PROPOSAL FOR REVIEW

PROJECT TITLE:	**Egypt** - Energy Efficiency Improvements and Greenhouse Gas Reduction.
GEF FOCAL AREA:	Climate Change
GEF ELIGIBILITY:	Under Financial Mechanism of Convention. (Convention ratified 5 December 1994)
TOTAL PROJECT COSTS:	$ 5.444 million
GEF FINANCING	$ 4.110 million
GOVERNMENT COUNTERPART FINANCING OF GEF COMPONENT	$ 356,000 (in cash) $ 178,000 (in kind)
COFINANCING	$ 800,000 UNDP
Associated Project	UNDP Energy Programme
GEF Operational Focal point	Mr. Salah Hafez, Egyptian Environmental Affairs Agency.
GEF Implementing Agency	UNDP
Executing Agency	Ministry of Electricity and Energy in cooperation with UN DDSMS
Local Counterpart Agency(ies)	Egypt Electric Authority
Estimated Approval Date	January 1997
Project Duration	3.5 years
GEF Preparation Costs	None

COUNTRY AND SECTOR BACKGROUND INFORMATION

Background Information: Energy Sector and Policies

1. This proposal is formulated in line with the Operational Strategy approved by the GEF Executive Council in October 1995 and as such is elaborated in response to the Climate Change Operational Strategy, Operational Programme # 5 "Removing Barriers to Energy Efficiency and Energy Conservation". The proposal therefore represents an attempt to remove barriers to both demand and supply-side energy efficiency from an economy-wide perspective.

2. In the Egyptian petroleum sector there has been steady growth in resource development, as well as in foreign income. Egypt is a net exporter of oil and oil products. Recent increases in the production of natural gas and its development for domestic consumption, especially in electricity generation, household use, and some industrial processes, has enabled the export of an increasing fraction of crude oil production. In 1992, approximately 27 Million Ton (MT), or 60% of total crude oil production, were exported. Total production of crude oil, as well as natural gas and other recoverable petroleum products, amounted to 54 Million Tons of Oil Equivalent (MTOE).

3. The abundance of domestic energy resources and the misplaced vision through which they were made available at subsidized prices for so many years has, unfortunately, turned Egypt into one of the least energy efficient countries in the world. Its energy consumption is one ton of oil equivalent per $1000 of GNP, or twice the average for the rest of the world. One-third of domestic fuel consumption is for generation of electricity. The consumption of electricity, as well as fuel resources, is inefficient. Government subsidies to the energy sector have created a negative incentive for customers to control consumption or conserve energy. Industry continues to use inefficient processes. Per capita consumption of electric energy in Egypt is nearly 700 kWh.

4. Within the Ministry of Petroleum, the Organization for Energy Conservation and Planing - OECP (originally Organization for Energy Planning - OEP) was set up to in 1983 to conduct energy planning and analysis, undertake studies and promote awareness of fuel energy consumption in various sectors of national economy. Over the last ten years, the OECP has conducted numerous studies and fuel energy audits primarily focused on the fuel energy consuming industry while only touching peripherally on the electric power consumption. The OECP's mandate does, however, not focus on the efficiency of electric power consumption and the efficiency of the electricity sector and has no direct link to the MOEE and the EEA.

5. The primary focus of the Ministry of Electricity and Energy (MOEE) and the Egyptian Electricity Authority (EEA) in the past, with substantial support from international donor agencies, has been to provide a reliable source of electricity for Egypt while operating within the Governmental laws and regulations. Objectives such as profitability and adequate return on investment have not been priorities. Moreover, the

Background Information

Electricity Sector:

12. Within MOEE, the EEA is responsible for generation and transmission of electric power. Distribution is now the responsibility of separate, regional distribution companies, each of which has an independent board of directors to whom company management reports. An amendment to EEA law has already been passed by parliament. The amendment abolishes EEA's monopoly on public power generation, and exempts private developers from a 10% cap on rates of return (Law 129).

13. Electric power generation is in balance with demand, with a 28% reserve margin of available capacity. A least-cost strategy is used for dispatch, with maximum hydroelectric generation consistent with irrigation requirements. The average efficiency of thermal generation has been steadily increasing and in 1993 surpassed 34%. The network has very long transmission paths, yet the transmission loss of 7% is comparable with many other well-run national systems in the world. However, further reduction in the transmission loss could be achieved using more advanced technologies.

14. To be sure, there are opportunities for additional loss reduction and improvements in measurements of network performance, which are appropriately addressed in this project brief and contribute to achievement of GHG mitigation objectives. However, a major source of benefit, both domestic and global, will come from programs directed to end users of electric power, an area of increasing interest and initiative by EEA through the expedient of conservation and load management, for which it certainly is the most appropriate leadership agency.

15. EEA does its job well, and has effectively brought production and transmission of electric power throughout Egypt to a very admirable standard. However, even though great strides have been taken on the supply side to improve utilization of energy resources, similar efforts and achievements on the demand side are still lacking. This is largely due to an inadequate institutional setting and the lack of the capacity that is necessary to be able to implement programs that support rational energy and power consumption and thereby lead towards the sustainable utilization of Egypt's energy resources. There is therefore a need to increase the capabilities of Egyptian power and energy sector authorities to evaluate and implement energy conservation activities and strategies and thereby improve the efficiency of power consumption across all sectors of Egyptian society.

Self-Generation and Cogeneration

16. The low prices of fuel and electricity have mitigated against a significant industrial development of small power self-generation systems. Nonetheless, among the few companies that self-generate, there are two with surplus capacity that currently sell to the grid. An increased amount of self-generation in the commercial and industrial sectors will release equivalent capacity for other consumers and could offer EEA a source of additional

21. The proposed intervention will be a step that will help put in place the necessary reformative mechanisms so that a more attractive climate is created in Egypt for private sector participation and future investments in this sector.

Donor Activities

22. In parallel to the present proposal, UNDP is supporting the following two projects in this sector which should be seen as complementary to the present GEF project: (i) "Operational Unit for Electricity Programme Approach" implemented by the Ministry of Electricity and Energy and (ii) "Geographic Information System for the Egyptian Electricity Authority", implemented by EEA. T[illegible]al budget of these two projects is $1.3 million. A follow-on project is being designe[illegible]mplementation starting 1996 to be funded under the 6th Cycle IPF. While the final bud[illegible]s still not determined, this project will address (i) training and technical assistance in org[illegible]ization of high voltage laboratory; (ii) environmental monitoring training (mainly emf radiation and air quality; (iii) network studies, primarily manpower training and (iv) electromagnetic transients; (v) assistance in identifying international practices, including prices and specifications for equipment in a data base form for the Rural Electricity Authority; (vi) transients (electromagnetic and electro-mechanical) and excitation control systems; and (vii) attracting private power and joint-venture in the electrical power sector. The present GEF project and the above-mentioned IPF projects have been designed in parallel to ensure full complementarity.

23. UNEP, with Finnish funding, supported a study by the EEAA of possible GHG reduction scenarios in the electricity sector. The reductions proposed in this brief are consistent with the possible reduction scenarios identified by EEAA, and are designed to fill part of the strategy and support gap by practical implementation schemes that promise to achieve the potential reductions sooner.

24. USAID is supporting the N[illegible]l Renewable Energy Authority (NREA) within MOEE, the Organization of Ener[illegible]on and Planning (OECP) within the Ministry of Petroleum and Natural Resou[illegible]MOPNR), the Energy Conservation and Efficiency Project (ECEP) which is being carried out by agencies outside the Government of Egypt, and most recently, EEA in a program of institutional development. USAID has also been strongly involved in the Egyptian power sector. Between 1979-93, USAID's involvement was assistance towards construction of power facilities. However, from 1993 onwards, the shift has been towards policy. In 1994 a policy matrix was negotiated, including the areas of (i) financial viability; (ii) regulatory reform; (iii) autonomy of enterprises; and (iv) improved planning and efficiency. The present GEF project is developed to complement this USAID effort as it is supporting other agencies with similar goals but with different responsibilities.

25. The World Bank (WB) is presently involved in assisting the Egyptian Authorities with their first private power project. The objectives of the project are to: (i) support the Government's effort in tapping new sources of capital for the power sector; (ii) enhance the gradual commercialization of the power sector; and (iii) add new generating capacity, in line with the least cost development plan for the power sector. The WB is also involved in the Egyptian Energy sector through the Energy Sector Assessment Programme (ESMAP) wherein an Energy Sector Assessment has just been completed. The assessment was

- promote public and private sector investments in energy projects that are beneficial for the global environment.

Improvement Targets

29. Measurable target objectives to be achieved at year 2005, include:

- reduction of electric transmission losses to 5%
- reduction in magnitude of daily load swing (peak to minimum demand) to 25% of average load through load management

  1000 MW of generating capacity from cogeneration and renewable energy sources connected to the Unified Power System

- three-year moratorium in construction starts for new generating capacity
- 10% reduction in energy consumption from fuels, as referred to GNP

30. It should be emphasized that the above represents goals and targets which, if the accompanying down-stream investments are mobilized through this project, could potentially be realized. Should subsequent investments be mobilized, large profits can be realized. However, in order to attain these efficiencies, a transaction hurdle will have to be overcome. This project is catalytic in enabling the Government and the utilities to overcome these transaction costs.

PROJECT DESCRIPTION AND OUTPUTS

Project and Programme Related Context

31. This project will address the removal of barriers to enhance energy efficiency in Egypt. By creating an appropriate institutional setting and adequate capacity to engage in energy conservation activities, alternatives to the existing tendency to meeting the ever increasing demand for power by expansion of generating facilities, will emerge. As such, the project will address both supply and demand side energy efficiency from an economy-wide perspective.

32. The project will thus address the following components:

1: Loss Reduction, Load-shifting and Load Management in the Unified Power System;

2: Energy Conservation and Engineering Services Support to ESCOSs; and

3: Cogenerated Power.

1.2 improved loss measurement program;

1.3 network reactive power compensation (for 11 KV and lower KV networks);

1.4 analysis of thermal station dynamic performance;

1.5 network analysis;

1.6 implementation of loss reduction strategies;

1.7 establish load management tariff incentives;

1.8 implement peak load reduction programs in selected industries, and monitor performance;

1.9 evaluate hardware options for remote time-of-day load control; and

1.10 identify potential residential, industrial, and commercial customers for remote load control installations.

Component 2: Energy Conservation and Engineering Services support to ESCOs.

39. *Goal:* Conduct an energy conservation programme, and establish an Energy Conservation Center within EEA's Research and Planning Sector. The Center will include a focal point which can act as a repository for experience on ESCO establishment, and further conduct training, outreach and information to private sector entrepreneurs interested in establishing ESCOs. Such ESCOs will provide engineering services to help the utilities and industries improve energy efficiency, and will help specify, install, and operate new equipment and systems, during the transitional period of privatization and energy price adjustments.

40. *Barriers*: This activity is not being undertaken at present due to a lack of trained personnel to carry out the energy audits and the lack of an appropriate institutional setting such as an energy conservation agency working on the power consumption side. This transactions barrier will be removed via public awareness campaigns, training of personnel, and detailed training of staff in energy conservation and audit techniques and institutional strengthening. Another transaction barrier is the lack of ESCO activity in the region. Egypt has very few energy service companies which have emerged to work as brokers to stimulate energy efficiency. There are a number of barriers to this, not the least of which is the energy pricing sending perverse incentives. There is also a shortage of personnel familiar with the technical aspects of energy conservation and also familiar with business management skills and principles. As the pricing policy is gradually adjusted to global standards, there will be important opportunities for ESCOs to begin undertaking business and investments in energy efficiency. This component is also designed to establish an ESCO-creation and support facility within the energy efficiency center. Small grants to provide technical assistance to ESCOs will help defray up-front costs of ESCO

power from cogenerators. Third, there is no tariff schedule for the purchase of power and no contractual arrangements for these tariffs to be negotiated. This component will assist the new unit, Small Power Group, in overcoming this set of hurdles.

44. *Tasks:*

3.1 establish Small Power Group within Studies, Research and Planning Sector of EEA;

3.2 establish safety and interconnection policy and procedures for small producers;

3.3 prepare guidebook;

3.4 establish a tariff schedule and Power Purchase Agreement for small producers; and

3.5 identify cogenerators for interconnection; and

3.6 promote cogeneration through Energy Conservation Center.

Outputs

Overall Project Achievements

45. The overall achievement of the project will be an increased capability to make Egypt more efficient in its consumption of energy resources, both electricity and fuels. This capability will be embodied in self-supporting institutions of the Egyptian energy sector, both existing and newly created, that are adequately equipped and trained to insure maximum efficiency of the Unified Power System, to provide an effective energy conservation programme, and to provide needed engineering support services to public and private industries as they adjust to the new reality of energy costs.

Specific Project Achievements

46. The Component Tasks, individually and in combination, will result in three major achievements:

- result in an overall reduction in energy consumption per capita and with respect to GNP,
- result in reductions in GHG in accordance with the following projections based on estimations for the year 2005, and
- result in deferring construction of new generating capacity.

49. *Component 3 - Cogenerated power*

Reduction in fuel consumption: Industrial and commercial cogeneration systems, that would be installed as a result of Components 2 and 3, contribute to a net reduction in consumption of fuel resources through the combined generation of heat and power. A typical small power cogeneration system with an average generating capacity of 5 MW and recovery of waste heat to replace combustion of other fuel resources, would save 4708 TOE/year. (See calculations and analysis in Annex 3.) With a long-term goal of achieving 1000 MW of cogeneration, projected fuel savings are 0.94 MTOE/year, or approximately 5% of total industrial fuel consumption. Although the reduction is referenced to industrial consumption, it is actually shared by industry and EEA.

Savings associated with the export of 300 MW of capacity from the sugar industry are equivalent to 0.3 MTOE/year, or approximately 1.5% of total industrial consumption. The actual reduction is allocable to EEA.

Assumed industrial sector fuel consumption 20 MTOE/year. Summary of potential reductions: Cogeneration: 5% and Biomass generation: 1.5%.

Basis of reduction calculation: Assumed 3.25% reduction in fuel consumption (approximately one-half of identified potential), based on limited participation of industry in conservation programs, and 1000 MW of cogenerated private power; 18,000 BTU/LB fuel oil, 90% Carbon.

Potential reduction in GHG (CO2): 2.02 MT/year

50. *Deferred Construction of New Generating Capacity:*

In addition to the specific component achievements, the implementation of the project will result in the de ·:ral of capacity expansion in the Egyptian power supply sector.

As explained in Component 1, the load shifting and load management will contribute to a reduction in the planned growth of generating capacity to meet the peak demand: projected reduction of 10%[2].

Within Component 2, energy conservation contributes to peak reduction, and in addition reduces the growth of average demand: typical reductions achieved in comprehensive conservation programs of 2 to 5% will have a direct GHG benefit, as noted.

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[2] Capacity additions are planned to meet peak demand. If the peak is reduced, the associated requirement for new capacity may be deferred. This deferral has only secondary short-term impact on GHG, since the pattern of electricity consumption is rearranged, rather than reduced. Small reductions in transmission loss and increase in system efficiency are assumed to be lumped in savings accrued under the potential reductions achieved from reduced transmission losses.

within the EEA, the agency directly responsible for the national Unified Power System. The project is crucial as facilitating and catalytic step for effective reorganization and efficient operation of the electricity sector.

55. The project contributes to meeting climate change mitigation objectives of the GEF. The project facilitates reductions in projected GHG emissions (CO2) of 7.7 MT/year by the year 2005, when emissions are expected to reach 100 MT/year. This is equivalent to an approximate 7% decrease in energy intensity from the current value of 1 TOE per US$1000 of GNP, a significant step in the right direction.

SUSTAINABILITY AND PARTICIPATION

56. The emphasis on energy loss reduction, conservation, and strengthening institutional roles invested in maintaining energy efficiency, establishes an energy efficiency awareness throughout the system. Sustainability is assured because GHG emission reductions are cost-effective and bring long-term economic benefits which will stimulate continued long-term support for project activities and services, and investment in energy systems. The project will actively promote the marketing of its services and capabilities to both the public and private sectors. It will build the necessary institutional capacity to insure continued sustainability of effort.

57. Many developing nations are wrestling with the problems of providing adequate and reliable electric power to sustain industrial development, satisfying domestic and industrial requirements for fuel, growing domestic awareness of environmental quality issues, and becoming responsible neighbors in the global environment. Demonstration of a methodology for managing developments in the energy sector, while at the same time achieving global benefits vis-à-vis GHG emission reductions, will provide a valuable model for adaptation elsewhere in the region and the developing world.

LESSONS LEARNED AND TECHNICAL REVIEWS

58. This project seeks to build institutional and technical capacities at the regional level to address the needs of the Convention on Climate Change, while at the same time supporting the need for policy and pricing reforms in the energy sector for the benefit of national economies and the global environment.

59. The project has been designed on the basis of extensive consultations with Egyptian authorities, GEF, the UNDP. The project has been submitted for independent technical reviews to STAP experts, and has been modified and improved in accordance with their recommendations. A technical review of the project is also attached, along with UNDP's response to comments of the reviewers. During the GEFOP review, GEFOP recommended that non-GEF resources should be identified for the funding of component 1. The UNDP has shown its support for this initiative in the Egyptian energy sector and is therefore cofinancing the project by covering the cost of component 1 which is equivalent to US $800,000.

65. A Board of Directors will be formed to provide overall guidance and program review, and to facilitate coordination among Government agencies, academic community, and the private sector. Membership of the Board of Directors will include representation from the following, Egyptian Environment Affairs Agency, Ministries of Electricity and Energy; Industry; Petroleum and Natural Resources; Egyptian Electricity Authority; New and Renewable Energy Authority; Cairo University; TIMS; FEI; Private Sector Member(s). In fulfillment of Component Tasks, it will be necessary to establish close working arrangements among several organizations.

MONITORING AND EVALUATION

66. The project will have formal review and oversight provided by the Board of Directors and its Technical Sub-Committee. Results form Component Tasks for follow-up energy auditing, equipment performance report monitoring, and periodic re-evaluation of required generating capacity in the UPS as a result of load management activities, will be incorporated in periodic Monitoring and Evaluation reports.

ANNEX 1

CALCULATION OF INCREMENTAL COST

Broad Development Goals

1. With a growing economy, Egypt's demand for electricity has increased rapidly in recent years, and is likely to continue increasing for the foreseeable future. Not surprisingly, its developmental goal is to meet the ever-increasing demand for electricity by increasing its supplies. Increasing the efficiency of transmission and consumption will also have the effect of reducing the need for supply-side enhancements. However, to date, many of the actions which can be taken to improve the situation have not been undertaken due of the existence of a number of barriers of a technological, human-resource, or legal nature.

Global Environmental Objective:

2. The global environmental objective being pursued through this project is the reduction of GHG emissions through increased efficiency in electricity transmission and utilization and the expanded use of cogeneration to supply power to the national electricity grid. As such, this project has been designed to correspond to GEF Climate Change Programme 5: Removing Barriers to Energy Efficiency and Energy Conservation. As described in the project brief, the different components of the project will all focus on removing different barriers to the achievement of greater energy efficiency (electricity and fuel) and the increased supply of power through cogeneration.

BASELINE

3. Under the baseline, Egypt's energy consumption per unit of GNP would remain roughly double that of comparable economies in the region. As part of the economic reform program upon which Egypt embarked in 1990, a plan to achieve a weighted average tariff of 100% of the LRMC by 1996 was implemented through a gradual annual price increase. The energy pricing reform initiated in 1990 also aimed to achieve fuel pricing that is equivalent to 100% of the import parity prices. Through these gradual increases, pricing equivalent slightly higher than 100% of the LRMC was achieved by the outcome of 1996. Thus, many of the financial incentives for energy conservation will be put in place with this shift in policy. However, experience has shown that this is a necessary, but insufficient condition needed to achieve energy efficiency improvements of the type discussed in this proposal.

4. For the transmission and distribution sector in Egypt, this project is critical for the continued acceptable operation of the system. Without intervention from the side of this project, it is likely that no action will be taken to sustain or improve the transmission system in Egypt. At best, the present rate of transmission losses (7%) would remain

raising public awareness to energy efficiency opportunities linked to this and other ongoing projects. With a high-level national institution focusing on energy efficiency, many of the public information, training, and regulatory obstacles to improved energy efficiency will be met. Furthermore, this component will seek to address the shortage of skilled personnel and private-sector entities dealing with investments in energy efficiency. It will establish an energy engineering center which will serve as an incubator for energy service companies (ESCOs). With this national center established, Egypt's private sector will be in a better position to establish ESCOs taking advantage of the many profitable energy efficiency investments which exist.

9. At last, Component 3 (Co-generated Power) is intended to address the legal obstacles to the purchasing of surplus cogenerated power by the EEA. At present, there is no framework for agreements allowing EEA to purchase power. With the technical assistance provided as part of this component, this obstacle shall be removed, paving the way for the purchase of power from the numerous cogenerators found across Egypt. As the detailed calculations in Annex 3 demonstrate, there are significant global benefits to be achieved for cogeneration

DOMESTIC AND GLOBAL BENEFITS

10. The project could potentially achieve reductions in GHG emissions (CO2) of 7.7 million tons by the year 2005. However, it is important to emphasize that additional investment beyond the technical assistance outlined in this proposal will be necessary to capture these global benefits. All of the components of this project are meant to lay the foundation for this potential significant investment.

11. As with most energy efficiency projects, there are significant domestic benefits which accompany the global benefits from this project. In order to respect the principle of incremental costs, two steps have been taken in the design of this project. First, GEF funding is not being requested for Component 1. Second, GEF grant funds are targeted only for the technical assistance elements and training. Any funds to be used in implementing the follow-on investments will have to be obtained independently from non-GEF sources.

12. Domestic benefits are measured as the value of the fuel saving resulting from decrease in transmission losses in Component 1, the reduction in consumption of fuel and electricity in Component 2 and the value of the estimated fuel savings from cogeneration in Component 3. The projected potential savings in heavy fuel oil are estimated at 0.343 MTOE/year for Component 1, 1.5 MTOE/year for Component 2 and 0.65 MTOE/year for Component 3, therefore totaling 2.493 MTOE/year. On the other hand, the global benefits are measured as the reduction in emissions of greenhouse gases. Component 1 could potentially achieve a reduction in CO_2 of 1.1 MT/year, Component 2 could curtail 4.665 MT/year of CO_2, while the potential global benefits associated with implementation of Component 3 are 2.02 $MTCO_2$/year. In total 7.7 $MTCO_2$/year.

INCREMENTAL COST MATRIX

Component	Cost Category	Cost (US$m)	Domestic Benefit	Global Environmental Benefit
Component 1: Loss reduction, load shifting & load mgt. in Unified Power System	Baseline	US$800,000[3]	Continuation of Price Reform Potential savings of equivalent of 0.343 Mtoe per year	Decrease in consumption due to pricing and Reduction of CO2 emissions by 1.1 MT/year
	Project	US$800,000	Fuel savings potential of 0.343 Mtoe per year	Decrease and reduction same as above
	Increment	0		
Component 2: Energy Conservation & Engineering Support Services	Baseline	US$300,000[4]	Unsustainable utilization of domestic energy resources & needless capacity expansion	Continuation of increase in level of current emissions due to inefficiencies
	Project	US$3,770,000	Deferral of capacity expansion meeting demand into next century and potential savings of heating fuel oil of 1.5 Mtoe/year	Reduction of CO2 emissions by up to 4.665 m T/year
	Increment	US$3,470,000	Fuel savings of up to 1.5 Mtoe/year and deferral of capacity expansion	Reduction of CO2 emissions by up to 4.665 m T/year
Component 3: Cogenerated Power	Baseline	US$56,000[5]	Unsustainable use of domestic energy resources	Unnecessarily high CO2 emissions
	Project	US$696,000	Help meet demand into next century deferring capacity expansion Fuel savings of up to 0.63 Mtoe/year	Reduction of CO2 emissions by 2.02 Mt/year helping defer capacity expansion
	Increment	US$640,000	Fuel savings of up to 0.63 m toe/year	Reduction of CO2 emissions by up to 2.02 m T/year
Totals	Baseline	US$1,156,000		
	Project	US$5,266,000		
	Increment	US$4,110,000	Total Potential Fuel Savings of up to 2.493 Mtoe/year	Total Potential CO2 emission reduction of up to 7.7 MT CO2/year

[3] The US $ 800,000 will be co-financed by UNDP.
[4] The US $ 300,000 will be a contribution from the Government of Egypt.
[5] The US $ 56,000 will be a contribution from the Government of Egypt.

ANNEX 3
ESTIMATION OF FUEL SAVINGS BY COGENERATION

INTRODUCTION

1. Individual process requirements for heat and electric power influence the design of a cogeneration system, as well as the type of fuel available at the site. Equipment options for typical systems in the size range of 1 to 10 MW include several types of engines, furnaces and boilers, steam turbines (back-pressure and condensing), heat exchangers and waste heat recovery units. Practical fuel options include heavy fuel oil (mazout), natural gas, and biomass.

2. Medium-speed diesel engines are capable of operation on heavy fuel oil. Spark-ignited engines and gas turbines are fueled with natural gas. Engines provide shaft power and generate electricity. Furnaces can be fueled with heavy oil, gas, or biomass, to produce process heat or to raise steam. Steam turbines can operate at high back pressure when the exhaust steam is required for other industrial purposes, or into a condenser.

3. Design of a cogeneration system is an optimization process to combine use of heat and power in the most practical way to provide highest efficiency and least cost of operation. Typical installed costs of such systems are in the range of US$1000 to 1500 per kW for engine-based systems, and US$2000 to $2500 for furnace-based systems. Payback time depends on the avoided cost of electric power, tariff for sale of power to the grid, fuel cost, and system utilization factor. When the cost of fuel and power is at current world market rates, payback times can be in the range of 3 to 7 years.

EXAMPLE

This calculation is based on a typical industrial facility (such as a paper mill, textile plant, or ceramics factory) that requires electricity purchased from EEA to run machinery and heavy fuel oil to provide process heat. The connected load is 5 MW, and monthly power consumption corresponds to an average load of 2.5 MW. 1000 T/month of heavy oil is burned in a boiler to raise steam and provide heat for a drying process.

Power plant generation efficiency = 34%

Transmission losses = 5%

Efficiency of delivered power = 0.95 x 0.34 = 32%

Yearly power consumption = 2.5 MW x 8760 hours = 21,900,000 kWh

There is a reduction in overall fuel consumption, as follows:

Power plant fuel requirement to produce 5 MW:

$$\frac{5000 \text{ kW} \times 8760 \text{ hour/year} \times 3413 \text{ BTU/KWH}}{0.32 \times 18000 \text{ BTU/LB} \times 2205 \text{ LB/T}} = 11{,}770 \text{ TOE/year}$$

Factory consumption of fuel for process heat = 12,000 TOE/year

Total fuel consumption before cogeneration: = 23,770 TOE/year

Total fuel consumption after cogeneration: = 19,062 TOE/year

Reduction in fuel consumption by cogeneration =

$$= 23770 - 19062 = 4{,}708 \text{ TOE/year}$$

When extrapolated to a total cogeneration contribution of 1000 MW, the fuel reduction based on the above example of a 5 MW cogeneration system totals 0.94 MTOE/year. This corresponds to 4.7% of yearly industrial sector fuel consumption.

The example was chosen to indicate that systems based on heavy fuel oil are practical. If natural gas is readily available and the fuel of choice, other equipment options would offer higher cogeneration efficiencies and quicker payback than systems based on heavy oil.

Arab Republic of Egypt
Cabinet of Ministers
Egyptian Environmental Affairs Agency

جمهورية مصر العربية
رئاسة مجلس الوزراء
جهاز شئون البيئة

13th, November, 1996

Dear Mr. Muzio ,

We have received your letter of 6th November and document for **Egypt - Energy Efficiency Improvements and Greenhouse Gas Reduction (GEF Project)** , and we are pleased to confirm our endorsement to this very important project . We would appreciate your keeping us abreast with the developments as they occur .

Looking forward to our mutual cooperation .

With best regards .

Chief Executive Officer,
EEAA

(Salah Hafez)

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17 Teiba St., El-Mohandeseen / Dokki, Giza Tel. : 3601839 / 3601391 / 3601326 Fax : 3610764

Ministry of Foreign Affairs
Department of International Cooperation for Development

Date : 10/11/96
Ref. : 047
File :

Cairo 10.11.1996

H.E. Costante Muzio.
UN Resident Co-ordinator
UNDP Resident Representative
Cairo, Egypt.

Dear Mr. Muzio.

Egypt-Energy Efficiency Improvements and Greenhouse Gas Reduction

We have received your letter on the above subject. and we are pleased to confirm our endorsement in principle (subject to the availability of UNDP funds) to the above mentioned project which falls very well within both our national priorities and UNDP's main areas of concentration. Meanwhile, as you know during the next few weeks we are in the process of looking into the pipeline project list and UNDP's funding situation,though we confirm that this would be incorporated for study in the second, not the first, amount allocated to Egypt from UNDP Funding.

Accordingly we shall revert to you soon with regards to the above subject.

With best regards

Your Sincerely,

Ambassador / Hassan Issa

Director of Department of International Cooperation for Development

Ministry of Foreign Affairs Building, Maspiro, 29 th Floor, Cairo, Egypt
Tel : 574 9854 - Fax 574 9622

needed. In order to justify the incremental costs of the project, the proposal needs to provide information on Egypt's current institutional capacity to undertake energy efficiency projects. Based on current institutional capability in Egypt, the proposal should ask for additional assistance from GEF.

INSTITUTIONAL ARRANGEMENTS

The revised proposal provides adequate information on institutional arrangements which should be modified later once the project is approved and a project document is being prepared.

FUNDING

Funding level is appropriate for the proposed activities. However, a detailed budget and identification of activities is needed in order to comment on the level of funding. For instance, the proposal needs to clarify whether activity component 1 will address only urban areas or the rural sector of Egypt as well.

INNOVATIVE FEATURES

An important innovation of the project will be the improvement of efficiency in context of the privatization of Egypt's electricity sector. GEF has two ongoing projects on electricity efficiency. One is the implementation of a DSM program in Thailand and another is the CFL program in Mexico. The institutional structure of electricity supply is not changing radically in either country. In other countries where privatization is ongoing, governments have adopted a hands-off attitude towards electricity efficiency improvement. The proposed project can lay the groundwork for addressing both efficiency improvement and privatization simultaneously by delineating and defining the roles and responsibilities of public and private companies. Given the large number of countries considering or embracing privatization, the proposed project will provide an important blueprint for others to follow.

DEVELOPMENT DIMENSIONS AND RATIONALE FOR GEF SUPPORT

The proposed project is consistent with Egypt's economic growth and social development aspirations.

However, the proposal provides no information by which the incremental cost of the project may be estimated. It provides the budget figures in Attachment 1. However, it is not clear as to why the budgeted amounts are incremental and therefore appropriate for GEF support.