resulting from each project activity shall be certified by Operational Entities (OE)
Validation
Registration
Monitoring
Verification
Certification

CDM - Participation
Participation in CDM project activity is voluntary
Between Annex I and Non-Annex I Parties
Private, and
Public entities
Basic Qualification:
Party has ratified the Protocol
Is in compliance or has not been found to be in non-compliance with Article 12 of the Convention or other provisions of the Protocol

Project Screening
Purpose:

To identify mitigation projects that will be consistent with national priorities and will appeal to investors in the CDM market.
To see if we can develop a systematic approach to doing this at the project conceptualisation stage, without a lot of information
To "weed out" concepts/projects with obvious flaws
Sharpen the focus of later efforts on competitive projects in competitive industries

Project Screening (Cont.)
Possible uses to project developers:
to find out what information is available now on "the project" and what information will need to be generated before it can be marketed externally to investors
to identify weaknesses in the existing project concept and/or plans that need to be addressed
to find out if we can identify, systematically, "fatal flaws" that apply to many different types of projects and incorporate them in the screening process

Project Screening (Cont.)
Help identify and rank projects/concepts from the standpoint of how they contribute to sustainable development, national interests and priorities
Give participants a better idea of the kind of projects that would fit best into CDM and adjust the domestic administration of CDM to fit these
For making domestic environmental, social, economic, and trade policies that are conducive to, or will expand incentives to participate in, CDM

Attributes of a "good" CDM Project - 1
The project is consistent with stated national development priorities
The project has the unqualified support of the government in the Non-Annex 1 country
The project is clearly additional and would not be developed , "but for" CDM
The Base Case against which the emissions reductions are measured is highly credible

Attributes of a "good" CDM Project - 2
The project is highly cost- effective: the incremental cost of reducing emissions is very low compared to Annex 1 Country costs (but not negative).
The methodologies for calculating the emissions reductions are transparent and widely accepted
The data for calculating the emissions reductions are easy to obtain and verify

Attributes of a "good" CDM Project - 3
The project, including revenues from CERU sales is financially viable:
has a high enough rate of return to attract foreign investment (private sector), or
cost-savings are large enough to justify internal financing (private sector), or
is favourable from a fiscal perspective (public sector)
The owner/operator of the project is an existing private/public sector entity OR

Attributes of a "good" CDM Project - 4
An organisational extension of an existing public/private sector entity

The project is compatible with that entity's current line of business, business plans, and does not involve the production, or use, of new goods and services in new markets
The regulatory requirements of the project are manageable under current practices/laws/regulations

Attributes of a "good" CDM Project - 5
The project uses technology that has already been commercialised and is highly reliable
Project technology is compatible with the existing infrastructure in which it will be placed
Project technology has been implemented successfully under similar local conditions
The emissions reductions are large enough to attract CERU buyers

Attributes of a "good" CDM Project - 6
The project will be supported by local residents, and responsible authorities welcome and support the project and its implementation under CDM
The project creates a number of other "ancillary" benefits in the form of jobs, reduction of other pollutants, increased trade, etc.
Adverse environmental impacts from the project are small or manageable under existing regulations

CDM Project Selection Criteria

Additionality
Consistency with "but for" criteria: Can a credible argument be made that the project would not be undertaken, "but for" the objective of reducing GHG emissions?
Realism of Base Case: Is the Base Case used to calculate emissions reductions and incremental costs/ton realistic?
No regrets options: Projects or options that have negative incremental costs/ton (i.e., benefits) do not fit the traditional definition of additionality.

Additionality Criterion
Environmental Additionality
Emissions are reduced below those that would have occurred in the absence of the CDM project
Financial Additionality
CDM funds shall be additional to ODA, GEF or other bilateral/multilateral funds
Investment Additionality
The value of CERs significantly improves the viability of the project
Technology Additionality
Environmentally safe and sound technology used for the project shall be the best practicable, internationally.

Financial Viability - 1
Many projects/options appear to be very cost-effective: the incremental cost/ton of GHG reductions is quite low.
But CDM revenues from the sale of CERUs to Annex 1 countries will pay for a fraction, not all, of the CDM mitigation project costs.

Thus, CDM mitigation projects will have to be financed from other sources - foreign or domestic, public or private.

Financial Viability - 2

Low-cost energy savings do not necessarily mean a high rate of return on investment. Mitigation projects must offer a high enough rate of return to attract other investors. Unless they are in competitive industries (in domestic or international markets), it will be hard to attract the basic investment for the project
Look for projects in industries that have a high rate of return on existing investment, and good growth prospects or else very low borrowing costs.

Financial Viability - 3

Financial viability screening:
Is the project/option in a growth industry that can attract foreign private investment?
Is the project/option a high priority domestic public sector project that is likely to receive strong public sector support and funding?
Is the project/option in an industry which has a strong incentive, and access to internal resources, to fund the project on its own, either to reduce costs or increase revenues?

CDM Criteria 2 -Sustainable Development

Contribution to sustainable development
Is the project/option consistent with the sustainable development goals of the country? If not, can a credible argument be made that the project/contributes to sustainable development by conserving resources?
Ancillary benefits: Does the project provide additional social, economic and environmental benefits in addition to GHG emissions reductions?

Sustainable Development Criteria - Economic

Increase investment in a priority sector of the economy
Transfer of clean and cost-effective technologies
Generation of local employment opportunities
Positive effects on the trade balance
Improved local economy

Sustainable Development Criteria - Social & Infrastructure

Improved access to power
Capacity building (e.g. transfer of technical skills)
Reduction of wealth disparities
Level of Support: Is there evidence that the project owner, local residents, and responsible authorities welcome and support the project and its implementation under CDM?

Sustainable Development Criteria - Environmental

Environmental impacts: Does the project have adverse environmental impacts that are outside the scope of existing regulation or costly to reduce?
Reduced air pollution
Reduced water pollution
Conservation of biodiversity
Reduced soil erosion caused by deforestation

CDM Criteria 3 - Implementation/Organisational Criteria
Descriptions of potential mitigation options rarely have very much information about how a mitigation option will be implemented as a project.
How easy it will be to transform the mitigation option concept into a working project that will a) produce goods and services and b) reduce GHG emissions will be another major factor in attracting investment.
The easier this is to do,
The lower the risk to investors
The lower the cost of the project

Implementation/Organisational Criteria
Do public or private sector entities exist, today, to "own" and operate all parts of the project, or will new organisations have to be created?
Is the project consistent with that entity's current "line of business" and business plans?
Does that entity have experience owning and operating similar projects?
Does the project require inputs from or produce any outputs in "new" markets?
Are the markets for any inputs or outputs subject to extensive regulation or undergoing privatisation/de-regulation?

Implementation/Organisational Criteria
Projects that are favourable for implementation:
Can be owned and managed by a single private or public sector entity
Do not require the creation of new public or private sector entities or organisations to own or operate the project
Involve the operation and management of processes and facilities with which the entity is already familiar

CDM Criteria 4: Technological Feasibility
Technological feasibility
Status - has the technology been commercialised at the expected scale of operation?
Technological compatibility with existing technological infrastructure - will it fit without extensive modifications?
Compatibility under local conditions - has the technology been implemented successfully before under similar local conditions?
Organisational compatibility - does the owner/operator have previous experience with the technology?

CDM Criteria 5- Size of Project
Magnitude of GHG reductions
Size of the project is important because it generally means lower average capital and operating cost due to economies of scale, but investment portfolios with just a few large projects in them are vulnerable to "failure" of one. Project risk can easily offset the benefits of economies of scale.
Bundling of smaller projects is an alternative approach, but only if it can be demonstrated that management costs do not increase with the number of projects and risk of individual project failure is low.

Low Risk is more Important than Large Size.

Project Selection:-Suggested Steps - 1

1. Using the ideas in this document, develop specific criteria under the following headings, and/or others you develop:

CDM
Financial viability
Implementation/organisational viability
Technological viability

Suggested Steps - 2

2. Develop the criteria in a way so you can qualitatively (and quantitatively) measure how well each project meets them on a scale of 1-10:

Project completely satisfies criterion (10 points)
Highly satisfies criterion (8 points)
Moderately satisfies criterion (5 points)
Poorly satisfies criterion (2 points)
Project can not satisfy criterion at all (0 points)

Suggested Steps - 3

3. Develop a set of "weights" for each (of the 6+) group of criteria in terms of how important the group believes these groups are in relation to one another. The weights should be positive and sum to 100.

4. Prepare a "score card" to be used for each project. See next page for a blank example:

Complete criteria would be written out in Col. A
Weights would be assigned in Col. C (yellow)
Qualitative scores would be assigned in Col. D
Quantitative Scores would be assigned in Col. E

Suggested Steps - 4

5. Complete score card for each project:

write in criteria
assign criteria group weights
assign qualitative and quantitative scores to each criteria
calculate weighted scores by criteria group
sum weighted scores by criteria group to obtain total score for each project

6. Use these totals scores to rank projects

7. Follow this procedure once on a trial basis for a sample of projects. If all the projects have the same scores, or are close, revise the criteria, and try again.

Suggested Steps - 5

8. Once you are happy that the criteria are meaningful to discriminate important differences in projects, conduct a preliminary screening to narrow the list down to around 10 projects/concepts.

9. Using the criteria developed, plus additional information on the projects, screen these 10 projects to see if the ranking changes.

10. Narrow the list down to 2-4 projects for detailed assessment, based on a combination of the screening and other information that has come to light.

APPENDIX IV

ENERGY USE IN INDUSTRY: AN OVERVIEW OF PAST EFFICIENCY INITIATIVES IN GHANA

By: Charles N. Anderson, Energy Commission, Accra, Ghana

1. INTRODUCTION

The industrial sector is the most important end-use sector in developing countries in terms of energy use. It accounted for 50% of primary energy use and 53% of associated carbon dioxide emissions in 1995.

In most parts of the world, the industrial sector is extremely diverse, encompassing the extraction of natural resources, conversion of these resources into raw materials , and the manufacture of finished products. Here in Ghana, the sector is composed essentially of manufacturing, mining and quarrying, electricity and water, and construction.

Under manufacturing, one can mention such sub-sectors, which though minor in developed economies, are very significant in our context. Among these are food and beverage production, textile, timber & saw-milling, oil-palm production, etc.

2. GHANA'S INDUSTRIAL VISION

According to Ghana's vision for becoming a middle-income country by the year 2020, the nation's GDP is expected to grow by 36%. Of this, industry is envisaged to contribute about 25%. The manufacturing sub-sector is expected to contribute to industry's share by 8%. If this is to be attained, energy supply to industry must be sustainable, reliable and qualitative while its efficient utilization is imperative.

Granting all these, and considering our experience in energy supply in the country over the past two decades or so, it is pertinent to explore the prospect, possibilities and barriers within which this vision can be attained. Industry must be capable of attaining energy intensities that will make it competitive and meet the expectation of the vision for year 2020.

We need to look at the past performance of industry within the context of energy supply and efficiency of energy use. For this purpose, we take a look at industry's limitations to practicing effective energy efficiency activities within the past two decades.

In most developed and transition economies, the predominant issues that drive industrial energy efficiency activities have tended to be more of technology - sensitive motivation: Research and Development results in advancement in technology in the end -use. Cost savings thus become a by-product of advancement in technology.

Here in Ghana, our initiatives to improve energy efficiency in industry have been pre-empted very often by supply -sensitive and energy cost-saving motivations.

In the early 80's Ghana was spending over 40% of its foreign exchange earnings on crude oil importation alone. Coupled with this was the shortfalls in electricity supply as a result of erratic rainfall patterns which affected the Volta lake reserves. Akosombo and Kpong were essentially the sole source of electricity supply in the country. One could not also ignore the oil embargo placed on the nation by Nigeria, our predominant supplier at the time.

The table below indicates the consumption of the major energy types by industry. These are petroleum, electricity and wood fuels, as depicted in the following table

Table 1: Industrial Energy Consumption, (1000xtoe), 1981 –1997

Year	Petroleum Products	Electricity	Wood fuels	Total
1981	19.52	339.42	233.43	652.37
1982	73.19	307.36	239.58	620.13
1983	37.33	111.15	245.73	394.21
1984	156.26	39.40	245.00	440.66
1985	157.15	124.53	251.37	533.05
1986	167.3	236.09	257.91	661.33
1987	161.62	270.72	264.61	696.95
1988	166.84	297.44	271.49	735.78
1989	206.88	303.28	278.55	788.71
1990	145.56	305.97	285.79	737.33
1991	167.78	319.40	293.22	780.41
1992	206.50	332.40	300.85	839.75
1993	215.96	341.25	308.67	865.07
1994	242.59	308.79	316.69	868.07
1995	258.99	316.67	324.93	900.59
1996	280.03	330.82	333.38	944.23
1997	280.59	308.79	342.04	931.43

Source: Ministry of Mines &Energy

Industrial electricity consumption declined from 339.42toe in 1981 to 111.15toe in 1983. This was followed by a sharp drop to the lowest ever ebb of 39.4toe in 1984. This decline was not due to the effect of any conservation or efficiency measures by industry, but rather due to acute short falls in supply. Electricity consumption thereafter picked up from 1985 with 124.53toe and increased steadily to 341.25toe maximum in 1993.

Even though petroleum supply to industry was some how erratic between 1981 and 1983 during the period consumption dropped from 19.52toe to 37.33toe. Wood fuel consumption however increased consistently from estimated 233.43toe to 342.04toe in 1997.

Within the same period, the share of industry in the real GDP growth declined persistently from 15.2% in 1981 to 11.3% in 1983 and then to11.6% in 1984. At the same time the contribution of manufacturing (which is the most significant sub-sector in industry) to the share of industry declined from 10.9% in 1981 to 6.9% in 1983.

Table 2: **Share of industry & sub-sectors in Real GDP, % (1981- 1999)**

Year	Industry	Manufacturing	Mining & quarrying	Electr. & Water	Construction
1981	15.2	10.9	1.0	1.0	2.1
1982	12.6	7.4	1.2	0.9	3.0
1983	11.3	6.9	1.1	0.6	2.7
1984	11.6	7.2	1.1	0.8	2.6
1985	13.0	8.5	1.2	0.9	2.5
1986	13.3	9.0	1.1	1.0	2.3
1987	14.1	9.4	1.1	1.1	2.6
1988	14.4	9.4	1.2	1.2	2.6
1989	14.0	9.0	1.3	1.2	2.6
1990	14.5	9.2	1.3	1.3	2.7
1991	14.3	8.8	1.3	1.4	2.8
1992	14.6	8.7	1.4	1.5	3.0
1993	**14.5**	**8.5**	1.5	1.5	3.0
1994	14.3	8.3	1.5	1.6	3.0
1995	14.2	8.3	1.5	1.6	2.9
1996	14.2	8.1	1.5	1.6	3.1
1997	14.8	8.4	1.6	1.7	3.1
1998	14.5	8.3	1.6	1.5	3.1
1999	14.6	8.3	1.6	1.5	3.2

3. PAST EFFICIENCY INITIATIVES- AN OVERVIEW

3.1 Any discussion on current energy efficiency levels in industry would necessarily have to examine where we have come from.

As a result of the global oil crisis that shook the world in the early 70's and 80's, Ghana was spending over 40% of its foreign exchange earnings on the importation of petroleum. Coupled with this were the shortfalls in electricity generation experienced by the country because of erratic rainfall in the Volta basin.

Despite these predicaments, the nation's energy consumption was expected to increase considerably. Indeed the demand for electrical energy was estimated to grow at an average rate of 13% generally, while industrial electricity demand was increasing at an average of 3.5% per annum.
Two options were available for meeting the anticipated growth in petroleum products and electricity demand:

- *Either increase the importation of petroleum and install additional power generation capacities, with its adverse implications on the then already precarious state foreign exchange earnings; or*
- *Postpone the need for major capacity additions by improving and adopting measures that increase the productivity and efficiency of petroleum and electricity usage.*

This situation pre-empted the erstwhile National Energy Board, NEB, to embark on the National Energy Conservation Programme in 1987.

The initiatives started with an NEB/ ESMAP/UNTCD mission in February 1987, which undertook a preliminary assessment of the potential for industrial energy conservation activities in Ghana. This was the first ever national effort to assess the energy performance of the industrial sector.

3.2 The objectives

The overall goal of this phase was to establish the potential for energy conservation in Ghana, and to draw up strategies for further activities.

3.3. Findings

The mission firmly established that

- ***the potential for energy efficiency and conservation activities in Ghanaian industry was considerable,***
- ***there was complete lack of awareness among plant operators of energy conservation measures***
- ***top management in most firms had little or no interest in the concept of energy conservation***
- ***very limited data, or none at all, existed on energy use in nearly all industrial establishments visited***

3.4. Recommendations

The mission recommended a comprehensive programme of energy efficiency and conservation activities, to be targeted at industry, commerce and households.

3.5. Energy conservation & efficiency in Industry: A first step

3.5.1 The activity started in 1988 with a baseline study of energy performance of industry. This which covered a cross-section of industrial establishments in the country, including the mines, food and beverage industries, textile firms, timber processing firms, oil palm industries, metal industries etc.

The study established the following scenarios in the three most energy-intensive industries in the country. The study however covered about 24 major and small industries in the country.

Studies conducted at the Valco Aluminum plant in Tema in 1988 produced the following summaries:

Table 3: Energy use at Valco, 1988

Type of Energy	% of Total energy used	Major end-user equipment
1. Electricity	94	Pot lines, motors, lighting
2. RFO	5.2	Boilers, Kilns, furnaces
3. Diesel, gasoline	0.4	Vehicles
4. LPG	0.036	Workshops

Table 4a: Examples of in-efficient use of electricity at Valco, 1988

	Motors & ratings (HP)	Quantity	Status
(a). Compressors	600	2	Normal load and operating voltage
	900	3	14% overloading, 6.3% overvoltage
	1250	1	Normal load and operating voltages
(b). Vacuum pumps	400	4	Normal loading, 25.4% overvoltage on 2
			Normal loading, 6.3% over-voltage on 2
(c). Fume control exhaust fans	400	10	2.4% overloading, 23.8% overvoltage on 1; Normal loading, 23.8% over-voltage on 4 Under-loading, 4.8% overvoltage on 2 Normal on 3
4. Ball Mills	400	2	Normal, no over-voltage

Average Plant Power Factor (Pf) = 83%

3.5.2 Comments

Overloading exists on several of the motors. This could be due to the elevated voltages at which motors were made to run.
Over-voltage of ~6% may be permissible; 20% or more when continuously imposed on the motors could damage insulation
Over 20% over-voltage could also increase magnetizing currents and thus increase core losses.

Table 4b: Examples of in-efficient use of electricity at Valco, 1988 - BOILERS

1. Type	Water tube
2. Year installed	1965
3. Fuel	RFO
4. Operating Pressure	175psig
5. Rating	11000lb/hr of steam
6. Efficiency	40 - 44%
7. Steam distribution losses	210lb/hr (1.7%)
8. Savings at 80% boiler efficiency	104,000gallons RFO/yr.

Energy intensities (toe/ton of product mix)

	1986	1987	1988
	1.546	1.569	1.623
Increases - Based on 1986		0.023	0.077

3.5.3 Remarks

The increases in intensities could amount to as much as 140,000 TOE extra energy intake for the total plant production by the end of 1988.
At 94% of toe due electricity, this would amount to over 117827.9MWh.

3.5.4 Major options for efficiency improvements.

i. Systematically turning off equipment & lights when not in use
ii. scheduling energy-intensive activities - load shifting from peak to off-peak periods
iii. proper insulation of tanks, process steam pipes, etc.
iv. repairing leakage
v. regular maintenance of equipment
vi. motor drive system improvements - use of high efficiency motors, use of adjustable speed drives
vii. improved steam production, distribution and management scheme - use of more efficient boilers, fuel switching, use of economizers and improved heat recovery systems

Energy Use at Tema SteelWorks (Gihoc Steelworks)

Table 5a: Melting Shop

Principal products: Melting shop	1986	1987	1988	
Tonnage of scraps consumed	6187.09	3935.4	1486	
Total effective tonnage obtained	5260.69	3146.21	1158.33	
Total steel tonnage recycled	476.32	348.19	114.59	
Yield (%)	85	80	78	
Total electricity consumed (x 1000 kWh)	1708.71	1687.79	1401.80	

Table 5b: Rolling Mills

	1986	1987	1988
Total weight of rolled ingots (tons)	5135.96	3166.9	1227.49
Total weight of ingots lost in process (tons)	2130.92	1065.98	331.54
Tonnage of finished bars	2878.71	2171.48	896.49
Percent yield (%)	56	69	73
Electricity consumed x1000kWh	519.32	268.58	
Electricity consumed per ton of rolled steel kWh/ton	180.4	123.7	
Total electricity consumption of finished steel x 1000Kwh	2187.52	1966.94	
Specific electricity consumption (kWh/ton)	759.9	905.81	

Table 5c: Energy Uses

	1986	1987	1988
Petroleum Products			
LPG (in lb)			
Gasoline			
Diesel			
Residual Fuel oil (RFO) gallons	375000	292000	65000
Lighting electricity consumption, x1000kWh	332	332	165.8
Melting Furnaces x1000kWh	1709.71	1687.79	--
Rolling Mill x1000kWh	519.32	368.56	-
Others x1000kWh	770.68	723..39	
LPG consumed per ton of finished steel lb/ton	9.71	6.14	9.36
Inland fuel oil/ton of steel (gal/ton)	124.67	110.98	92.03
Diesel / ton of finished steel (gal/ton)	9.11	10.1	9.11

This picture existed among the wide spectrum of industrial manufacturing sub-sectors during the period. Consequently a wide range of assistance was provide to industry to enable it improve upon the efficiency of energy use at the plant level.

3.5.5 Further activities

The second step involved training of 40 Ghanaian professionals drawn from industry, research institutes, the universities and consultants. The training focused on methods for analyzing industrial energy consumption, and the practical application of the techniques for identification and implementation of energy conservation measures.

3.5.5.1. Objectives

The policy objectives underlining the energy conservation programme were:

a. to promote greater energy conservation awareness among all consumers;
b. to facilitate the achievement savings in per capita energy consumption in all areas of energy use;
c. to develop Ghanaian capabilities for the identification and implementation of energy conservation measures especially in industry
d. to develop the institutional capability and implementation strategies required for the realization of the potential efficiency improvements.

As part of the training, participants undertook energy surveys/audits of 24 medium to large scale industries. These efforts highlighted several areas for energy conservation, including process heat management, power factor improvement, load management, etc.

Recommendations for measures to improve energy consumption and effect savings were made to each firm according specific findings. Most of the measures were of good housekeeping type, and did not involve any capital expenditure. A few required very low investments to undertake retrofitting that could effect the necessary savings with very low pay back period.

A third industrial energy conservation activity was sponsored in 1989 by CIDA. This involved a more advanced training for 10 Ghanaians in detailed audits in 3 industrial firms.

3.5.5.2 Project assessment

Follow-up assessments were carried out in all the firms that benefited from the energy audits carried out in the previous exercise. This was to determine the level of implementation of recommendations made from the audits.

It was found out though some companies had implemented some energy efficiency measures and achieved significant energy savings, there were some major constraints that limited the total implementation of energy conservation measures in Ghanaian enterprises. These include

(a) the lack of awareness on the part of plant owners, managers and technical personnel, about specific options to improve energy efficiency;

(b) the lack of local expertise to assist the industries to identify, evaluate the cost effectiveness of, and implement measures to improve energy efficiency;

(c) the inadequacy of existing framework of fiscal and financial incentives to support energy efficiency improvement schemes such as retrofit measures; and

(d) the lack of awareness of and access to energy efficiency equipment on the part of local equipment suppliers.

Other causes of low patronage of energy conservation were:

a) low entrepreneurial capabilities of local Energy Services Companies

b) ***lack of knowledge of specific problem areas that needs urgent attention and the solution of which could yield immediate results.***

c) ***lack of codes, standards and guides on energy efficiency.***

In addition, it was realized that those local companies that had demonstrated some appreciable level of energy management capacities as a result of the programme, and had put in place energy management schemes on their own, required further assistance to improve their capabilities to exploit the full potential for improving energy efficiency.

The bulk of Ghanaian firms, however, had little or no energy management skills. Lack of adequate internal energy management capability in local firms prevented local industrial/commercial managers from making sound and informed judgement on energy efficiency investments. This threatened to undermine any efforts to eliminate other financial and technical constraints.

The need to introduce effective energy management tools and techniques to these industries prompted the Ministry to outline fresh initiatives to enhance efforts at improving energy efficiency in all sectors of the economy. These initiatives include the following:

3.5.6 Electricity demand management programme

To address the concerns mentioned above, the MOME collaborated with ESMAP to design the Electricity Demand Management Component of the Ghana Thermal Power Project which sought to address specific areas of industrial energy conservation with special emphasis on electricity. Components of this programme are given below.

3.5.6.1 Power factor improvement project

In 1993-1994, the MOME carried out a survey in industry which identified the widespread

- low power factor and
- poor load management
- poor conditions of electric motors and motor repair facilities.

as some of the causes of inefficient energy use in industry.

The survey confirmed the reported trends of electricity waste and identified the equipment needs of specific plants to improve **power factor and institute load management measures.**

Based on these findings over 400 Special Load Tariff (SLT) electricity consumers, mainly industrial consumers, were assisted to conduct surveys to determine electrical system performance and to determine size of capacitors required to correct power factor to a minimum of 0.98. It was estimated that about **38MVA** would be freed into the system if all plants involved did correct their power factor to this level.

3.5.6.2 Electrical demand load management pilot scheme

This was another scheme that was initiated to improve the efficiency of the electrical system. It was mainly concerned with shifting of load from peak to off-peak periods.

3.5.6.3 The project objectives.

The project started with an initial survey of selected candidate firms. The basis for selection of candidate firms was that the firm/consumer should be operating round the clock and must have a maximum demand of not less than 0.5MVA.
The objectives of the activity were:

- identify opportunities to control electricity demand
- reduce electrical energy consumption at minimum cost
- examine the feasibility of shifting electrical loads from peak to off- peak periods.

3.5.6.4 Scope of work

A number of industrial firms which satisfied the set criteria were covered. Large industrial/commercial consumers were considered more appropriate targets for alleviating load shedding at peak.

The results established the following conditions at the following plants, among others:

Table 6: Energy intensities of selected firms

Name of company	Annual Production	Annual energy consumption (kWh)	Energy Intensity
Wahome Steel	60,000 tons	48,415,200	806.92kWh/ton
Tema Steel Ltd	33,492 tons	36,762,180	1097.64kWh/ton
Ferro Fabrik Ltd.	30,000 tons	27,014,268	900.46kWh/ton
Aluworks Ltd.	25,000 tons	10,896,900	435.96kWh/ton
Kumasi Brewery Ltd.	225,313 hectoliters	4,104,686	18.21kWh/hectoliter
Guinness Ltd.	295,000 hectoliters	6,590,857	22.34
Accra Brewery	220,000	18,708,857	85.04
ABC Brewery	146,005	2,920,270	20.0
Tropical Glass Ltd.	7300tons	16,050,600	2198.71kWh/ton
Ghana Australia Goldfields (surface) SAG mill	4,516,819 metric tons	50,365,296	11.15kWh/ton
Teberebie (east & West) Goldfields (Heap Leah) surface	7,549,425	43,841,500	5.8kWh/ton
Barnex (Prestea) Ltd. (underground) sag mill	231,909	62,449,387	269.28kW/ton
Goldfields (Gh) Ltd underground	240,413	45,084,720	187.53kWh/ton
Amansie Resources Surfacce mining- SAG	1,029,794	22,437,071	21.78kWh/ton

mill			
Bogoso Goldfields surface –SAG mill	**1,908,505**	**37,099,080**	**19.44 kWh/ton**
Abosso Goldfields – surface/SAG mill	**3,650,000**	**78,117,000**	**21.40 kWh/ton**
Ghana manganse Co. Nsuta	**656,000**	**7,055,800**	**10.75 kWh/ton**
GTP –Tema (no spinning & weaving)	**14,000,000 meters**	**4,811,743**	**343.69kWh/1000 meters**
GTMC- including spinning & weaving)	**6,000,000 meters**	**9,161,500**	**1526.9kWh/1000 meters**
Ghana Cement Works – Tema	**1,057,397**	**35,634,428**	**33kWh/ton**
Ghana Cement Works – Takoradi	**700,000tons**	**25,377,928**	**36kWh/ton**
Scanstyle Ltd Mim (sawmill & Furniture)	**24,000 cubic meters**	**4,124,500**	**172kWh/cu-meter**
AG Timbers	**63,000 cubic meters**	**4,482,011**	**71kWh/m^3**
Bondplex Ltd Kumasi (plywood)	**61,000 cubic meters**	**4,912,952**	**80kWh/m^3**
Takoradi Flour Mill	**70,000 tons**	**2,930,428**	**41.86kWh/ton**
Irani Brothers (Flour Mill) Tema	**117,049 tons**	**6,660,367**	**56.90kWh/ton**
Interplast (PVC pipes)	**3100 tons**	**2,572,825**	**829.94kWh/ton**

The study also established that by shifting loads from peak to off-peak periods, the potential of reducing system peak demand amounted to over 26.6MVA. The energy savings amounted to 1786MWh. This is illustrated in the table below:

Table 7: Potential savings from load shifting

Plant	Peak Power savings	
	Demand (MVA)	Energy (MWh)
Wahome	9.560	607
Aluworks	1.440	59
Ghacem –Tema	4.877	458
GTMC-Tema	0.800	31
GTP	0.200	16
Accra Brewery	3.44	100
Interplast – Accra	0.200	20
Ghacem – Takoradi	3.865	350
Takoradi Flour Mill	1.171	50

Guinness Ltd. Kumasi	0.500	55
Kumasi Brewery	0.300	30
Scanstyle	0.220	10
Total	**26.577**	**1786**

Table 8: Ghana, some energy consumption indicators.

Population (million)	18.5	GDP (billion US$)	8.27
Total primary energy supply (mtoe)	7.3	Elect. Consumption (TWh)	7.69
Total primary energy supply/population (toe/capita)	0.39	Total primary energy supply/GDP (toe per 100 US$)	0.88
Elect. Cons./population (Kwh/capita)	416.6	Elect. Cons. /GDP (kWh/$)	0.93

Table 9: Sources of energy and projected demand

Current electricity supply & potential for the future **Source**	**Present capacity (MW)**	**Projected Demand 2010 (MW)**
Hydro	1072	1200
Thermal	550	1600
Solar	Negligible	100
Wind	0	100
Biomass	Negligible	100
Nuclear	0	400

Current energy supply situation

VRA energy supply		8000GWh/yr
Akosombo contribution		61%
Kpong	contribution:	13%
Balance:	Thermal	

Hence,
6000GWH of energy supply is from Hydro source
2000GWh is from thermal which uses Light Crude Oil (LCO) as fuel

3.6 Lessons Learned

3.6.1 Lease financing scheme failed

Most firms which signed on for the lease scheme later decided to outright purchases since they computed that to be cheaper in the long run. Secondly two firms which remained with the scheme defaulted in the monthly payment for close to a year. One significant contributing factor to this state of affairs was that Leasafric, the leasing firm refused to undertake plant visits or monitoring. This they claimed increased their overhead costs and therefore made the scheme unprofitable to Leasafric.

3.6.2 Lack of upfront investment capabilities

Many firms complained of lack of finances for an up-front investment. A number of contacts were established with the Banking institutions. These however could not help as the Banks felt uneasy with the concept cost recovery through energy savings.

3.6.3 M & T meters did not work

Most of the firms which were involved with the M & T project fizzled out because among other operational difficulties, most of the metering did not work after some time, or were just not the right specification. Other reasons include the capacity for data analysis required for the monitoring and targeting exercise did not exist with the host plants. The bureau service center established at the Ministry of Energy ceased to exist after the unit was transferred to the Energy Foundation.

3.6.4 Most firms were indifferent

As a result of the effects of (b) many firms were indifferent to the concept of energy conservation, even at the top management level.

3.6.5 Electricity tariff was a disincentive.

ECG tariff structure did not provide any incentive for conservation initiatives at the plant level. Tariffs for a long time remained very low. Firms found the investment required in some conservation initiatives as not being worthwhile compared to the savings computed at the time.

APPENDIX V

TECHNOLOGY TRANSFER
(PART I)

A
PREVIEW
OF
THE STEEL AND ALUMINIUM SECTORS

By: Dr. Joseph K. D. Annan
P. O. Box CT 5277
Cantonments
Accra-Ghana
e-mail: j_annan@hotmail.com

Monday, 14th May, 2001

1. INTRODUCTION

It is reckoned that biotechnology and information technology are those technologies that most probably will show the most dramatic development in the next century.

Significant technical progress is expected across a broad spectrum of technologies, e.g. new raw materials, in particular miniaturisation and smart composites, energy, transportation, and environmental preservation.

What significance will the steel and aluminium industries, especially the material steel, have in the next century? Obviously new technologies will show the fastest speed of development, but it should be realised that as in the past and present, and in future, the basic human requirements should firstly be met such as:-

1. food
2. clothing
3. housing
4. heating (at least in cooler regions)
5. transportation of commodities to expected destinations
6. health
7. information

Associating the appropriate industrial sectors with these basic requirements will result in the following:-

(i) agricultural technology, food processing and preserving; kitchen technology
(ii) textile industry
(iii) construction
(iv) power generation and distribution
(v) transportation and traffic
(vi) medical technology, pharmaceutical industry
(vii) media industry in a broad sense.

The current challenge is the **sustainable development of human society.**

The target is how to attain maximum efficiency in the use of energy, with **zero waste** for disposal from each process!
Advanced technology is essential for sustainable development and **an information network system** to guarantee maximum efficiency is required to realise each target.
The concept of **global sustainability** cannot be overlooked in evaluating and assessing individual processes, materials, and products.

Steel and aluminium cannot be ignored in the 21st century, and steel will remain the basic material in the field of infrastructure, transportation, traffic, power generation, and mechanical engineering.

How are developing countries keeping pace with this global phenomenon in the effort to realise their objectives and priorities?

It is necessary to enhance methodological, technical, process, and institutional capacities thereby helping to :-

(i) **identify and implement a strategy to remove barriers to the transfer of climate-friendly industrial technologies;**
(ii) develop and monitor industrial projects;
(iii) increase the flows of climate-friendly industrial technology; and
(iv) absorb and manage the technologies to be transferred.

It is within this context that one should relate the regionalisation effort in Africa to the global phenomenon.

2. GLOBALISATION VRS REGIONALISATION

Globalisation has become a central theme on the agenda of many executive meetings, with frequent news of spectacular company mergers.
The automotive and chemical industries, insurance companies and financial institutions are currently taking the lead in this trend.
In the meantime, this trend has also taken hold of the steel and aluminium industries.
More and more companies have established international business links.

Global networking is on a fast upward track but the adaptation of economic policies is lagging far behind this changing environment.
The prevalence of peace is essential to enable the networking of economies to prosper, but wherever conflicts escalate to the point of war, glogalisation will come to a standstill.
Globalisation will lead to a sort of worldwide standardisation and uniformity of products.

Regionalisation could very well be a deliberate countermove to globalisation – however, at a cultural and not an economic level.

The main challenge for both industrial and developing countries is globalisation.
The challenge of regionalisation, though significant, is subordinate to the challenge of globalisation.
The importance of foreign direct investment and inter-firm tie-ups points to the importance of policies to attract such investment, but it also points to a danger of excessive competition among governments seeking to attract it.

Regionalisation can work to strengthen the effectiveness and credibility of the state and of economic policies in general, which are required for attaining political stability, macroeconomic stability, and investment growth.
Given the uncertain outcome of regional trade arrangements and given the need for improved international competitiveness due to ongoing globalisation, it may seem

advisable to promote those policies at a national level which might help to enhance integration into both regional and world markets.
The priorities of such policies are:-
(i) the development of infrastructure at the national regional level; and
(ii) human capital formation.

Presumably the greatest competition between nations, in terms of bidding for a larger share of mobile resources, occurs in the context of the competition among successful multinational enterprises for managerial and technological skills, including the competition for the talents of highly skilled professionals. Therefore **human capital development** should be a priority on the policy agenda.

Given the importance of foreign direct investment as a driving force of both regional and global integration, there is an urgent need to ensure a **fair international competitive environment**, in particular with regard to foreign direct investment.

Other proposals aim at the negotiation of multilateral rules on foreign direct investment in the framework of international organisations with global membership, e.g. World Trade Organisation (WTO).

The further development of regional and international rules on foreign direct investment needs to consider at least the following key issues:-

- investment measures that affect entry and operations by foreign investors, particularly
  relating to admission and establishment, ownership and control, operations, incentives, and investment-related measures;
- application of certain standards of treatment , particularly national treatment, most-favoured-nation treatment, and fair and equitable treatment;
- measures dealing with broader concerns, including the proper functioning of the market, particularly related to restrictive business practices, transfer pricing, transfer of technology, employment, the environment, and illicit payments;
- investment protection and the settlement of disputes, relating to expropriations and property taking in general, abrogation of state contracts with investors, transfer of funds, and dispute settlements.

3. STEEL

3.1 Global Demand

Table 1. Steel Consumption – Analysis and Forecast (1995 – 2005)

Million tonnes						
	1995	1998	1999	2000	2005	1995-2005 % p. a.
PR China	87.4	113.9	125.0	130	140	+4.8
Japan	80	70.3	68.3	67.2	70	-1.3
(Korea)	-	(24.9)	(32.1)	(34.6)	-	
Other Asia	117.2			114.2	128	+0.9
Total Asia	**284.6**	**285.2**	**302.5**	**311.4**	**345**	+1.9
Nafta	116.9	143.0	134.6	135.8	140	+1.8
(USA)	-	(117.4)	(108.8)	-	-	
(Brazil)	-	(14.5)	(14.4)	-	-	
S. America Total	23.4	27.6	26.8	29	33	+3.5
EU(15)	127.1	137.0	134.6	139.1	142	+1.1
Other Europe	31.6	35.1	35.4	37.5	40	+2.4
CIS	36.3	29.6	30.5	31.3	33	-1.0
Oceania	6.6	6.7	6.5	6.5	7	+0.6
Africa	13.7	15.5	14.0	14.2	15	+0.9
Middle East	12.7	13.6	13.9	14.2	15	+1.7
World Total	**652.9**	**693.3**	**698.8**	**719**	**770**	**+1.6**

Table 1. gives an analysis and forecast of steel consumption. A 1.6%/year growth rate is forecast for the decade from 1995 – 2005.

A world total consumption of around 770 million tons in 2005, about 51million tons above the year 2000 figure, and 117 million tons higher than consumption ten years earlier.

3.2 Future trends in EAF steel making technology

Focus will be on safety issues, recycling aspects, and the sustainability of steel.

By the year 2010 it is reckoned that electric steel making will account for 40% of world crude steel output. The current figure is 33%.
This corresponds to a rise of 2% /year which is double the growth rate of total world crude steel output.

Table 2. shows the energy of production from ore and scrap respectively of steel and aluminium.

Table 2. Energy of Production from Ore and Scrap of Steel and Aluminium

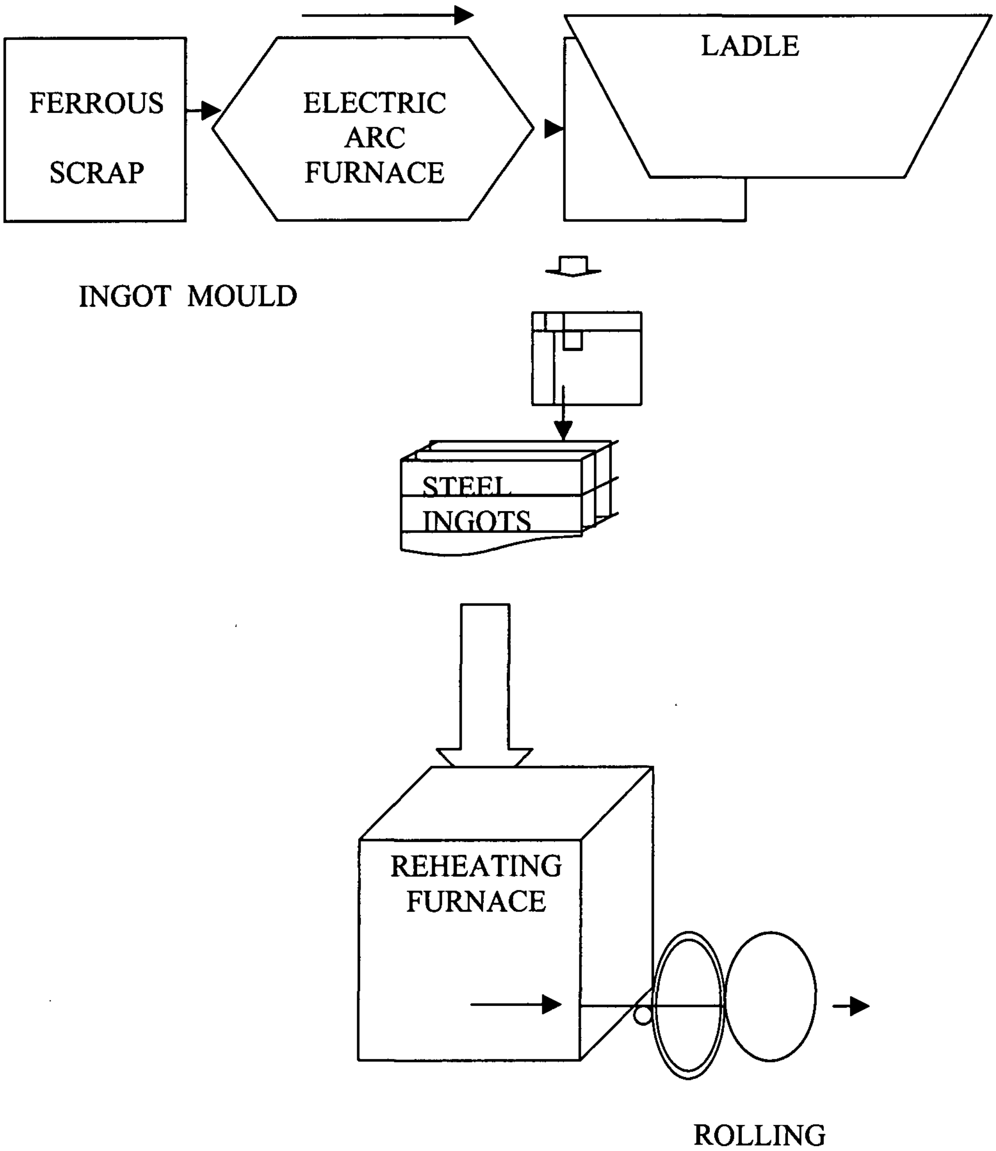
Metal	Density (g/cm3)	Specific Strength (kg/mm2)	Energy from Ore (MJ/kg)	Energy from Scrap (MJ/kg)	World Consumption (Mt/y)
Steel	7.9	6	25 (6,944.5 kwh/t)	8 (2,222.2 kwh/t)	720
Aluminium	2.7	7	220 (61,111.6 kwh/t)	6.7 (1,861.1 kwh/t)	17

Thus electric steel making will be one of the fastest evolving metallurgical technologies.

Scrap will remain the most important charge material for electric steel making.

EAF operational data will continue to improve. Electrical power consumption will go down from currently 390 kwh/t to 360 kwh/t at typical coal and oxygen injection rates of 23 kg/t and 40m3 respectively. Tap-tap times will drop from 68 minutes to 58 minutes, and power-on times to 45 minutes.
As far as environmental issues are concerned, it is expected that carbon dioxide emissions will reduce, dust emissions will decrease and both dust and slag will be reused.

Figure 1. TYPICAL SCHEMATIC PROCESS FLOW DIAGRAM OF A LOCAL STEEL PLANT



The process involves scrap preparation and charging into an Electric Arc Furnace (EAF).

The furnace consists of a tilting cylindrical bowl-shaped hearth with 3 graphite electrodes inserted vertically through the roof.
Three-phase supply is connected to the electrodes via a transformer.
The furnace is charged from the top by using a swing-type roof.

An arc is struck between the charge and the electrodes to supply energy. The temperature of the arc is about 3400°C (6152°F). It is possible to operate the furnace under oxidising, reducing, or neutral conditions, thus making it very suitable for the production of high-grade steels.

The furnace can be tilted to tap molten steel and remove slag.

Steel making techniques have been developed for continuous charging of pre-reduced sponge as a substitute for scrap steel.
Molten steel is **tapped** from the furnace into a ladle. The molten steel is then **teemed** into moulds to form ingots.
The steel ingots are then processed by rolling to produce various sizes of steel products.

Alternately, molten steel from the Electric Arc Furnace is sent directly to a Continuous Casting Section for rolling into various products.

4. ALUMINIUM

4.1 Commercial Production

The commercial electrolytic plants of today are based on the process that was simultaneously discovered by Hall and Heroult.

Cryolite is used to dissolve the alumina in the process. It is a snow-white, translucent, sodium-aluminium-fluoride mineral compound found only in Greenland.

A method of producing synthetic cryolite has been developed.
Held at about 980°C (1796°F), the molten cryolite dissolves up to about 20% of alumina readily.

Modern reduction plants may contain up to eight lines of electrolytic - "pot lines".
Each pot line may contain 100 or more cells of 50,000 – 150,000 A each, operating at only 4.0 – 5.5 V.

There are two basic types of cell – the **Soderberg** and the **prebake**.

The Soderberg cell is equipped with a self-baking anode into the top of which a carbon paste made of coal tar pitch and petroleum coke is fed at regular intervals.

The anode of the prebake consists of a number of suspended baked carbon blocks which are replaced with new blocks at regular intervals.

4.2 Global Demand

4.2.1 The Source And Use Of The Energy Consumed

Table 3. The sources of energy to produce a tonne of molten aluminium from alumina

Source of energy	Energy consumed per tonne of molten alumimium produced (GJ/tonne)
Electricity	209.0 (58,056.0 kwh/tonne)
Gas	0.9 (250.0 kwh/tonne)
LPG	2.9 (805.6 kwh/tonne)
Fuel oils	0.3 (83.3 kwh/tonne)
Motor spirits	0.1 (27.8 kwh/tonne)
Coal tar pitch	4.9 (1,361.1 kwh/tonne)
Petroleum coke	14.6 (4,055.6 kwh/tonne)
Carbon material for manufacture of the Cathode	0.1 (27.8 kwh/tonne)
Total	**232.8 (64,667.1 kwh/tonne)**

Table 4. The way the energy is used to produce a tonne of molten aluminium from alumina

Use of energy	Energy consumed per tonne of molten aluminium produced (GJ/tonne)
For the electrolytic process	198 (55,000.4 kwh/tonne)
For the calorific value of consumed carbon anode	20 (5,555.6 kwh/tonne)
For baking the carbon anode	3 (833.3 kwh/tonne)
For fume treatment (environmental)	10 (2,777.8 kwh/tonne)
For the manufacture of the cathode, mixing and shaping the anode materials, and other uses	1 (277.8 kwh/tonne)
Total	**232 (64,445 kwh/tonne)**

Table 5. A typical breakdown of voltage for a cell that consumes 16,200 kwh/tonne of molten aluminium and operates at 86.5% current efficiency

	Volts/cell	Equivalent kwh/tonne (86.5% current efficiency)
Across the anode (anode drop)	0.41	1414
Across the cathode (cathode drop)	0.46	1586
Across the electrolyte (bath drop)	1.87	6445
Due to the anode effects*	0.17	586
Across the conductors between the cells	0.10	344
Conductor runs by-passing out of circuit and to the rectifiers	0.02	68
	3.03	**10,443**
Effective electrolysis potential	1.67	5,757
Total	**4.70**	**16,200**

- The anode effect is a temporary voltage rise which occurs when the alumina in solution falls to a level at which fluorine in the electrolyte is released and reacts with the anode carbon to form a film of gas on the anode face. The increase in resistance causes the voltage to rise by about 25 volts or more. The cell is fed with fresh alumina and the voltage returned to normal as quickly as possible.

4.3 The Factors Affecting Electrical Energy Efficiency

The Soderberg cell has gone out of favour in the industry because it is difficult to collect the pitch and fluoride fumes that are emitted from it.
The prebake cell does not emit pitch fume. It lends itself to hooding which enables the fluoride fume to be easily collected for treatment and recovery of the fluorides. Currently, in most countries, there are environmental regulations either existing or are being considered that would induce a company to choose the **centre-break prebake cell** for a proposed new smelter. The extent of research and development that has been investedin this type of cell makes it a preferred choice.

4.4 The effect of current density and current rating

The higher the current rating of a cell the smaller the number of cells required to produce a given output and consequently the smaller the capital and operating costs.

The current density of cells in countries where energy is more expensive is less than in countries where energy is cheaper.

4.4.1 The effect of bath voltage and current efficiency

At the same current densities, second generation cells have a higher current efficiency.

4.5 The anode/cathode gap

4.5.1 Feasible improvements to the energy efficiency of existing smelter

Improvements with existing designs of cell

1. *Control techniques.* The anode/cathode gap of the cells of most modern smelters is
   controlled by digital computer, either centrally or distributed with microprocessors.
   By this means the anode can be kept at the compromise level above the molten-metal cathode. Also the anode effect voltage can be returned to normal much more quickly
   by computer control.
2. *Anode quality.* This can easily make a difference of 2% or more in current efficiency.
3. *Cathode quality.* Quality and care with which it is assembled is important. The distribution of current from end to end of the cathode must be even to minimise horizontal currents in the molten metal.
4. *Alumina quality.* Variations in alumina quality particularly with respect to its particle size distribution and its level of calcination, can produce operating problems
   that will cause a reduction in energy efficiency from which it may take weeks to recover. A smelter receiving alumina from several sources is at a disadvantage compared with a smelter with only one source. Operating techniques can be adapted to cope with most reduction alumina qualities but they cannot cope readily with **sudden** alumina quality changes.

- **Improvement to the design of cells**
- **Improvements in the electrolyte**
- **Future Improvements**
- **Improvements to existing smelters**
- **Other Electrolytic use in future**

4.6 Local Production and Energy Consumption Trends

Table 6. Analysis of Annual Production and Power Consumption of Volta Aluminium Company (VALCO) – 1987 to 2000

Year	Annual Output (metric tonnes)	Annual Power Consumption (kwh)	kwh per tonne
2000	147,078	2,504,761,248	17,030.2
1999	110,668	1,928,331,264	17,424.5
1998	55,446	926,655,456	16,712.8
1997	149,995	2,466,638,940	16,444.8
1996	135,725	2,212,421,312	16,300.8
1995	133,984	2,197,579,792	16,401.8
1994	139,091	2,275,446,528	16,359.4
1993	176,135	2,821,876,664	16,021.1
1992	179,022	2,853,642,692	15,839.6
1991	168,637	2,795,159,000	16,575.0
1990	171,359	2,788,500,000	16,272.9
1989	166,749		
1988	161,032		
1987	150,381		

** Compare kwh/tonne values of VALCO to 16,200 kwh/tonne of Table 5.

APPENDIX VI

THIRD MEETING ON THE IMPLEMENTATION OF THE UNIDO-EPA CDM PROJECT ON "DEVELOPING NATIONAL CAPACITIES TO IMPLEMENT CDM IN SELECTED NUMBER OF COUNTRIES IN AFRICA: PREPARATORY ASSISTANCE".

WEDNESDAY 27 JUNE 2001

The fourth stakeholder meeting on the above-mentioned project took place on Wednesday 27 June 2001 at the EPA Conference Room.

3 Present

1.	Mr. D.S Amlalo	In chair
2.	Mr. E. Mc-Addy	Member
3.	Mr. Emmanuel K. A Dickson	"
4.	Mrs. M Ahiadeke	"
5.	Dr. H. Mensah Brown	"
6.	Dr. Joseph Annan	"
7.	Mrs. Patience Damptey	"
8.	Mr. Emmanuel Mensah	"
9.	Mr. Isaah Nikabs	"
10.	Mr. Ben Treveh	"
11.	Humie Annie-Seini	

4 Absent With Apologies

1. Dr. P C Acquah
2. Mr. I. C Acquah
3. Mr. E. Ahiable
4. Mr. W. K Agyemang-Bonsu
5. Mr. Emmanuel Mensah
6. Mr. N. Anderson
7. Mrs. M. Ahiadeke

5 Opening

The meeting commenced at 0930 hours and was chaired by Mr. D. S Amlalo on behalf of the Executive Director.

4.0 Members made presentations on their respective themes followed by discussions. The presentations are attached.

5.0 Categorisation of identified barriers and removal strategies by all stakeholders.

Barriers and Removal Strategies identified are as follows:-

Identified Barriers	**Strategies for Removal**
1. Inadequate human resources and Institutional capabilities	Need for capacity building through training
2. Technology	Enhance and facilitate access to information. To set up think tank on technology transfer
3. Economic Regime	Acquisition of Negotiation skills
2. Sourcing of funds and interest Rates	Removal of perceived risks. Create equal playing field for all competitors.
3. Lack of certified Baseline Information.	Develop Database
6. Lack of adequate legislation	Update existing policies, standing agreements and legislations eg. Factories and Shops Act.
7. Keeping pace with rapid technological advances	Use of international standards if none exists in Ghana
8. Estimation of project cost of procurements and Feasibility with or without CDM	Need to consider holistic approach to costing. One has to shop around towards obtaining competitive costing
9. Marketing	Create level playing field for all
10. Lack of information	Improve Information Technology

The members discussed briefly the draft national programme, and agreed that the discussions of the fifth meeting will serve as the basis of the draft country component of the regional 'thematic' programme. These should address the capacity building needs, barriers and barrier removal strategies that were identified at the third and fourth meetings.

The next meeting was scheduled for 1st August 2001.

APPENDIX VII

MINUTES OF FOURTH MEETING ON "DEVELOPING NATIONAL CAPACITY TO IMPLEMENT CLEAN DEVELOPMENT MECHANISM PROJECT (CDM) IN A SELECTED NUMBER OF COUNTRIES IN AFRICAN" PREPARATORY ASSISTANCE

The fifth stakeholder's meeting on the above mentioned project took place on Wednesday 1st August 2001 at the EPA conference room

1.0 Present

1. Mr. D. S Amlalo
2. Mr. E. Mc-Addy
3. Mrs. M Ahiadeke
4. Dr. Joseph Annan
5. Mr. Isaah Nikabs
6. Mr. Ben Treveh
7. Mr. D. F Korsah-Brown
8. Mr. Benjamin Agyare
9. Mr. W. K Agyemang-Bonsu
10. Mr. I.C Acquah

2. Absent

1. Mr. E. Ahiable
2. Mr. Emmamuel Mensah
3. Mr. N. Anderson
4. Dr. H Mensah Brown
5. Mr. Emmanuel K. A Dickson
6. Mrs. Patience Damptey

3. Opening

The meeting opened at 10:45am and was chaired by Mr. D. S Amlalo on behalf of the Executive Director.

4.0 MAIN ISSUES DISCUSSED.

4.1 Categorisation Of Identified Barriers And Removal Strategies

Members deliberated on the ten identified barriers and categorised them into four main barriers with subsets as shown below:

a. Inadequate Human Resources
b. Inadequate Institutional Capacity
c. Access to Technology`
d. Economic Regime.

The group, in addition, identified the following barriers under the main barriers:

Lack of personnel with specific skills in;

I. Baseline development
II. Greenhouse gas mitigation cost analysis
III. Climate change issues
IV. Modern management practices.

The institutions lack capacities in;

I. Greenhouse gas inventories and emission database management, in terms of records and archives management.
II. Greenhouse gas monitoring.
III. Adequate information on equipment.
IV. Baseline data.

Access to technology;

I. Keeping pace with rapid technological advances.
II. Lack of information on new technologies.

Economic Regime;

I. Sourcing of funds and interest rates.
II. Lack of regulatory frameworks on competitive policies in terms of trade and standards.
III. Access to market.
IV. Estimation of project cost of procurements and feasibility with or without CDM.

4.2 Strategies

The underlisted strategies are identified to remove the above-mentioned barriers:-

- ❖ Need for capacity building through training and capacity mobilization
- ❖ Identification of relevant stakeholders for retraining or re-orientation to understand the CDM programme
- ❖ Awareness creation for management of industries
- ❖ Acquisition of negotiation skills

- Institutions should be encouraged to change the organizational structure to accommodate certain types of personnel
- Corporate policies must also be changed
- The need to develop baseline
- Enhance and facilitate access to information technology infrastructure
- Existing institutions with some capacity to undertake pollutant monitoring should be strengthened to take up greenhouse gas emission monitoring

- ▪ Adopting international standards on general quality and enforcing them
- ▪ Improved information technology
- ▪ Strengthening of international cooperation in technology transfer
- ▪ Creation of level playing field for all in information technology

- Manpower capacity building to manage improved technology
- Dissemination of current efficient technologies through workshops.

- Update existing policies, standing agreements and legislations e.g. Factories and shops Act.
- Need to consider holistic approach to costing
- One has to shop around towards obtaining competitive costing

4.3 The project team after a lengthy deliberation on the project concept, personnel and institutional capacities, requested Dr. Joseph Annan to submit to the secretariat within a week the following:

i. One page CDM eligible project concept
ii. Personnel and institutional capacity needs of the industrial sector

4.4 Mrs. Ahiadeke was reminded by the group to consult with Mr. Agyemang-Bonsu to look into the government policies and legislations in relation with the CDM and report to the group at the next meeting.

5.0 Any Other Matters

Mr. Agyemang-Bonsu briefed the meeting again about the terms of reference of the CDM. He mentioned that the programme will dwell on two options with regard to the steel industries, which will be used for the pilot phase. He said the emphasis will be on energy efficiency improvement or emission reduction.

He also mentioned that the first report has been submitted to UNIDO. The second and third reports, which concern the Barriers and Strategies for Removal of the Barriers respectively, are expected to be merged and submitted as one report, and this has already been communicated to UNIDO.

It was mentioned that members will discuss and develop the *Draft National Programme* at the next meeting.

6.0 Closing

The meeting came to a close at 12:45p.m and the next meeting was scheduled for 15 August 2001.

APPENDIX VIII

FIFTH MEETING ON "DEVELOPING NATIONAL CAPACITY TO IMPLEMENT CLEAN DEVELOPMENT MECHANISM PROJECT (CDM) IN A SELECTED NUMBER OF COUNTRIES IN AFRICA: PREPARATORY ASSISTANCE"

1.0 Attendance

1.1 Present:

i. Mr. W.K Agyemang-Bonsu
ii. Mr. E. Mc-Addy
iii. Mrs. M. Ahiadeke
iv. Dr. J. Annan
v. Mr. C. N Anderson
vi. Dr. H. Mensah-Brown
vii. Mr. E. Ahiable
viii. Mr. Issah Nikabs
ix. Mr. Ben Agyare
x. Mr. D. F Korsah
xi. Mr. G. K Ofosu
xii. Mr. Eric Okorae
xiii. Mr. Emmanual Mensah
xiv. Mr. I. C Acquah

1.2 Absent:

i. Mrs. Patience Damptey
ii. Mr. E. K.A Dickson
iii. Mr. Ben Treveh

1.3 Absent with apology

i. Mr. D. S Amlalo

2.0 Opening:

The meeting opened at 9.35am and was chaired by Mr. W.K Agyemang-Bonsu on behalf of the Executive Director.

3.0 Barriers and Removal Strategies

Members continued deliberation on the specific barriers that had previously been identified and categorised under the four main headings:

a. Inadequate Human Resources
b. Inadequate Institutional Capacity
c. Access to Technology
d. Economic Regime

3.1 Lack of personnel with specific skills in:

- Baseline estimation
- Greenhouse gas mitigation cost analysis
- Climate change issues
- Modern management practices

3.2 The institutions lack capacities in

i. Greenhouse gas inventories emission database management in terms of records and archives management
ii. Greenhouse gas monitoring systems
iii. Information on efficient equipment
iv. Baseline data

3.3 Access to Technology

i. Keeping pace with rapid technological advances
ii. Lack of information on new technologies

3.4 Economic Regime

i. Sourcing of funds and interest rates
ii. Lack of regulatory framework on competitive policies in terms of trade and standards
iii. Access to market
iv. Estimation of project cost of procurements and feasibility with or without CDM

4.0 Strategies

The following strategies were listed:-

- Need for capacity building through training and capacity mobilization
- Identification of relevant stakeholders for retraining or re-orientation to understand the CDM programme
- Awareness creation for management of industries in relation to CDM
- Acquisition of negotiation skills

- Institutions should be encouraged to change the organizational structure to accommodate certain personnel (especially those on retainers).
- Corporate policies should be modified to reflect the changes in global environmental agreements.

- Existing institutions with some capacity to undertake pollutant monitoring should be strengthened to take up greenhouse gas emission monitoring.
- There is the need to develop baselines.
- There is the need to enhance and facilitate access to information technology.

- Adopting and enforcing international standards
- Assessment of existing information technologies
- Strengthening international co-operation on technology transfer
- Creation of a level playing field for all in information technology
- Human resources capacity building to manage improved technology
- Dissemination of current efficient technologies through workshops

- Update existing polices, standing agreements and legislation eg. Factories and shop Act.
- Need to consider holistic approach to costing
- One has to shop around and obtain competitive costing

4.1 Possible Programme to be adapted for the Metal Finishing Industries:

Mr. C. N Anderson briefed members on the possible programmes which could be adopted for these industries (that is the aluminium and steel industries). These are:

- Energy efficiency improvement
- Reduction of carbon dioxide emission

Under the above mentioned programmes he stated that there should be an investment in the existing plant technology and the basic steps to be undertaken should include the following.

i. energy accounting
ii. energy management systems through adaptation of motor driving systems
iii. heat recovery process
iv. establishment of motor rewinding shops
v. fuel switching to LPG
vi. production cost per ton under various categories compared with imported items or investments and foreign exchange rate
vii. carbon dioxide emissions.

4.2 Preparation of Country Programme

Mr. E. Ahiable, Dr. H. Mensah-Brown, Dr. Joseph Annan, and Mr. C. N Anderson were requested (as per the TOR for the project) to come up with project proposals and should encompass the two areas eluded to earlier on by Mr. Anderson. These project proposals would be incorporated into the draft country programme.

The proposal should be submitted to the secretariat in two weeks.

4.3 Mrs. Ahiadeke asked for an additional week to complete her assignment on the government policies and legislations in relation to the CDM before submitting her findings to the secretariat.

5.0 Any Other Matters

Members deliberated on the importance of the CDM in the socio-economic development agenda of the nation and the need to incorporate CDM in the National Development Planning Policy through the Ghana Poverty Reduction StrategyProgramme.

Members agreed that a memo relating to this should be channeled through the Minister of Environment, Science and Technology to the National Development Planning Secretariat.

The acting chairman informed members that a delegation from the Stockholm Environment Institute is expected in the country between 20-24 August and hope to discus possible CDM projects to be undertaken in the country with them.

6.0 Closing

The meeting came to an end at 11.45a.m and the members agreed to meet on 26 September 2001.

APPENDIX IX

TECHNOLOGY TRANSFER
(PART II)

IDENTIFICATION AND STRATEGY FOR REMOVAL OF BARRIERS

THE STEEL AND ALUMINIUM SECTORS

By: Dr. Joseph K. D. Annan
P. O. Box CT 5277
Cantonments
Accra-Ghana
e-mail: j_annan@hotmail.com

Monday, 25th June, 2001

1. INTRODUCTION

Extractive metallurgy is concerned with the production of metals from their ores and comprises the processes of pyrometallurgy and hydrometallurgy. Both processes employ chemical reactions which involve oxidation and reduction steps.

Such chemical reactions require **energy** either to drive thermodynamically unfavourable reactions or to accelerate thermodynamically favourable ones.

This energy is often provided by thermal means using fossil fuels.

Electrical energy offers an alternative means of supply either through **direct electrolytic** processes or by indirect means, i.e. **electrothermal** processes.

In extractive metallurgy, electrochemical processes are already widely used viz:- hydrometallurgical; pyrometallurgical.

The operation of the steel mills in Tema, Ghana, essentially involves the recycling and 'refining' of ferrous scrap metals by electrothermal means. The aluminium smelting operation of VALCO (also in Tema, Ghana), produces aluminium by a direct electrolytic process.

Issues relating to the identification and removal of barriers to technological transfers in the above-mentioned industries **would require, among others, a knowledge and understanding of the processes and operations involved, and more importantly of basic electrochemical principles.**

2. BASIC ELECTROCHEMICAL PRINCIPLES

a) Electrode Potentials

A metal in contact with a solution of its ions has a certain tendency to react. The magnitude of this tendency is measured by the **electrode potential** (relative to standard hydrogen electrode) which is **characteristic of the metal** and varies with its ionic concentration and with temperature.

When a current is passed through an electrolytic cell, the positively charged ions having electrode potentials more electropositive than the cathode potential will tend to discharge or deposit thereon, provided they are more noble than hydrogen, with the most noble depositing first.

b) Electrolysis

An electrolytic cell consists essentially of a vessel, an electrolyte, and two electrodes for leading **direct current** to and from the electrolyte.

Electrons enter the cell at the cathode where reduction reactions take place and leave the cell at the anode where oxidation reactions occur.

In extractive metallurgy there are two distinctly different kinds of electrolysis:-

i) Firstly, where metal is anodically dissolved and deposited at the cathode with little or no net change taking place in the electrolyte composition **provided that** any impurities contained in the metal being dissolved are less electropositive than the metal itself, then impure metal may be refined by this process which is called **electrorefining**;

ii) The second process is one where a metal salt is electrolysed using an inert anode. Metal is deposited at the cathode and a gas is given off at the anode. Here a considerable change takes place in the electrolyte composition during electrolysis and furthermore the impressed voltage across the cell that both electrode reactions are taking place. Such a threshold voltage is called the decomposition voltage and obviously **electrowinning** processes have much higher operating voltages than electrorefining processes. Power consumption is therefore much larger for electrowinning than for electrorefining.

c) Polarisation and Overvoltage

When a current is passed through an electrolytic cell under an applied potential difference the electrodes are disturbed from their equilibrium potential. This excess potential required for current flow is known as polarisation and relates to the slowness of one or more processes occurring at the electrodes. When it pertains to gas discharge this excess potential is called the overvoltage, and hydrogen overvoltage and oxygen overvoltage are the most common.

d) Cell Voltage

The cell voltage arising in an electrolytic cell can be broken down into the following components :-

i) electrode potential for the cathode reaction;
ii) cathode overvoltage and polarisation;
iii) voltage drop in the electrolyte;
iv) anode overvoltage and polarisation;
v) electrode potential for the anode reaction; and
vi) resistive losses in electrodes, leads and connection.

e) Power Supply

3. BARRIERS TO TECHNOLOGICAL TRANSFER

1. Lack of knowledge, know-how, and expertise.
   Affects ability to make the best technical choices, e.g. of equipment for industries; inability to ensure proper maintenance procedures; etc.

2. Unpredictable rises in operating costs due to uncontrollable external factors and unstable currency affects the profitability of operations and the ability to generate finances to replace equipment.
   The tables of the electricity bills of Ferro Fabrik Ltd. may be a good illustration.

Table 1. Total Electricity Bill in 1995 of Ferro Fabrik Ltd.

Year	**Amount (cedis)**
1995	**Total 911,314,250**

Table 2. Electricity Bills - 1996

Month	**Amount (cedis)**
January	40,983,300.00
February	64,147,300.00
March	73,309,700.00
April	75,532,500.00
May	84,477,900.00
June	78,955,500.00
July	91,866,700.00
August	81,300,500.00
September	85,860,900.00
October	80,020,500.00
November	87,410,900.00
December	67,036,500.00
Total	**907,902,200.00**

Table 3. Electricity Bills – 1997

Month	Amount (cedis)
January	79,580,500.00
February	87,614,100.00
March	75,030,100.00
April	94,853,300.00
May	79,749,300.00
June	64,014,300.00
July	105,107,700.00
August	89,127,700.00
September	83,754,900.00
October	86,406,500.00
November	83,754,900.00
December	86,406,500.00
Total	**845,238,400.00**

Table 4. Electricity Bills – 1998

Month	**Amount (cedis)**
January	34,270,100.00
February	44,104,400.00
March	43,640,000.00
April	**135,973,060.00**
May	283,411,959.00
June	244,363,724.00
July	306,236,887.00
August	255,416,230.00
September	413,030,965.00
October	344,848,349.00
November	284,367,903.00
December	234,533,769.00
Total	**2,524,197,346.00**

Table 5. Electricity Bills – 1999

Month	**Amount (cedis)**
January	203,485,427.00
February	229,752,767.00
March	289,411,865.00
April	230,236,538.00
May	300,434,472.00
June	349,936,637.00
July	309,306,861.00
August	336,808,956.00
September	329,018,500.00
October	330,684,156.00
November	324,368,528.00
December	336,015,583.00
Total	**3,569,460,290.00**

Table 6. Electricity Bills – 2000

Month	**Amount (cedis)**
January	350,033,120.00
February	356,681,256.00
March	398,082,916.00
April	364,253,032.00
May	399,022,140.00
June	373,917,442.00
July	402,056,611.00
August	510,099,024.00
September	476,903,993.00
October	505,970,125.00
November	513,154,051.00
December	403,635,860.00
Total	**5,053,809,570.00**

Table 7. Electricity Bills (To date) – 2001

Month	**Amount (cedis)**
January	407,803,948.00
February	431,675,420.00
March	431,439,960.00
April	497,575,473.00
May	**1,256,510,585.00**

3. Lack of adequate updates of legislature on relevant industrial standards and best practices.

4. Lack of **adequate** legislature regulating the practices of professionals … (the lack of strict adherence to professional ethics often results in shoddy work and poor standards being accepted).

5. Lack of proactive policies regarding industry-specific training; and research and development..(affecting manpower/human resource development).

6. Inability to keep pace with rapid technological advances.

7. Issues relating to property rights (viz patents and copyrights).
   Most developing countries are unable to take advantage of free assess stipulations of patent laws…(..after the 20 years monopoly grant of a patent for an invention!

…; a copyright is essentially a negative right which prevents others from making copies of the work of an author).

8. Tendency of manufacturers to protect know-how.

9. Miscellaneous.
   i) Inadequacies in the screening of so-called experts.
   ii) Proliferation of so-called "manufacturer's representatives".
   iii) Etc