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**IMPLEMENTATION STATUS OF ENERGY
EFFICIENCY INITIATIVES IN THE
EGYPTIAN POWER SECTOR**

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Implementation Status of Energy Efficiency Initiatives in the Egyptian Power Sector

Dr. Ibrahim Yassin

Energy Research Centre – An Najah National University

Email: iyassien@thewayout.net

1. Introduction

The past decade has witnessed a strong political commitment by the Government of Egypt (GOE) to the improvement of energy efficiency at the national level, where several initiatives and projects have been endorsed and executed to design and implement energy efficiency measures.

The sector is actually expanding its basic role to supplying electricity as a commodity, to include providing the information and the measures that guarantee the most efficient use of this energy. This will certainly have a direct economic benefit for the sector and the country as a whole.

Meeting the ever-increasing demand on electricity with a high degree of reliability and sustainability has been one of the main issues addressed by the strategy developed and implemented by the Ministry of Electricity and Energy.

In addition to this target, the Egyptian Electricity sector has adopted strong measures in order to improve energy efficiency at both the supply and demand sides, this resulted in reducing the overall average specific fuel consumption from 340 gm to 221 gm of oil equivalent per kWh, reducing losses from 18 % to 11.5% in 2004/2005. Comparable efforts have been conducted on the demand side to effectively utilize the electrical energy.

2. Energy Efficiency Improvement and Greenhouse Reduction Project:

Among these efforts, the Ministry of Electricity and Energy has started since 1999 implementing one of its most important projects which is the “**Energy Efficiency Improvement and Greenhouse Gas Reduction**” project for a duration of five years and a total budget of MUS\$ 5.9, jointly financed by the Global Environment Facility (GEF), the United Nations Development Program (UNDP) with the support of the Government of Egypt.

The overall objective of this project is to meet suppressed and still growing electricity demand through reliable, efficient and rational consumption patterns, thereby reducing greenhouse gas emissions emanating from electric power generation, protecting the local environment while at the same time providing a sustainable alternative to capacity expansion as the sole method of meeting demand.

This objective is to be achieved through:

- Supporting efficiency improvement and loss reduction in generation, transmission & distribution of electric power.
- Facilitating adoption and implementation of energy conservation measures in residential, commercial and industrial sectors through initiation of energy audits, promotion financing and standard-setting activities.

- Stimulating and guiding the private sector in the development of a capability for end use energy efficiency service planning, feasibility analysis, conceptual design and project implementation including the manufacture of energy efficient products.
- Assisting in international and regional transfer of technology and experience that could be instrumental in GHG emission reduction.
- Promoting public and private sector investments in energy projects that are beneficial for the global environment.

The Ministry of Electricity and Energy, as the government implementing agency, has expressed its full commitment to sponsor the objectives and outputs of this project and to continue with their full implementation beyond the project completion where it is expected to reduce energy consumption by a total of 4.2 million tons of oil equivalent (MTOE)/year by the year 2010. These energy savings represent 11.8% of Egypt's total estimated energy use and are equivalent to 11.7 million tons of CO₂ per year.

The project is expected to achieve its objectives through measures and activities classified under three main components:

- Loss Reduction and Load Shifting of the Egyptian Unified Power System
- Energy Efficiency Market Support.
- Promotion of Cogeneration.

The activities under these components are implemented by:

Ministry of Electricity and Energy:

- Egyptian Electricity Holding Company (EEHC).
- Electricity Companies (ECs).

Ministry of Housing:

- Housing & Building Research Institute (HBRC)

Ministry of Industry and Technology Improvement:

- Egyptian Organization for Standards (EOS)

Ministry of Planning:

- Organization for Energy Planning (OEP).

A. Component 1: Loss reduction, Load shifting and Load Management in the UPS

The target of this component is to reduce the transmission losses from 7% to 5% and introduce a time of use tariff to encourage load shifting, resulting in reducing energy consumption by 0.17 Million tons of oil equivalent and CO₂ production by 0.48 million tons;

This target is achieved through:

- Improving Network Loss Measurement Capability

- Improve Dynamic Response for All Thermal Stations
- Reduce Transmission Losses through Network Analysis and Control Strategies
- Introduce Time of Use Tariff to Encourage Load Shifting

(1). Improving Network Loss Measurement Capability

- In order to get accurate measurements of losses, the project has set a plan for calibration and maintenance of measuring devices. All measuring devices of the power sector have been calibrated using the high accuracy (0.01%) calibrating equipment procured by the project.
- Holding training courses for engineers and technicians to improve their capability in the field of measurements, and calibration.

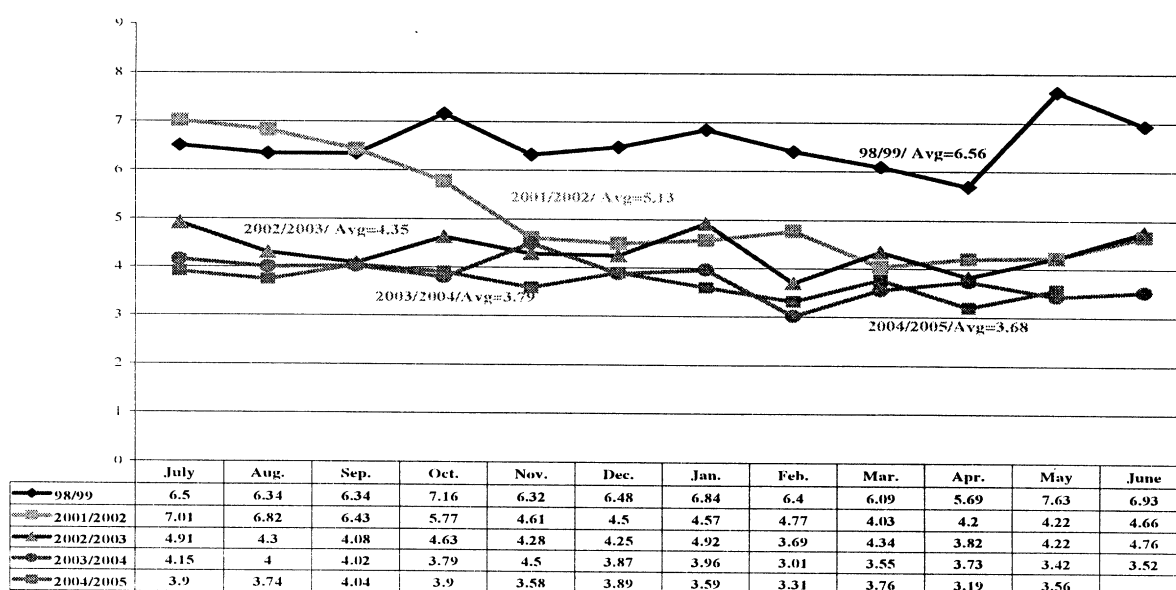
(2). Improve Dynamic Response of All Thermal Stations

- Dynamic tests (ramp rates) of generating units with a capacity more than 150 MW have been conducted, and engineers have been trained to conduct and analyze these test.

(3). Improve Transmission Losses through Network Analysis and Control Strategies

- Maximum use of reactive power of the generating units
- Improve the power factor through installation of capacitor banks at selected locations
- Optimization of network planning by using the up to date software program “Optimum Power Flow (OPF)”

As a result of all previous achievements the network losses came down from 6.57% during 1998/1999 to 3.68% in year 2004/2005, resulting in reducing energy consumption by 0.13 MTOE and CO₂ by 0.42 MTons.



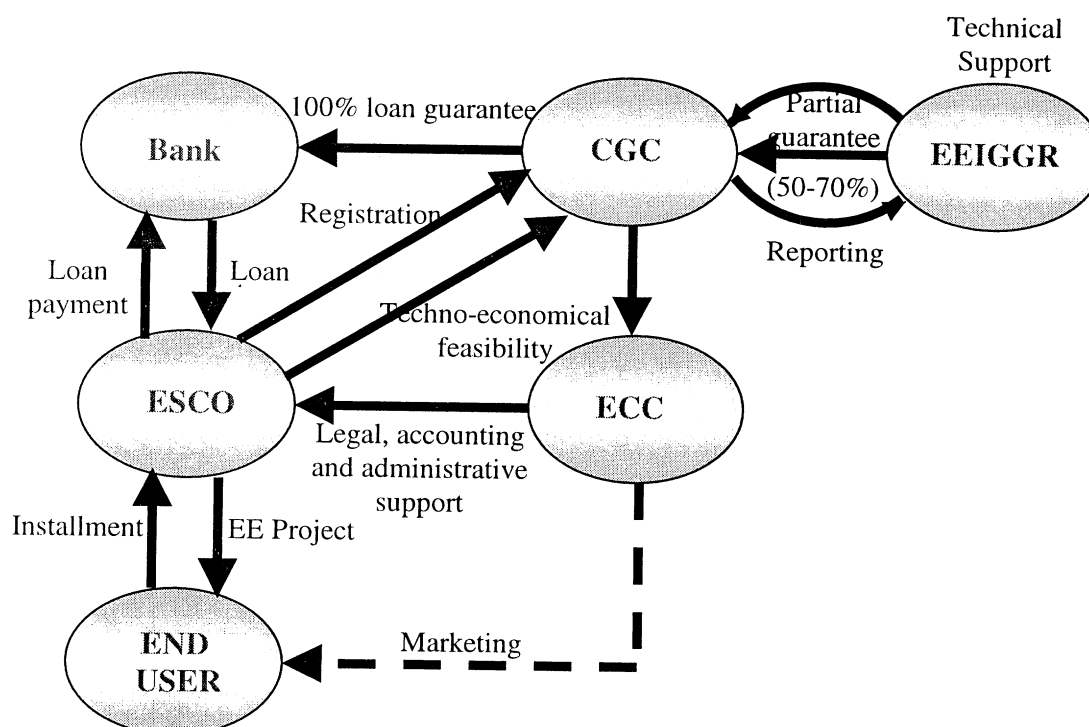
- (c). Reform the loan guarantee program such that it enables ESCOs to access finance as well as offer them with guarantee against customer default. This program should be executed through a professional financial institution and the role of EEIGGR will be limited to technical support
- (d). Redefine the working ESCOs which could benefit from the loan guarantee program. This include the following measures:
 - 1. The ESCO should have a previous experience in one of the targeted technologies. This experience should be supported by a reference list.
 - 2. The ESCO should have an acceptable financial condition.
 - 3. The ESCO should have the capacity to offer studies, engineering, procurement, installation and monitoring service. If the ESCO is lacking one of these activities it should at least have the capacity to out source this service.
 - 4. The ESCO should accept to operate with the proposed model, which includes offering finance to the customer which is guaranteed by the loan guarantee program. In this case the ESCO will be responsible on the technical risk while the program will be responsible on the financial risk.
 - 5. The ESCO should be approved by the financial institution managing the loan guarantee program. This approval is based on pre-decided criteria which include legal and financial measures.

Accordingly EEIGGR has developed what is called an Egyptian Sustainable Loan Guarantee Mechanism (ESLGM) to enable access to finance to the ESCOs to finance their projects. EEIGGR has allocated a budget of 280,000 US\$ to this mechanism. The mechanism is being executed through a local financial institution. The Credit Guarantee Company (CGC) for small and medium size enterprises was selected as the financial institution which manages the mechanism. CGC is an Egyptian company which has been established by twelve public as well as private banks to enable access to finance for small and medium size enterprises.

For the projects which are executed through the mechanism, the customer will be requested to pay a down payment in the range of 10-20% of the project cost (including cost of finance). The ESCO will be eligible to get a loan which will be 70% of the project cost minus the down payment. CGC will offer 100% credit guarantee to the loan. The guarantee will be effective as the ESCO sign the contract with the end user and present a bank document showing that the end user has already paid the down payment

The proposed financing mechanism is shown in Figure 3. As shown in the Figure the ESCO will be responsible for collecting its money from the customer and paying the loan payments to the bank after deducting their postponed profit. Since neither CGC nor the bank will deal directly with the customer, therefore CGC issues guidelines for the ESCO on the criteria to accredit the customer. CGC has subcontracted the Egyptian Consulting Center (ECC) to provide support to the ESCO in doing this credit study to the customer. Furthermore ECC will provide marketing support to the ESCOs.

Figure 3. Loan Guarantee Mechanism

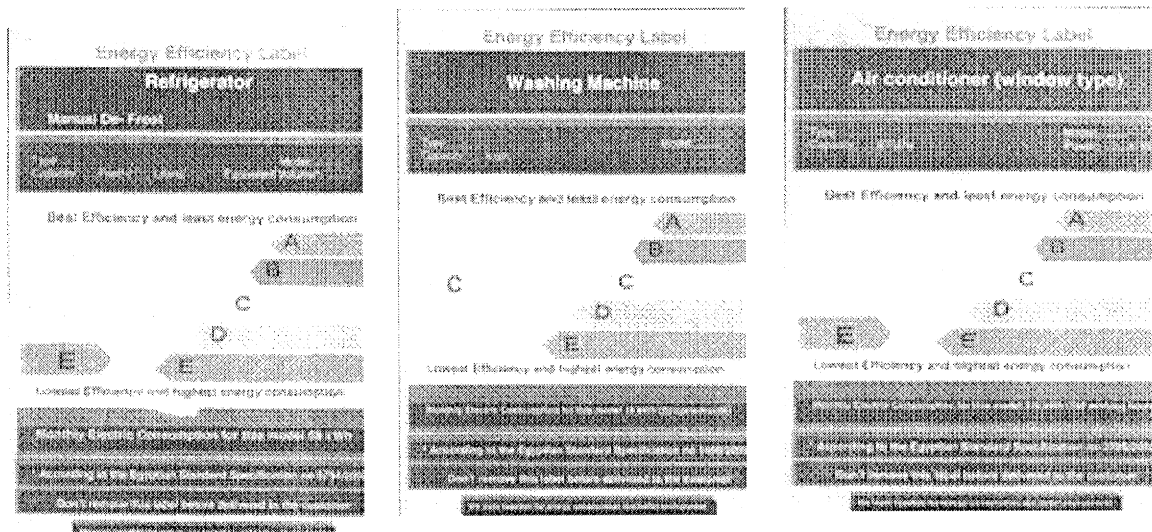


(2). Energy Efficiency Standards for New Equipment

There are no energy efficiency equipment or appliance standards in Egypt; the only standards for equipment pertain to health, safety or electrical technical compatibility. The objective of this activity is to develop and implement energy efficiency standards and labels to be applied. The standards and labels will be applied first on equipment selected based on the following criteria: degree of saturation, energy consumption intensity, growth rates and potential savings, where three equipment have been selected: refrigerators, air conditioners and automatic washing machines. Efficient technical specification as well as labels for refrigerators, air conditioners and washing machines have been developed and a ministerial approved by the ministry of industry and a ministerial decree has been issued to enforce the code application and the labeling system.

The project received a fund from the Thematic Trust fund with an amount of US\$ 300,000 to establish an accredited Energy Efficiency Testing Laboratory at the New and Renewable Energy Authority. The laboratory will test and certify the appliances and classify them according to the minimum energy efficiency standards as well as for labeling requirements. At present the testing laboratory for refrigerators and washing machines is ready for testing.

Figure 4. Labels of the Three Appliances



Several campaigns have been organized for education and social marketing of appliance standards and labeling program. To cope with efficient standards and to improve efficiency of selected appliances, manufacturers started to develop their products considering the change in market requirements for higher efficient products

(3). Energy Efficient Design and Construction for New Buildings:

Despite the considerable energy savings available; designers, builders and owners of buildings are either unaware or not interested in selecting building designs that reduce energy requirements, due to the fact that many energy efficiency design features have a higher initial cost.

On other hand there are no energy efficiency standards for building construction in Egypt. The project has focused on developing and applying a code of practice for energy efficient design in newly constructed residential and commercial buildings, and setting a plan for implementation and enforcement of this code.

One of the main objectives of the project is energy efficiency in buildings; it is to be realized through the development of an energy efficient code for Residential and Commercial buildings. This objective has been assigned to the Housing and Building Research Center (HBRC) of the Ministry of Housing. To fulfill the objectives, the activities were split into two resembling paths one for developing the residential code and the second for developing the commercial code. The two activity groups are performed in cascade, with 6-month overlap. Each objective includes five main activities:

- Revision of codes of countries with similar conditions, and development of the Egyptian code skeleton (outline)
- Survey of buildings and equipments and selection of a base case for different building categories in Egypt
- Code development and performing energy analysis and public reviews

- Planning for code implementation by considering the governmental steps and procedures involved
- Training and capacity building for all groups involved in the different stages of code analysis, development, implementation and enforcement.

The above activities required the formation of seven technical working groups namely; Building envelopes, HVAC, lighting, electrical, survey, simulation and training group.

Over 10 codes were reviewed, 125 buildings were surveyed, 10 training courses were conducted, over 800,000 simulations run executed, concepts in thermal comfort, partial condition buildings were developed, and sections of electrical and natural lighting were uniquely presented in the Egyptian.

The Energy Efficiency code for residential buildings was finalized (English and Arabic version). A public review meeting has been held to release the Arabic version for code enforcement through a ministerial decree by the Ministry of Housing Utilities & Urban Communities for the new buildings. As for the energy efficiency code for commercial buildings, the English version has been finalized and the Arabic version is under preparation for public review.

(4.) Energy Efficiency Center:

Energy efficiency markets need information that is: accessible, reliable, updated, and relevant. Without it, this market will be slow to emerge.

The energy efficiency center established within the project, and expected to sustain beyond the lifetime of the project, will act as information focal point and has the role of information provision, management, and dissemination. This is currently achieved through:

- Developing an energy information data-base for the electricity big consumers, this database contains information about the big consumers as well as electrical and thermal information such as annual electrical consumption, peak demand, power factor, contracted demand, annual fuel consumption...etc. The big customer's data are regularly updated and indices are communicated to distribution companies for improving their performance
- Increase public awareness through information campaigns, publications, forums and newsletters.
- Developing a project website: www.eeiggr.org, which contains a description of the project, achievements, energy tips, energy audit analysis, seminars and workshops.
- Developing an information data base for the energy audits including the various technologies used such as efficient lighting, efficient motors, process control, boiler tune up, HVAC systems, management systems, insulation, convert to gas, cogeneration...etc as well as detailed information about the total savings, CO2 savings, investments and pay back periods.

C. Component 3: Promotion of Co-generation

The target of this component is to reduce 3% of the total energy consumption by the year 2010 resulting in reducing CO2 production by 3 million tons; this will be achieved through:

- Establishment of Small Power Group within the Planning Department of EEHC
- Establish Safety and Interconnection Requirement for Parallel Grid Connection with Small Producers

- Create an Infrastructure for EEHC to Purchase Electricity from Small Producers
- Develop Industrial Co-generation and Agriculture Waste Projects for Small Power Production to introduce co-generation application, the project has created a small power group within EEHC's Planning Studies and Design Sector responsible for achieving this objective, up till now the following have been achieved:
 - Preparation of a legal framework for co-generation projects
 - Development of a power purchase agreement for small power producer.
 - Preparation of specification for required interconnection equipment.
 - Development of tariff structure for cogeneration.

Two demonstration projects were supposed to be implemented:

1. Co-generation pilot application in MOUT power plant at Dekhlah Oasis (remote isolated area)
2. Waste heat recovery application in an oriental resort at Sharm El sheikh. The oriental resort is a five stars resort located at Sharm El-Sheikh and relies for its power supply on an independent power producer (IPP) "Power House" through a BOO contract,

The techno-economic studies of these projects have proved to be feasible but after the latest increase of fuel prices, the pay back period of these projects was doubled, this led to reconsidering their implementation.

A new approach was adopted for the interconnection of the existed cogeneration in the industrial sector to increase their loading capabilities this will be as an addition of cogeneration power.

3. Improving Energy Efficiency Program in Egyptian Governmental Buildings

As the governmental sector is one of the high consuming sectors, reaching 4325 GWh for the year 2003/2004 and amounting to 0.8 Billion L.E. it was decided to conduct a study aiming at recommending actions to be taken in order to implement energy efficiency measures in Egyptian governmental buildings (EGBs).

In addition to the high consumption of EGBs, many other reasons led to the selection of the EGBs as a candidate for the study:

- The similarity of energy consumption patterns which support replication of feasible energy efficiency projects among governmental buildings.
- The existed electrical facilities are of old types and in many cases operate inefficiently.
- Procurements guidelines for new equipment in governmental buildings do not include energy efficient constrains or incentives.
- Lack of programs or efforts regarding raising the capabilities of the technical operators within EGBs on energy efficiency and energy conservation.
- Lack of awareness efforts directed to the employees occupying the EGBs regarding energy conservation practices.

Moreover, the electricity bills of most of the governmental buildings are paid partially by the administrative authority of the building according to their budget capabilities, the remaining of the electricity bills are paid by the Ministry of Finance through the annual settlement. This practice discourages any effort regarding improving energy efficiency or energy conservation.

The study was based on real consumption of all governmental buildings belonging to the different ministries, identification of energy consumption patterns, energy conservation opportunities and implementation of pilot projects.

The energy efficiency study on EGBs concluded three main clusters of recommendations on short, medium and long-term implementation timeframe.

The short-term recommendations include:

- Appointment of an energy manager for each governmental building provided with sufficient training, responsible for following up the energy conservation measures
- Conducting awareness programs targeting the employees occupying the governmental buildings.

The medium term recommendations include:

- Implementing retrofits of the current governmental building facilities especially for the lighting system, including replacement of incandescent lamps by the compact fluorescent lamps and using electronic ballasts instead of the magnetic ballasts, in addition of improving power factor for these buildings.

The long-term recommendations concentrate on:

- Developing governmental procurement guidelines to take into consideration energy efficiency concept. This stage will rely on the results and experience gained from the medium term recommendations.

The recommendations of this study have been presented by the Minister of Electricity & Energy to a Ministerial committee which approved it and decide to start its application.

To encourage the application of such programs, the Ministry of Electricity & Energy decided to start its implementation in the ministry buildings.

The Energy Efficiency Improvement & Greenhouse Gas Reduction Project (implemented by the Ministry of Electricity & Energy and funded by the UNDP and GEF) through its own resources, will finance the application of energy efficiency projects in the electricity distribution companies buildings by selecting two buildings, in each company, as an example. The distribution companies will reimburse the cost to the project according to the pay back period, after which the cost of savings will be shared equally by the distribution company and the project. This will act as a revolving fund to implement more energy efficiency projects.

4. Barriers and Actions Taken

A. Barriers

1. Difficulties facing diffusion of efficient lighting systems
2. Absence of an Existing Neutral Governmental Testing Facility for Accreditation of Energy Efficiency Tests Results
3. Lack of Capital Financing Required for Introducing Energy Efficiency Improvement Technologies
4. Difficulties Facing Loan Guarantee Scheme Application
5. Difficulties due to Required Changes in Legislation Concerning the Time of Use and Co-generation Tariffs
6. Low Consumer Awareness

B. Actions Taken

1. *Difficulties facing diffusion of efficient lighting systems:* The efficient lighting system market in Egypt is low mainly due to high capital cost and lack of public awareness. The project has faced these barriers by:
 - Replication of the leasing program applied at Alexandria Distribution Company in two other distribution companies for the diffusion of the CFL
 - Implementing a study for reducing the custom duties on imported CFL to minimize its cost.
 - Assisting local manufacturers to partially assemble some CFL components and electronic ballasts, currently three local manufacturers have been established and the project is organizing exhibitions to sell the compact fluorescent lamps to governmental employees.
2. *Absence of an Existing Neutral Governmental Equipment Testing Facility for Accreditation of Energy Efficiency Tests Results:* The project has succeeded in getting a US\$ 300,000 fund from the Thematic Trust Fund for establishing an accredited testing laboratory. The laboratory is ready for carrying the energy efficiency tests for the refrigerators and the washing machines.
3. *Difficulties facing Loan Guarantee Scheme Application:* This scheme has not been fully utilized due to the fact that local banks are reluctant in lending energy efficiency projects, due to their relatively small size and difficulty in understanding the technologies used in these projects. The project has developed a new loan guarantee mechanism and already several projects are under implementation benefiting from this scheme.
4. *Difficulties due to required changes in legislation concerning the time of use and co-generation tariffs* until the Cabinet of Ministers approves changes in legislation, the project is implementing pilot project for load shifting.
5. *Low Consumer Awareness:* Organizing several campaigns and assisting NGOs working in the field of energy efficiency to organize promotional campaigns all over the country in addition to press articles and media.

C. Lessons Learned

1. Increasing awareness of end users on energy efficiency is the most effective way to promote energy efficiency projects.

2. NGOs can play a significant role in public awareness campaigns, at least the residential sector.
3. The cooperation between the project and the GEF small grant program to encourage NGOs in implementing energy efficiency projects has been very successful in supporting NGOs as well as in disseminating energy conservation principles.
4. Project impact on policies is realized to be an important factor for achieving development objectives.

D. Conclusions

- Transmission and distribution losses can be decreased dramatically through applying energy efficiency measures such as:
 - Power factor correction
 - Redistribution of electrical loads
 - Improving characteristic of generating units
 - Optimum planning of electrical networks.
- Electrical energy consumption can be decreased by using efficiency lighting in residential and commercial sectors as it represents large percentage of the consumption in these sectors.
- Applying energy efficiency codes and standards for electrical equipment and buildings is a must to save energy. This needs a new legislation
- Promotion of co-generation project depends on energy pricing.

5. References

- Egyptian Electricity Holding Company (EEHC) Statistical Annual Report 2004/2005
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- Project Progress Reports 2004 / 2005
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