UNITED NATIONS

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ESCWA EEA EEAA

Distr.
LIMITED
E/ESCWA/ENR/1999/WG.3/2
9 June 1999
ORIGINAL: ENGLISH

Economic and Social Commission for Western Asia

Expert Group Meeting on the Harmonization of
Environmental Standards in the Energy Sector
of the ESCWA Member States
29 June - 1 July 1999
Cairo, Egypt

THE ENERGY RELEVANT ENVIRONMENTAL ISSUES IN THE INDUSTRIAL SECTOR - THE CASE OF EGYPT

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99-0567

THE ENERGY RELEVANT ENVIRONMENTAL ISSUES IN THE INDUSTRIAL SECTOR - THE CASE OF EGYPT

Ahmed Amin Abdel-Magid(*)

ABSTRACT

In this paper, the energy relevant environmental issues in the Egyptian industrial sector are discussed. It includes an analysis of the sector's structure and its available energy use data over the last five years (1992-1997), identification of the major energy efficiency/environment indicators of the industrial sector and a survey of the main environmental regulations and standards relevant to the Egyptian industry. In addition, the efforts within the sector to improve the efficiency and reduce the environmental risks are reviewed and the key strategic elements, policies, institutional measures and recommended procedures are discussed together with the required coordination for implementing environmental standards and norms in the Egyptian industry.

The main findings of the present work are the urgent need to develop a sustainable energy/environment information system allowing accurate analysis of the key issues servicing the national industrial policy and introducing the need to include "The Emission Factor" into the existing environmental regularity framework as a third dimension enabling quantifying the actual pollution burden from industrial sector. The paper also emphasizes the importance of two issues; the first is to develop and enforce an energy efficiency act for environment protection including and integrating all the scattered proposed measures and procedures towards establishing effective national standards and labeling programmes; the second is identifying a fiscal and economic incentive scheme to support the energy efficiency improvement and securing the continuous flow of energy/environment information from the industrial sector.

(*) Dr. Ahmed Amin Abdel-Magid, Director, Tebbin Meteorological Institute, Cairo, Egypt.

ABBREVIATIONS

CAIP	Cairo Air Improvement Project (USAID)
CO_2	Carbon Dioxide
DRTPC	Development Research and Technological Planning Center
DSM	Demand-Side Management
ECEP	Energy Conservation and Environment Project (USAID)
EEA	Egyptian Electric Authority
EEAA	Egyptian Environment Affairs Agency
EEPP	Egyptian Environment Policy Project (USAID)
EERC	Energy and Environment Research Center (Tabbin-Cairo).
EESBA	Egyptian Energy Service Business Association
EGPC	Egyptian General Petroleum Corporation
EI	Energy Intensity
EOS	Egyptian Organization for Standardization
FEI	Federation of Egyptian Industries
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Green House Gases
GOEIC	General Organization for Exports and Imports Control
GOFI	General Organization for Industrialization
IPCC	Intergovernmental panel on Climate change
KOE	Kilo-gram Oil equivalent
LE	Lever Egyptian (Egyptian Pound)
LPG	Liquefied Petroleum Gases
MEE	Ministry of Electricity and Energy
MIMW	Ministry of Industry and Mineral Wealth
MOP	Ministry of Petroleum
MST	Ministry of Supply and Trade
NREA	New and Renewable Energy Authority (Egypt)
NEC-WEC	National Egyptian Committee for the world Energy Council
NGOs	None Governmental Organizations
NRC	National Research Center
OBI	Overseas Bechtel Inc.
OEP	Organization for Energy Planning
SRA	Scientific Research Academy
TIMS	Tabbin Institute for Metallurgical Studies
TOE	Tonne Oil Equivalent
UNDP	United Nations Development Program
U$	United States Dollar
USAID	United States Agency for International Development

1. MAJOR ENERGY RELEVANT ENVIRONMENTAL ISSUES IN THE INDUSTRIAL SECTOR OF EGYPT

1.1 INDUSTRIAL SECTOR STRUCTURE IN EGYPT

The Egyptian industrial sector has more than 23,000 enterprises (public and private), which are classified according to nine industrial subsectors, and distributed over 26 Egyptian Governorates. The size of industrial plants vary widely between the huge public companies incorporating "399 enterprises" the major private sector plants and the huge number of small private enterprises. After the recent economic reforms, there is no differentiation between private and public enterprises, and the new industrial communities are considered within their designated governorates. According to the end of 1997 data, the investment cost of the industrial sector in Egypt reached about of 78,4 billion LE (23,467 billion US$), 152,929 million LE for salaries (2,122 billion US$) and 2,030,000 employees.

The distribution of the number of industrial enterprises over the industry subsectors is as follows(*):

1.	Textile , spinning , weaving and finishing	5,321
2.	Metallic products, tools and equipment	4,989
3.	Food , beverages and tobacco	4,399
4.	Wood and furnitures	2,454
5.	Basic chemicals and by products	2,089
6.	Building materials , ceramics and refractories	1,742
7.	Paper and prints	1,394
8.	Basic metals	363
9.	Others	532
	TOTAL	**23,283**

The highest industrial intensity is located in greater Cario area (Cario, Giza and Kaliobia) 12,023 plants, followed by Sharkia 2,889 plants, Alexandria 1,993 plants and dakahlie 1,167 plants.

Under the current economic reform strategy 314 from 399 public enterprises have been designated for possible privatization, and are assigned to 17 holding companies under the Minister for Public Sector Enterprise. All subsidies and price controls have been removed, and each enterprise is expected to operate on a business like basis to compete with the slowly emerging private sector in these areas. The current law allows the unrestricted sale of shares and assets of the 314 designated for privatization public enterprises and currently held by 17 diversified holding companies. The same law placed the maximization of profits as the prime guiding business objective which have a positive impact on the efficiency of energy use in the sector. Although a small portion of the public enterprises are financially viable, most require restructuring, recapitalization, and other internal changes before being offered to provide investors.

1.2 SPECIFICS OF ENERGY USE IN INDUSTRIAL SECTOR

1.2.1. Consumption Pattern

The industrial sector was the major energy consumer in 1996/1997. Its share reached 49% of the total final energy consumption in all economic sectors including about 32.11% of the total petroleum products consumption, 28.48% of the total natural gas consumption, 42.87% of the total electricity consumption (OEP Report 1996/1997).

In 1996/1997 the industrial sector total energy consumption reached 12.755 mtoe. It is distributed as 3,874,000 of fuel oil, 1,903,000 of gas oil, 1,006,000 of lubricants, asphalt and other products, 60,000 of LPG and 4000 of Kerosene. Natural gas consumption in industry, for the same year, was 2,940,000 TOE including NG for non-energy use. Electricity consumption in industry for 1996/1997 is equivalent to an additional 2,963,000 TOE.

1.2.2. Growth Tendency

Analysis of the final energy consumption in Egyptian Industry over the five years 1992/1993- 1996/1997 (DEP reports), considering 92/93 as a base year- is showing a growth rate factors over the four successive years 1.056, 1.32, 1.44 and 1.43. Despite the stagnation of consumption over the last two years, an average annual growth rate of 8.6% in the industry final energy use is recorded.

Considering the overall country final energy consumption growth rates over the same years which are 1.015,1.175, 1.275 and 1.297, giving an average annual increase of 5.94%, the comparison shows that the industry consumption growth rate is almost 45% higher than the country average final energy consumption growth rate.

Table (1.1) and figure (1.1) shown hereinafter summarize the growth tendency results of the industrial sector of Egypt with respect to the Country figures.

1.2.3 Efficiency Indicators

Considering the availability of energy and production data, the only available energy efficiency indicator is the "energy intensity". There may be different expressions for EI relating the coefficient to the unit GDP in reference to a specific base year. For example, it is possible to use final energy consumption or primary energy consumption in KOE per 1000 LE of GDP provided that the factor cost is at 1991/1992. Here, it is going to consider the final energy use intensity as an efficiency indicator for the analysis of industrial sector over the last five years 1992/1997. Taking longer analysis period is going to introduce the industry restructuring influences to the results.

TABLE 1.1 GROWTH TENDENCY OF THE INDUSTRIAL FINAL ENERGY USE (1000 TOE) W.R.T THE COUNTRY AVERAGE. 1992-1997 (1992/1993- BASE YEAR).

COUNTRY F.E USE	20.100	20.400	23.621	25.634	26.076
GROWTH EACTOR	1.00	1.015	1.175	1.275	1.297
INDUSTRY F.E. USE	8.900	9.400	11.725	12.825	12.750
GROWTH FACTOR	1.00	1.056	1.320	1.440	1.430

Figure 1.1. Comparison between industry and country final energy consumption growth factors over the years 1992-1997

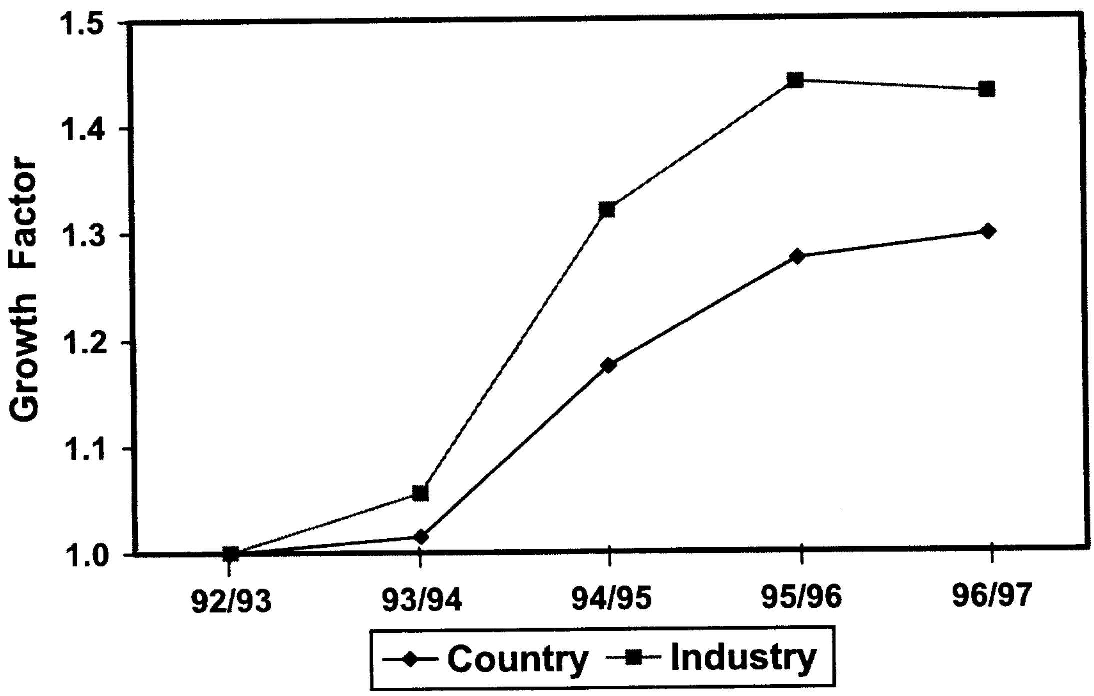


TABLE 1.2. FINAL ENERGY USE INTENSITIES FOR INDUSTRY AND THE COUNTRY OVER THE PERIOD 1992-1997

(Treated Data Are Based On OEP Official Reports)

	92/93	93/94	94/95	95/96	96/97
EGYPT GDP (10^9 LE)	134.300	139.200	146.149	153.369	161.488
INDUSTRY GDP (10^9 LE)	22.400	23.300	23.741	24.470	25.310
EGYPT FINAL E.U (10^6 TOE)	20.100	20.400	23.621	25.634	26.076
INDUSTRY FINAL E.U (10^6 TOE)	8.900	9.400	11.725	12.825	12.750
EGYPT F.E.U.I. (KOE/1000 LE)	150	147	161	167	132
INDUSTRY F.E.U.I. (KOE/1000 LE)	397	403	428	524	504
INDUSTRY F.E.U.I. RATIO To 92/93	1.00	1.02	1.08	1.32	1.27
INDUSTRY TO COUNTRY RATIO	2.65	2.74	2.66	3.14	3.80

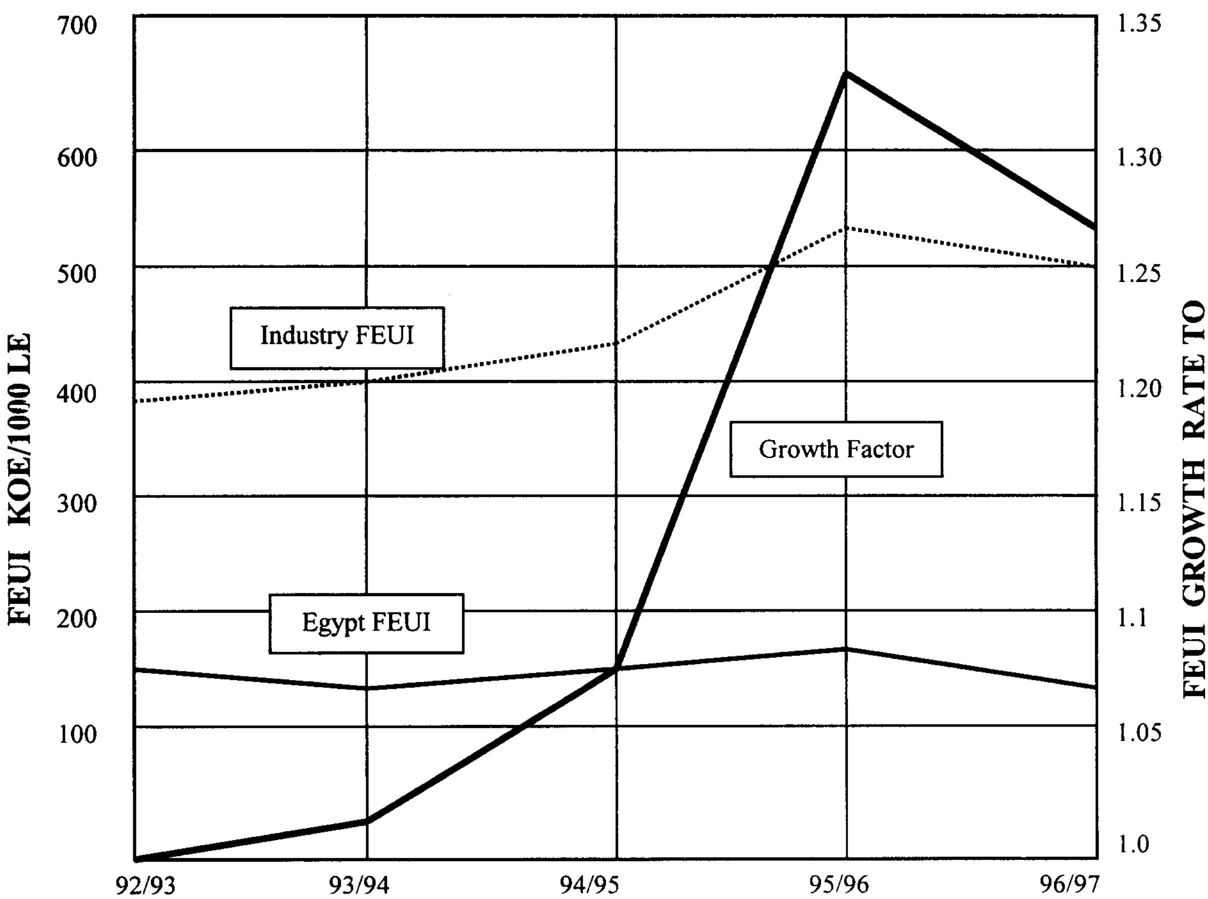


Figure 1.2. Industry And The Country Final Energy Use Intensities And The Growth Rate Of Industry FEUI With Respect To 92/93 Record.

Table (1.2) and figure (1.2) show a comparison between the industry and the country final energy intensity over the concerned period. For better indication, other factors like growth factors of intensities and the ratio of the two intensities are also provided. As shown by the table, the average annual increase of the industry F.E.U.I is about 6%, while the average ratio of industry to the country F.E.U.I is almost three to one.

1.3 ENERGY RELATED EMISSIONS IN INDUSTRIAL SECTOR

As shown previously, industry in Egypt is consuming different types of petroleum products, natural gas and electricity. Such energy consumption has several negative environmental impact particularly Greenhouse Gases emissions, which come in the top of the bad impacts of energy use reflecting what is called Global Warming and its effect on climate change. The increasing emissions of CO_2, followed by its increasing concentration, causes the climate change. In Egypt, one of the most bad impacts of climate change is expected to effect costal area of Nile Delta.

In general, fossil fuels, such as oil, natural gas, and coal are considered as the main source of CO_2 emissions through exploration, production, manufacturing, transportation and final consumption. The amount of CO_2 in tons per ton of liquid fuel is ranging between 2.95 and 3.22 , while it is 2.61 for NG (IPCC, 1996).

Other harmful emissions are also produced as a result of fuel burning like SO_2,NOx and the total suspended particulate TSP. for example, SO_2 concentration in waste gases of heavy oil used in Egypt is in average 0.4%, while it is 0.1% for light oil, and almost 0.0% for natural gas. The concentrations of Nox is about 0.132% for heavy oil, 0.057% for light oil and 0.021% for natural gas (ECEP-gas analyzer reports).

The average figures of the current fuel mix in the country is giving that for each TOE burned 12 kg of NOx, 5 kg of SO_2 and 0.7 kg of TSP are produced. (ECEP-reports).

The treatment of 1996/1997 OEP data shows that industry in Egypt is releasing totally 31.394 million tons of CO_2 to the atmosphere, among which 23.186 million tons from direct combustion of petroleum products, and 8.208 million tons released from electric power stations servicing industry. Considering that Egypt as a whole is releasing 85.00 million tons of CO_2 at the same year, the industry CO_2 burden is presenting 27.27% of the country total.

Taking into account the GDP developed by the country and industry, CO_2 intensity per unit, GDP in industry is amounted to 1240 kCO_2/1000 LE, while it is for Egypt 526 kCO_2/1000 LE, i.e. it is about 2.36 times as much as figure.

The above analysis is leading to the following important findings:

1. Industry is responsible for 49% of the final energy consumption in Egypt which leads to the release of 31.394 million tons of CO_2 beside other harmful emissions like SO_2,NOx, and TSP in 1996/1997.
2. The effectiveness of energy use in the sector is deteriorated by 27% over the last five years (about 6% increase in FEUI annually)
3. The development of 1000 LE GDP from industry is consuming 3.8 times as much energy and releasing 2.36 times CO_2 emissions as the country average.
4. Industry in Egypt is in urgent need to strategy for improving energy efficiency and reducing environmental risks.

1.4 HIGHLIGHTS ON THE MAIN ENVIRONMRNTAL REGULATIONS AND STANDARDS RELEVANT TO EGYPTIAN INDUSTRY

In 1994, Egyptian Law for the Environment (Law Number 4 for the year 1994) had been ratified and promulgated by the People's Assembly. In the First article of the law it had been stated that "Along with compliance to the regulations and provisions mentioned in the special laws, provisions of the attached law shall apply to the environment. Establishments existing at the time of promulgating this law shall be granted three years, from the date of publishing its executive regulations, to conform to the provisions of this law, **without affecting compliance to the protection of law 48/1982, which deals with the provisions of the river nile and waterways from pollution**".

However, since 1946, eight laws have been passed pertaining to waterquality and waste water discharges. Most of them have replaced pervious laws. Currently, Law No. 93 of 1962 and Law No. 48 of 1982 and their supplemental implementation decrees form the standing regulatory framework for wastewater discharges, water quality, and management.

Law 93 and its subsequent resolutions address a variety of water and sewerage related issues and applies to all general kinds of water bodies. According to the law, emitters of wast water must obtain licenses which "should indicate the standards and specifications of such wastewater." Samples from sewerage treatment plants should be periodically analyzed. The law also gives standards for wastewater discharged into public sewers according to eight criteria (temperature, pH, settleable solids, granular solids, hydrogen sulphide, fats, poisonous substances, and sublimating gases susceptible to ignition). Receiving bodies are devided into tow categories: public, commercial or industrial, and sewerage wastwater. Short lists of standards are then defined for each type of discharge into each of the three kinds of receiving bodies. In the case of discharge into seas and lakes, the law is very non-specific, forbidding discharges only when marine life is "harmfully affected".

Law 48, "regarding the protection of the River Nile and Waterways from Pollution", and its Decree No. 8, defines targeted water bodies and discharge types much more specifically for a long list site types, discharges, and conditions. Water bodies falling under the jurisdiction of this law include fresh surface waters, brackish surface waters, and groundwater reservoirs. Of particular interest are conditions under which permits and licenses must be obtained. The law is quite specific, defining standards for over 30 parameters for some water and effluent classification, including a variety of organic and inorganic chemicals. Finally, law 48 also establishes a fund for the collection of tariffs and fines, which is to be used to facilitate enforcement.

Before the Law No. 4, 1994, there were laws address only air pollution control, and 25 law and decrees within several ministries contain sections on the subject. Penalties and enforcement procedures often overlap among agencies and tend to be poorly defined. The Government of Egypt has defined ambient air quality standards for a sizable list of gaseous and particulate components, but standards tend to be inconsistent with international air quality standards, with some standards being much higher and others much lower.

However, the clean air regulations under law No. 4,1994 had succeeded to a larg extent in unifying the existing regulations.

For convenience, tables summarizing Egyptian Environmental legal Requirements for Industrial Wastewater, total particulates and maximum limits of gas and fume emissions from industrial establishments are attached as annexes to the present paper. For more details, it is advised to return back to refernces 23 and 26.

2. SURVEY OF ENERGY/ENVIRONMENT EFFICIENCY EFFORTS IN EGYPTIAN INDUSTRY

2.1 Overview

Despite the absence of a coordinated national strategy to improve industrial energy efficiency and reduce environmental risks, the last two decades show a lot of activities towards the improvement which had been done and many of them could be considered as scattered elements on the map of the absent strategy. The majority of these efforts had been well demonstrated in the national experts group works 7,14,15 and 20. However, one may group these efforts under the following defined fields:

- Establishing energy efficiency organizations and institutions. In particular; Supreme Energy Council, Organization of Energy Planning, Supreme Council of New and Renewable Energy, New and Renewable Energy Authority, the National Egyptian Committee for the World Energy Council and Energy and Environment Research Center at Tabbin Institute for Metallurgical Studies (Ministry of Industry & Mineral Wealth).

- Building Capacities within existing institutions to handle energy efficiency/environment issues. In particular; Energy Conservation and Environment Protection Units in Universities, National Research Centers, Academy of Scientific Research & Technology, Egyptian Electricity Authority and General Organization for Industrialization.

- Conducting industrial energy audits. In particular, about 35 detailed EA in large industrial companies were conducted by OEP and many other less-detailed audits had been carried out under different universities and research institutes, for example; ECEP energy audits conducted by TIMS & DRTPC.

- Implementing energy efficiency/environment demonstration industrial projects. ECEP/TIMS/DRTPC had implemented 30 capital investment projects in industry. The cost of energy efficient equipment reached 25 million U$ over the last 7 years (1991-1998). At 1985-1988, TIMS/UNDP had implemented 3 projects in glass and metallurgical industries for about 4 million U$ equipment. NREA, had also implemented few industrial low and medium temperature solar energy heating and drying in food, spinning and weaving and chemical industries. Industrial companies had also invested in energy efficiency technologies more than 150 million U$ mainly in cogeneration, industrial furnaces and boilers revamping and power factor improvement. More details about the implementation are included in references 7,9,14,15,20. and 24. However, the following table is summarizing the results of applications and limitation conditions related to Egyptian industry.

- Implementing national programs for low-cost energy efficiency and pollution prevention measures. The most important in this concern is the national program for boilers and furnaces tuning in 140 of the largest energy consuming industrial plants. The program had been implemented by ECEP/TIMS/DRTPC using USAID fund and technical assistance and resulted in about 30 million U$ fuel savings over the last 6 years. More details about the program are provided in item 1.5 and included in references 4 and 30. The cost of implementation didn't exceed 2 million U$ over the implementation period. In addition ECEP had also started two other pilot programs for demand side management and pollution prevention in industrial companies. The two programs showed promising results in the early years of implementation. OEP had also implemented large number of low cost measures in small and medium industries (1).

- Providing training on energy efficiency/environment protection technologies. In this concern, the largest training campaign in the country had been provided through ECEP/TIMS/DRTPC/FEI over the last 10 years. The total number of trained industrial engineers and specialists reached about 5000. However, OEP, universities and technical institutions had also conducted large number of training workshops for industrial people. Training under ECEP had efficiently used the demonstrated technologies to increase the industrial management awarness of economic environment and technical benefits of the applications. The evaluation of energy efficiency and pollution prevention training in the country is included in reference 9.

- Policy Successes. Egypt had undertaken a group of measures which can be considered as policy successes, regarding mainly the energy pricing and the conversion to natural gas use:

  Energy pricing:

  - Petroleum prices average 80% of economic levels in 1997 compared to 25% in 1990.

- Electricity prices average 100% of LRMC in 1997 compared to 50% in 1990.
- Issuance agreement with IMF to increase prices to economic levels by mid-1999.

Conversion to the Natural Gas Uses :

- Natural gas consumption in industry reached 27.41% of the total final energy consumption in the sector in 1996/1997 compared to 22.55% in 1993/1994. The amount of increase is 1.146 million TOE;
- The impact of NG conversion increse over the targeted period on environment is equivalent to 700,000 tons reduction of CO_2 emissions;.
- Further elaboration on natural gas conversion and its effect on emission from the industrial sector is provided under item 1.6 and with more details in reference 25;
- Distribution network of 2900 km of pipeline in 1997 compared to 650 km in 1982.

2.2 SUMMARY OF ECEP BOILERS & FURNACES TUNE-UP PROGRAM

A unique low cost tune-up program for the thermal units in the largest Egyptian industrial public sector plants has resulted in a saving of LE 84,812,500 in energy costs as well as a significant reduction in pollution by hazardous toxic substances. Targeted towards boilers, the major industrial consumers of fossil fuels, the USAID-sponsored Energy Conservation and Environment Project (ECEP) started in 1991. Currently in its second phase since January 1995, the project covers all of Egypt geographically and all sectors of industry, including Spinning and Weaving, Chemical Industries, Food industries, Metallurgical Industries, Mining and Refractores, Engineering and Petroleum Industrialization.

The project is based on the use of a portable electronic digital gas analyzer which allows the ECEP- trained industry staff to monitor and adjust the combustion efficiency of their boilers on a regular basis. Although 100 analyzers have been distributed to 81 companies to date, this data only deals with 60 of the analyzers (the ENERAC 2000 model) which were distributed to 54 public sector companies. Improvements relaized so far have already recovered the project costs (LE 3,340,000) ten-fold while realizing an annual energy saving of 7.7%. This represents a fuel saving of more than 208,000 T.O.E In addition to the energy benefits, the project has achived a huge reduction about 634,000 metric tons in toxic emissions to the environment of pollutants such as oxides of carbon, sulfur and nitrogen.

The project has several unique features. While the principle on which the analyzer is based, the optimum air –to-fuel ratio, is well-estalished, the instrument it self is new. Also, the key to the successful use of the analyzer and continuous monitring of industrial efficiency levels is a management challenge which the project has successfully met: how to maintain high and sustaninable standards in the use of the analyzer and the reporting of results when dealing with a wide spectrum of industrial end-users.

2.2.1 PROGRAMME BACKGROUND

In the Egyptian industry, a high potential of energy saving for the most of the operating thermal units can be achieved through combustion efficiency improvement procedures. Screening done for boilers, ovens and furnaces has shown that at least 25% of the industrial thermal units have the potential for significant savings through the application of combustion efficiency improvement measures.

Optimum combustion efficiency occurs when fossil fuel is burned with exactly the right amount of air to ensure complete combustion. In the industrial thermal processes using fossil, fuels as energy sources, care should be exercised in the indication of the degree of combustion completeness. Cofficient of air utilization is the main factor that influences the character of the burning process. If the mixing of fuel with air is poor, combustion is not completed. In this case, the combustion products will include combustibles such as carbon monoxide (CO) and hydrogen (H2). With good mixing, perfect combustion can be obtained, when the flue gas analysis indicates no CO, H2 or oxygen (O2) and when the percentage of carbon dioxide (CO2) is at a maximum. In case an axcess of air is supplied, a surplus of oxygen will be found in the flue gases giving a dramatic reduction in the combustion efficiency.

In local industry, excess air levels in combustion systems are generally higher than necessary. Saving can be realized if the cofficient of air utilization is adjusted. In existing opertional systems, fuel type, air/fuel ratio control systems, and burners are fixied and improvements are limited to optimizing combustion air. This means the system must be properly adjusted and operated. Proper adjustment or tune-up can only be done effectively with a combustion portable gas analyzer. Prior to the project, the use of such combustion analyzers was not widespread in Egypt.

2.2.2 PROGRAMME DESCRIPTION

The heart of the programme is the loaning of 60 portable electronic combustion analyzers to 54 public sector companies located throughout the country. The gas analyzer used by ECEP is an ENERAC model 2000, manufactured by Energy Efficiency Systems of Westbury, New York, USA. The instrument measures different gas parameters including combustion and temperature, and calculates combustion efficiency. Each unit includes sensors for measurement of oxygen, oxides of sulfur, carbon and nitrogen, unburned hydrocarbons and a thermocouple probe for measuring flue gas and ambient air temperature. The unit can be preprogrammed for the fuel type used. Combustion efficiency is automatically calculated by the unit's built-in microprocessors. The loan period is 12 months.

The participating company does not own the analyzer. The key point in the project's management success has been to make the companies responsible for the equipment. Before participating, companies commit to using the equipment on a regular basis and to submiting a monthly report to ECEP. This enables the compiling of a data base to track the success of the project as well as to enable ECEP staff to monitor the energy savings achieved by the individual industries, give feedback to each company and identify plants requiring additional training or assistance. At the outset, all industry staff receive a general training so they can operate the equipment with minimum assistance from ECEP staff.

In addition to this training and the establishment of the database, certain other sustainable features have been built into the programme. Additional training has been provided to key players. For example, engineers from the Development Research and Technological Planning Center of Cairo University (DRTPC), and the Tabbin Institute of Metallurgical Studies (TIMS), responsible for providing technical assistance in the private and public sectors respectively, received extensive training. These local engineers now train the staff in each recipient company. ECEP staff has also developed facilities for periodic calibration, testing and repair of the units. Thus, maintenance and calibration is now carried out locally on a regular basis.

2.2.3 BENEFITS TO EGYPTIAN INDUSTRY

Exhibits (1) and (2) show the energy improvements achieved in the different industrial sectors. Exhibit (1) demonstrates the ECEP/TIMS absolute amounts of fuel savings in T.O.E. for each sector over the three years successively while exhibit (2) gives the percentage of each sector's contribution to the total annual savings.

FUEL SAVINGS AND EMISSIONS REDUCTION BY INDUSTRIAL SECTORS

SECTOR	FUEL SAVING T.O.E.	CO Reduction, by Ton	CO2 Reduction, by Ton	NO_x Reduction, by Ton	SO_x Reduction, by Ton
Spinning & Weaving	80152	2695	227525	713	2851
Chemical Industries	81920	1674	229734	862	7129
Food Industries	23248	618	75628	320	3562
Metallurgical	8272	8.45	35079	591	137.6
Mining & Refractories	10391	109	29048	44	48.79
Engineering	2938	271.5	9601	39.25	484
Petroleum	1775	0.94	5148	4.27	63.3
Hospital	56		183	0.34	-2.9
Environment Protection Impact					

Exhibit 1. Fuel Savings and Emissions Reduction by Industrial Sectors

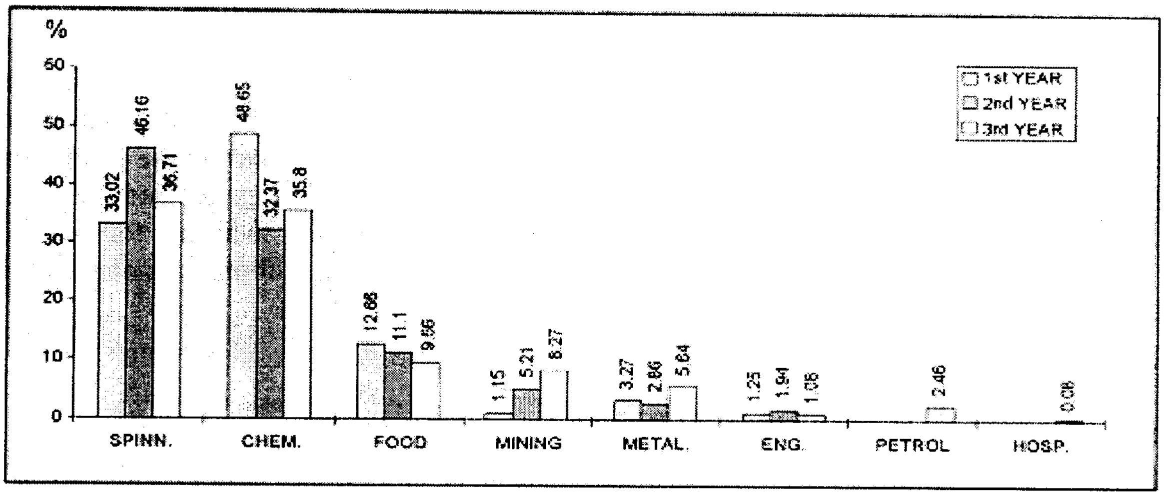


Exhibit 2 : Percentage Contribution of the Industrial Subsectors to the Annual Fuel Savings

The following table shows the programme impact on environmental protection. It specifies how much each industrial sector contributes to the reduction of different emissions.

This unique low-cost project has had many significant benefits for Egyptian Industry. The companies are currently using energy more efficient and paying for the same level of production, and consequently their profit increased.

2.2.4 LESSONS LEARNED

In addition to producing significant results, the project experience has yielded a number of valuable "lessons learned".

- Low cost measures distributed to many end-users can result in large savings normally difficult to achieve without a large capital investment, provided the project is managed effectively;
- It is more effective to adopt simple, locally handled and sustained technologies rather than high-level sophisticated systems with a short-term sustaining period;
- To facilitate project success, the individual companies must be responsible for the equipment and willing to accept project pre-conditions, such as the submission of monthly reports. The global statistics obtained from these reports have been valuable for the work of many energy and environment-related ministries and organizations. To collect this information, the programme must be supported by a very efficient database;
- There must be a high level of Egyptian technical support to repair the equipment. This expertise must be supported by an adequate spare parts inventory;
- There must be ongoing training, to train replacement personnel in the participating industries.

2.3 SUMMARY OF OEP STUDY ON FUEL SUBSTITUTION OF OIL WITH NATURAL GAS

The present study has investigated the switching to natural gas in industrial sector as GHG mitigation option. This study comes within the framework of Support National Action Plan (SNAP) in Egypt.

According to the SNAP technology assessment TOR, the main items included in the study are: (1) An overview on NG as a fuel; (2) Evaluation of the cost of using NG instead of petroleum products including capital and variable costs; (3) Estimation of specific cost of CO2 abatement (US$/ton CO2 saved); (4) Evaluation of effectiveness of switching to NG in terms of GHG mitigation; (5) Studying the effect of replication of switching to natural gas in industrial sector in Egypt; (6) Evaluation of technical, environmental, economical, and social impacts of substitution of petroleum products with NG as GHG mitigation option; and (7) Barriers against conversion to NG, and ways for diffusion of NG in industrial sector.

The data and information needed are collected through a field survey. A special questionnaire has been designed and distributed to a sample of industrial companies, where 80 companies have been selected representing the different industrial sectors in Egypt. Twenty companies among the 80 are converted to NG. Those 20 companies are considered the base case for the present work. In order to study the effect of switching to NG in industrial sector, two main options have been considered for in-depth evaluation. These options are: 1. Switching from gas oil to NG; 2. Switching from fuel oil to NG. Five cases for each option have been selected, where the percentage of NG is increased gradually by converting 20% of liquid fuel to NG for each case. About 18 spreadsheets have been designed using Ecxel software in order to perform the analysis and calculations.

The total NG consumption in Egypt is estimated by about 11,930 million cubic meter in 1994/1995, which represents about 0.51% from the total world NG consumption. The present NG consumption for energy use in industrial sector is about 2.26 million TOE per year, which represents about 27.5% from the total thermal energy in industrial sector. The present CO2, N2O, Nd CH4 emissions from industrial sector are estimated by 24.23 million ton/year, 931 ton/year, and 54 ton/year respectively. If the industrial sector working completely with natural gas, CO2 and N2o can be reduced to 18 million ton /year and 683 ton/year respectively, but, CH4 will be increased to 103 ton/year.

Based on the data collected from the field survey, the companies converted from gas oil to NG recorded about 27.7% reduction in CO2, and 7.4% energy saving. The companies converted from fuel oil to NG recorded about 32.7% reduction in CO2, and 8.4% energy saving. Where, the companies converted from kerosine to NG recorded about 26.5% reduction in CO2, and 7.4% energy saving. The reduction in CO2 per 1000 cubic meter NG consumed is estimated by 0.8 ton, 1.02 ton, and 0.76 ton for conversion from gas oil, fuel oil, and kerosine to NG respectively. Simple pay back period of conversion to NG is about 0.31year in the case of gas oil, and 3.19 year in the case of fuel oil. In average, the simple pay back period is less than one year (about 0.73 year). Many of the industrial companies have a desire to switch to NG, but they are facing barriers. High capital cost and remote of NG pipelines from the plants are the main barriers against companies to switch to NG.

Cost of CO_2 saved due to conversion from gas oil to NG is estimated by-103 US$/ton CO_2 (the negative sign means posisive revenue), and –122 US$/ton CO_2 in the case of kerosine. But in the case of Converion from fuel oil to NG, the cost of CO_2 saved is reached to –14 US$/ton CO_2. The analysis revealed that, there is a big opportunity due to replication of NG technology in all industrial sector in Egypt. For example. If all liquid fuel converted to NG, CO_2 reduction is expected to be about6.2 million ton /year (25.8%) and the revenue is about 257 million US$/year. Where the cost needed foe that is estimated by about 80 million US$.

Finally, conversion to natural gas is considered a very effective option for GHG mitigation. Natural gas has positive environmental, economic, technical, and social impacts.

3. THE KEY STRATEGIC ISSUES FOR REDUCING THE ENVIRONMENTAL RISK IN INDUSTRY

3.1 GENERAL FINDINGS

The previous survey on energy efficiency and emissions abatement efforts in Egyptian industry is pointing out to three main findings:

1. Absence of some key elements which are very strategic for efficiency improvement and reducing the environmental risk.
2. Absence of integration and continuity.
3. All the described above energy efficiency projects using national and international inputs had been carried out without a sustainable industrial energy information system covering private and public enterprises, which resulted in a considerably poor global monitoring and evaluation of the results over the sector.

3.2 THE KEY ISSUES

A part from the valuable achievement of the implemented projects, the current status incorporates a number of key issues for consideration, including:

- It can be easily noticed that, except pricing revisions and the restructuring of the industrial sector, there is no other policy element which may affect energy efficiency in industry, in particular:

- There is almost no energy efficiency related standards, although Egypt has some 3,000 standards in use and about 500 standards are under either preparation or revision. However, these ES are voluntary except for those related to public health, safety, consumer protection and sometimes export.

- There is almost no energy efficiency testing laboratories, testing procedures, accredited testing facilities, and energy labelling which represents the major elements in many EE national standards programme.

- There is almost no fiscal and/or economic incentives for energy efficiency promotion such as, income tax credit or reduction, accelerated depreciation, or reduction on tax for industrial energy efficient equipment. There is also still no investment subsidies or soft loans to finance the implementation of high energy performance technology.

- There is almost no supportive policies include government procurement requirements, voluntary programs, incentives to manufacturers of efficient equipment, consumer awareness campaigns and wide scale industrial demand-side management and integrated resource planning.

- Regarding integration and continuity there still much difficulties among cross-ministries energy efficiency activities especially in the area of information exchange and regulations.

- The recently approved environmental law number 4 for 1994, and its related regularity executive framework, is only focusing on the concentrations of pollutants coming from fossile fuels burning which gives just two-dimension picture regarding the evaluation of real pollution burden. Still there is no action plan to add the third dimension to the picture through the introduction of emission factor per unit product to express the effect of energy efficiency on the amount of pollutants released to atmosphere.

3.3 THE RECOMMENDED PROCEDURES AND INSTITUTIONAL LINKS FOR IMPLEMENTING ENVIRONMENTAL STANDARDS AND NORMS RELATED TO ENERGY USE IN THE EGYPTIAN INDUSTRY.

To realize less environmental risks from energy use in industry, i.e. reduce emissions and enhance energy use performance, Egyptian industry is in need to secure for it energy efficient equipment, man-power resources well oriented to energy efficiency practises, energy efficiency services through capable and flexible providers, fiscal and economic incentives encouraging investment in energy efficient and environment protection technologies and to facilitate the flow of technical information about vendors, products and processes.

This can be only done through integrated structure combining the efforts of energy/environment related institutions and organization in one unified structure having the following components:

1. A regularity frame in the form of inforced "Industrial Energy Efficiency Act".
2. Industrial Energy Efficiency Information System, sustainable and confident.
3. Energy Efficiency services system, flexible and capable for matching industrial needs
4. Standards/Norms Energy Efficiency Development System having governmental support to protect the industry from penetration of biased EE technologies and to promote the diffusion of environmentally-sound technologies in Egyptian industry.
5. Fiscal/Economic Incentives System grouping some of taxation and custom regulations suitable for the Country economy conditions and allowing promotion of EE/Environmentally-sound technologies in industry.

6. International Technical Assistance/Donors System enjoying high degree of coordination to avoid duplications and to maximize the use of donors inputs in EE industry.
7. Building Man-Power EE Capacities System including internal evaluation mechanism to provide suitable training services to the different technical levels within industrial enterprises.

4. CONCLUSION

Figure 4.1 shows the author recommended Industrial Energy Efficiency Structure for abatement of environmental risks in Egypt. The figure shows also the institutional links which integrate the system activities together. Figures from 4.2 to 4.8 give the details of the 7 supporting sub-systems elements and their communication channels.

ANNEX 1

EGYPTIAN Envirnmental Legal Requirements for Industrial wastewater

Parameter (mg/l unless otherwise noted)	Law 4/94 Discharge in Coastal Evnvironment	Law 93/62 Discharge to Sewer System (as modified By Decree 9/89)	Law 48/82 Discharge into			
			Underground Reservolr& Nile Branches/Canals	Nile (Main Stream)	Drains:	
					Municipal	Industrial
BOD (5 day,20 deg.)	60	<400	20	30	60	60
COD	100	<700	30	40	80	100
PH (units)	6-9	6-10	6 9	6-9	6-9	6-9
Oil & Grease	15	<100	5	5	10	10
Temperature (deg.)	10 c > avg. temp. of receving body	<40	35	35	35	35
Total Suspended Solids	60	<500	30	30	50	50
Settleable Solids	-	<10	-	20	-	-
Total Dissolved Solids	2000	-	800	1200	2000	2000
PO4	5	<5	-	1	-	10
NH3- N (Amonia)	3	<100	-	-	-	-
NO3- N (Nitrate)	40	<3	30	30	50	40
Total Recoverable Phenol	1	<0.005	.0.001	0.002	-	0.005
Fluoride	1	<1	0.5	0.5	-	0.5
Sulfide	1	<10	1	1	1	1
Chlorine	-	<10	1	1	-	-
Surfactants	-	-	0.05	0.05	-	-
Total Coliform Cells /100 ml	5000	-	2500	2500	5000	5000
Aluminum	3	-	-	-	-	-
Arsenic	0.05	-	0.05	0.05	-	-
Barium	2	-	-	-	-	-
Beryllium	-	<10	-	-	-	-
Cadmium	0.05	<10	0.01	0.01	-	-
Chromium	1	Total conc. For these metals should be : 0-10 for flow <50 m3 /d 0.5 for flow >50m3/d	-	-	Total conc. For these meatals should be : 1for all flow streams	
Chromium Hexavalent	-		1	1		
Copper	1.5		1	1		
Iron	1.5		1	1		
Lead	0.5		0.05	0.05		
Manganese	1		0.5	0.5		
Mercury	0.005	<10	0.001	0.001	-	-
Nickel	0.1	<10	0.1	0.1	-	-
Silver	0.1	<10	0.05	0.05	-	-
Zinc	5	<10	1	1	-	-
Cyanide	0.1	<.01	-	-	-	-
Total Metals	-	0-10for flow <50m3/d 05 for flow >50 m3 /d	0.1	1	1	1
Organic Compounds	Should be absent	Should be absent	Should be absent	Should be absent	Should be absent	Should be absent
Pesticides	Should be absent	Should be absent	Should be absent	Should be absent	Should be absent	Should be absent
color	Should be absent	Should be absent	Should be absent	Should be absent	Should be absent	Should be absent

ANNEX 2

PERMISSIBLE LIMITS OF AIR POLLUTANTS IN EMISSIONS

This annex refers to gaseous, solid, or liquid air pollutants emitted by different establishments within certain periods of time that result in harm and damage to public health, animals, plants, materials, or properties, or that interfere with people's daily lives. The emission of pollutants at concentrations higher than these is therefore considered air pollution in excess of the maximum permissible limits for outdoor air.

TABLE 1. TOTAL PARTICULATES

NO.	KIND OF ACTIVITY	MAXIMUM LIMIT FOR EMISSONS (mg/m3 in exhaust)
1	Carbon Industry	50
2	Coke Industry	50
3	Phosphate Industry	50
4	Ingots Industry, Extraction of lead Zinc, Copper, And other Non- Ferrous Metallurgical Industries	100
5	Ferrous Industries	200 Existing 100 New
6	Cement Industry	500 Existing 200 New
7	Industrial Timber and Fibers	150
8	Prtroleum Industries and Oil Refining	100
9	Other Industries	200

ANNEX 3
MAXIMUM LIMITS OF GAS AND FUME EMISSIONS FROM INDUSTRIAL ESTABLISHMENTS

	POLLUTANT	MAXIMUM LIMITS FOR EMISSIONS (mg/m3 in exhaust)
	Aldehydes (measured as formaldehude)	**20**
	Antimony	**20**
	Carbon Monoxide	**500 Existing 250 New**
	Sulfur Dioxide (Burning Coke and Petroleum) Non-ferrous Industries Sulfuric acid Industry	 **4000 Existing 2500 New** **3000** **1500**
	Sulfur Trioxide in addition to sulfuric acid	**150**
	Nitric Acid (Nitric Acid Industry)	 **2000**
	Hydrochloric Acid (Hydrogen Chloride)	**100**
	Hydrochloric Acid (Hydrogen Floride)	**15**
	Lead	**20**
	Mercury	**15**
	Arsenic	**20**
	Heavy elements (total)	**25**
	Silicon Fluoride	**10**
	Fluorine	**20**
	Tar (Graphite Electrode Industry)	 **50**
	Cadmium	**10**
	Hydrogen Sulfide	**10**
	Chlorine	**20**
	Carbon Garbage Burning Electrode Industry	 **50** **250**
	Organic Compunds Burning of Organic Liquids Oil Refining	 **50** **0.04 % of crude**
	Copper	**20**
	Nickel	**20**
	Nitrogen Oxides (Nitric acid Industry)	 **3000 Existing 400 New**
	Other Industries	**300**

FIG. 4.1 RECOMMENDED INDUSTRIAL ENERGY EFFICIENCY STRUCTURE FOR ABATEMENT OF ENVIRONMENTAL RISKS

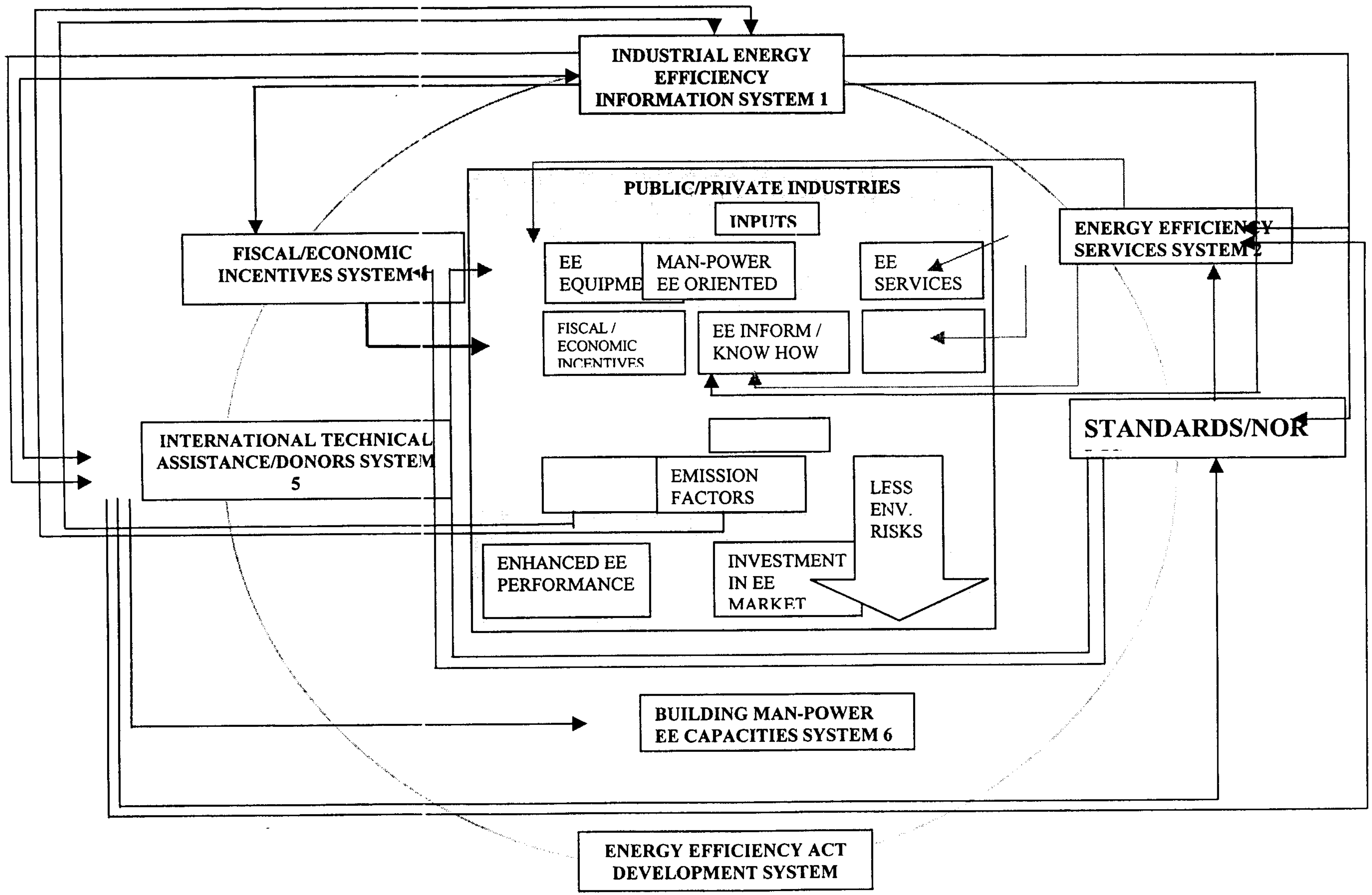


FIG. 4.2

STRUCTURE OF INDUSTRIAL ENERGY EFFICIENCY ACT DEVELOPMENT SYSTEM

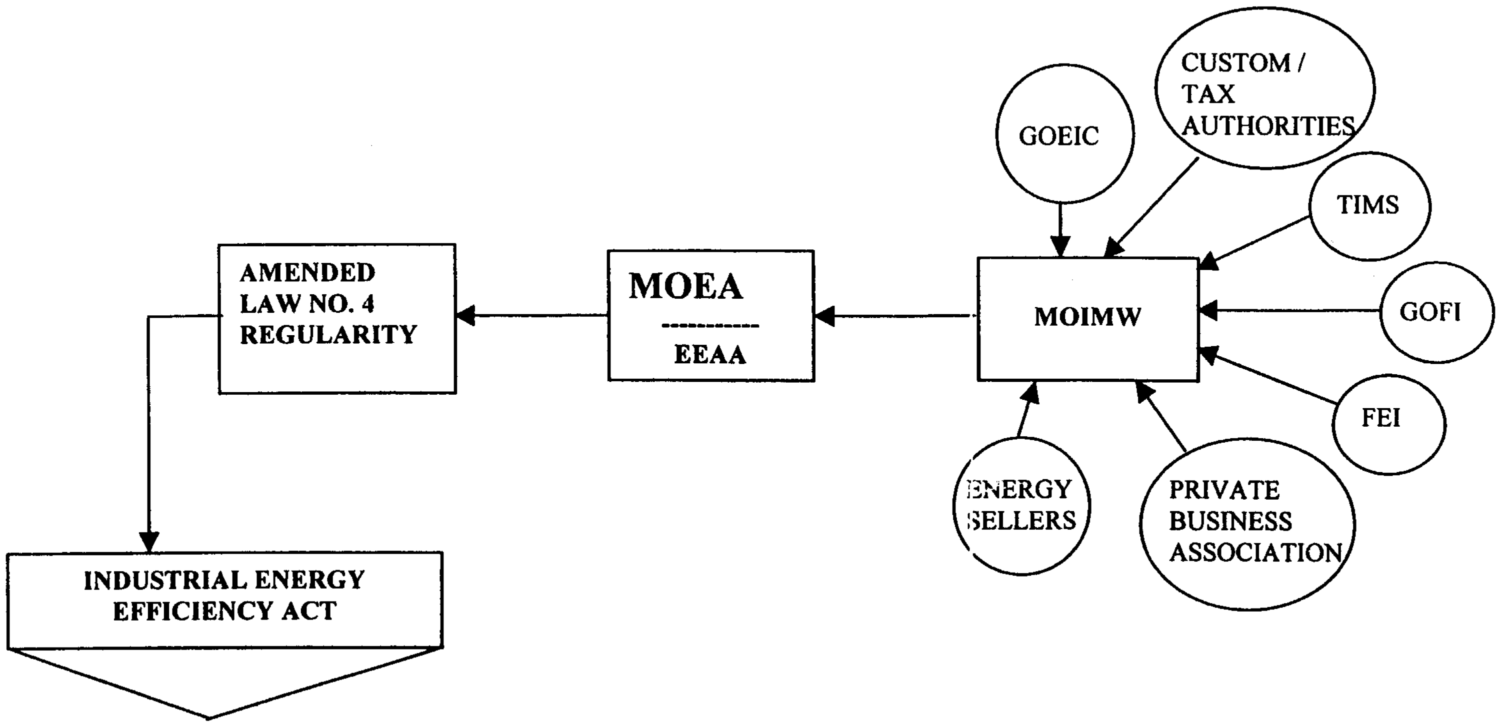
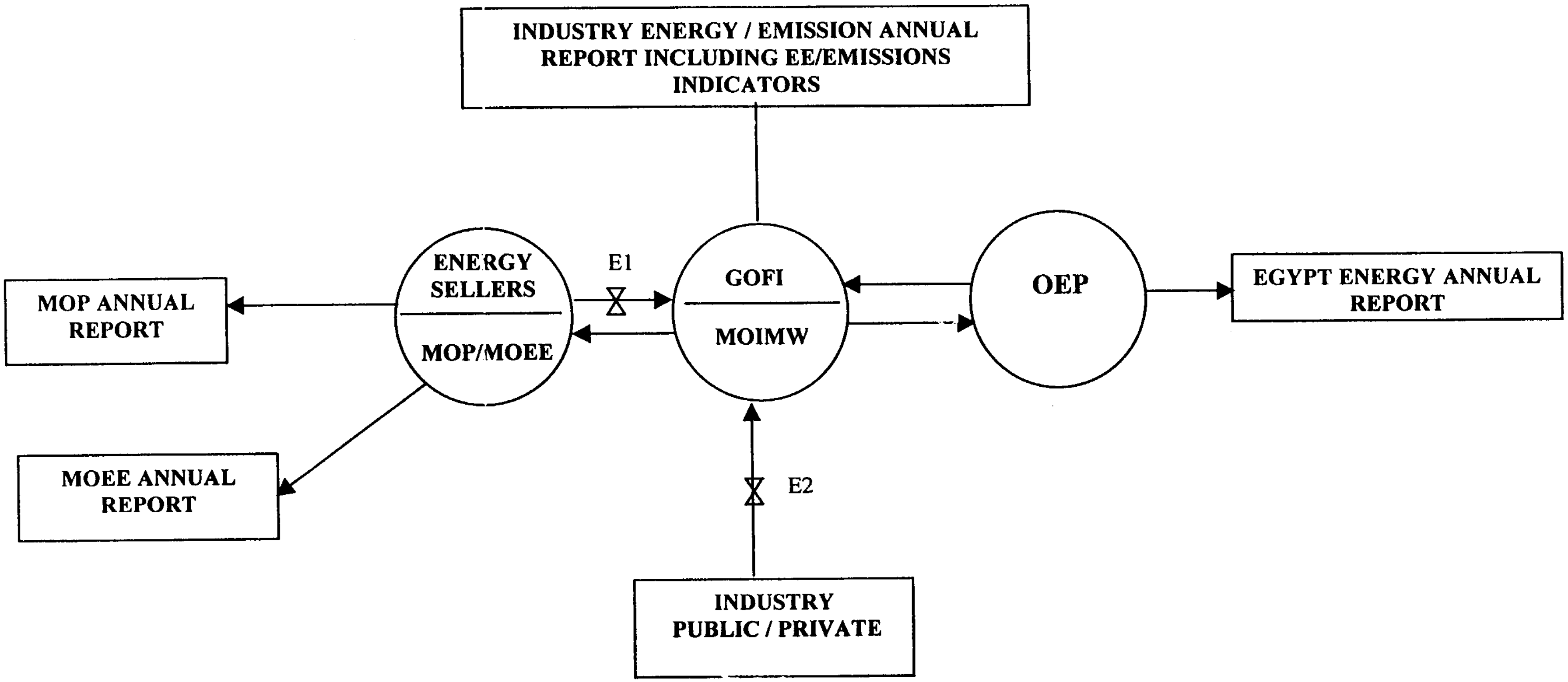


FIG. 4.3

STRUCTURE OF INDUSTRIAL ENERGY EFFICIENCY INFORMATION SYSTEM



E1 & E2 - Elements 1&2 included in the proposed ENERGY EFFICIENCY ACT to secure information flow to GOFI

FIG. 4.4

STRUCTURE OF ENERGY EFFICIENCY SERVICES SYSTEM

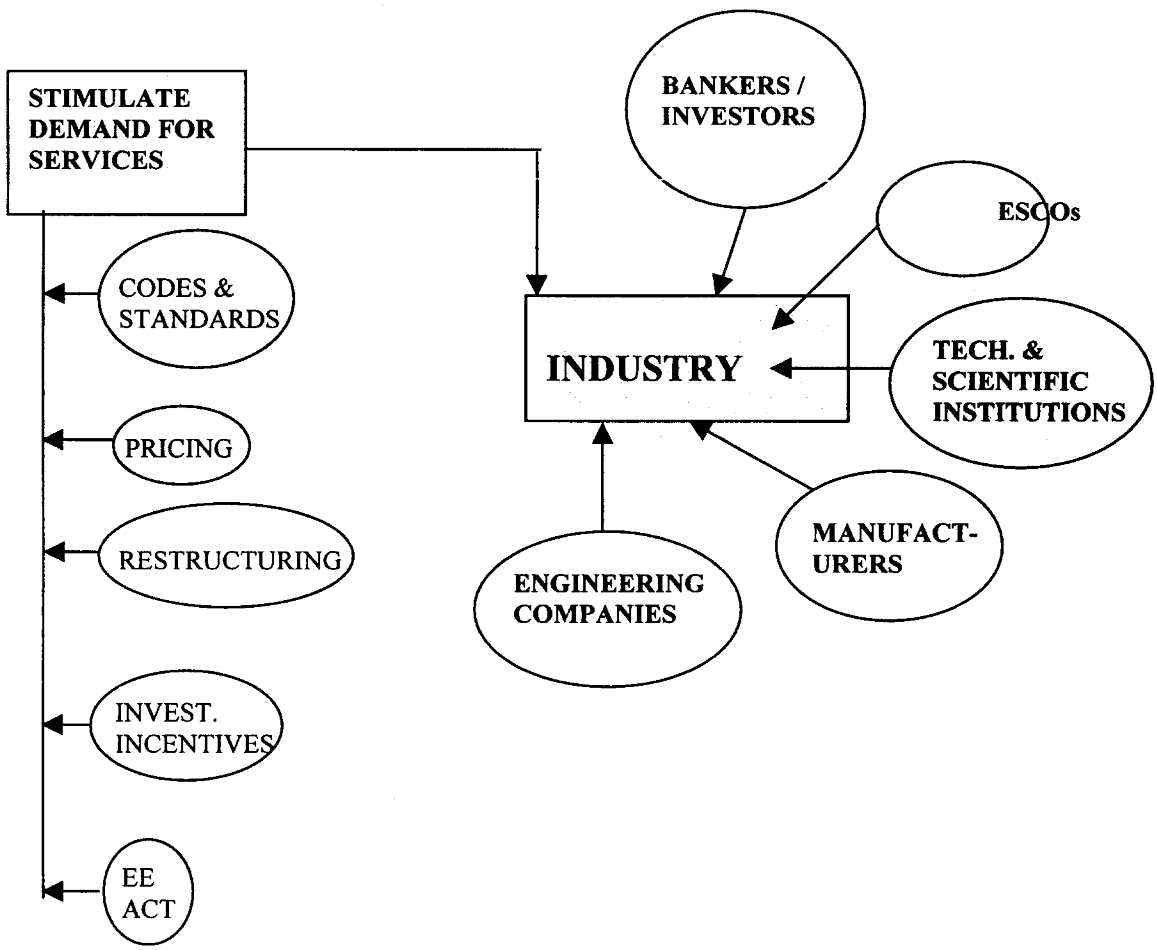


FIG. 4.5 **STRUCTURE OF STANDARDS / NORMS DEVELOPMENT SYSTEM**

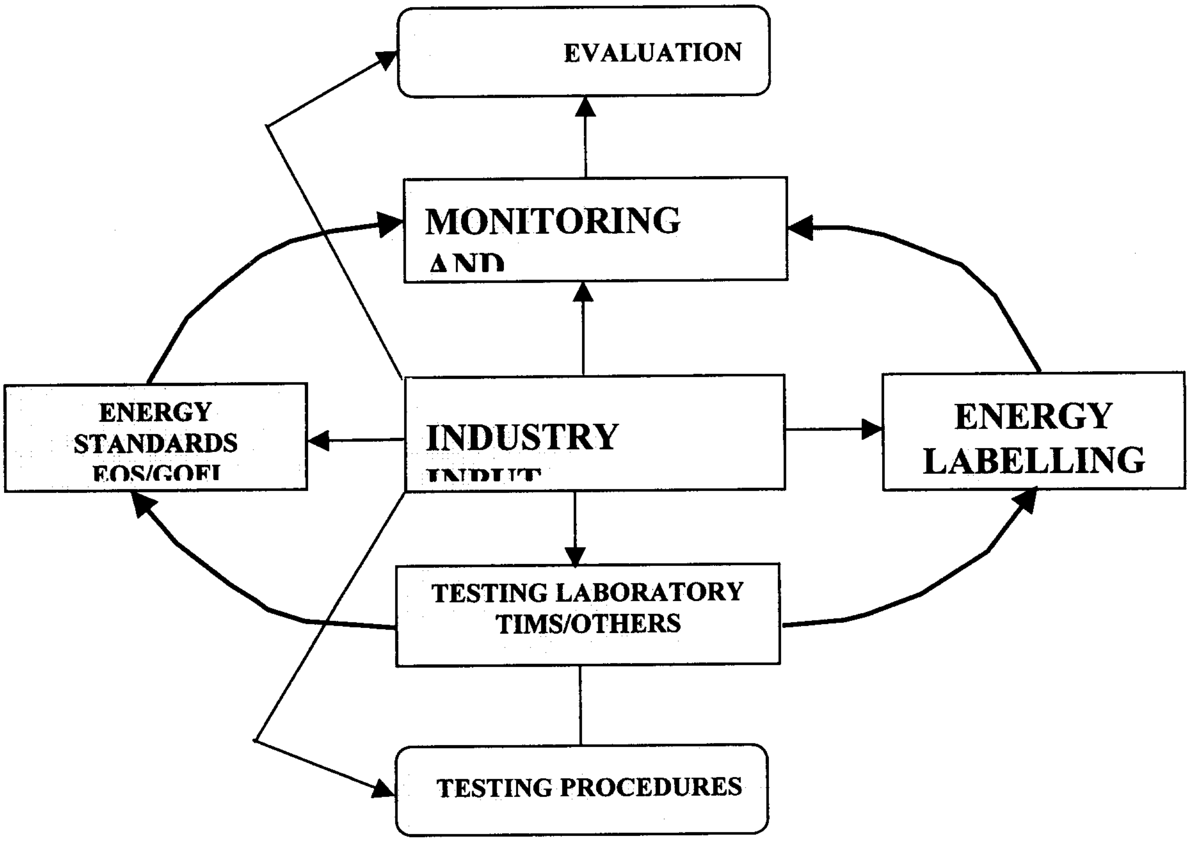


FIG. 4.6 STRUCTURING OF BUILDING MAN-POWER ENERGY EFFICIENCY CAPACITIES SYSTEM

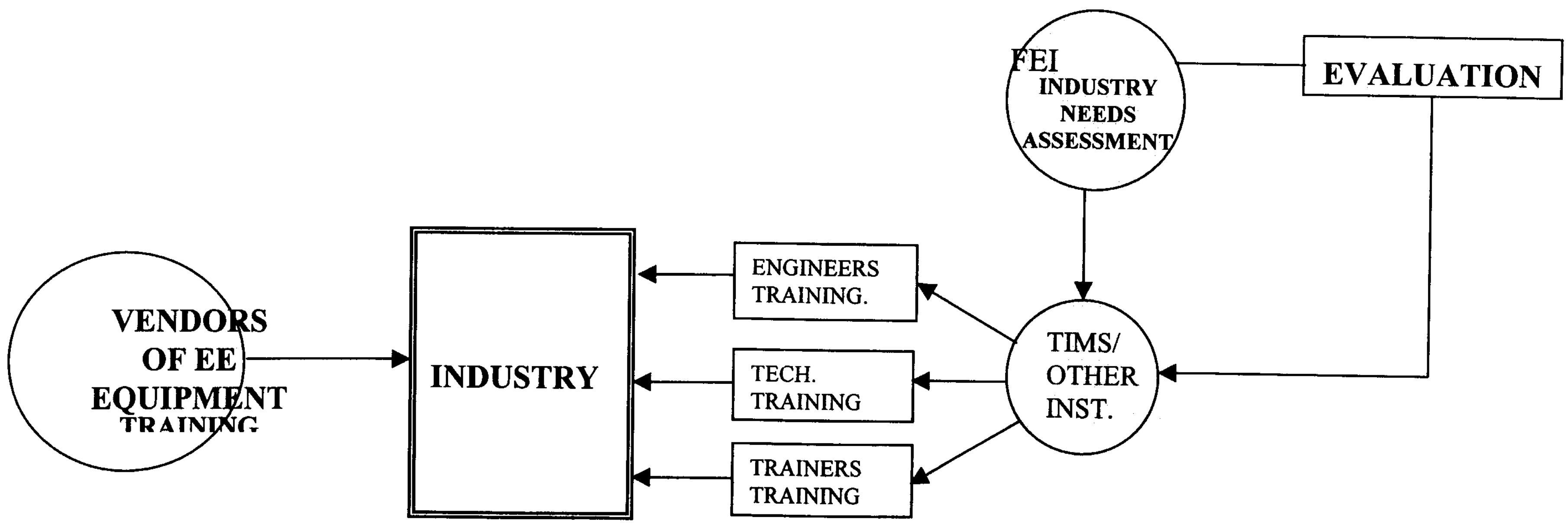


FIG. 4.7 STRUCTURE OF INTERNATIONAL TECHNICAL ASSISTANCE / DONORS SYSTEM

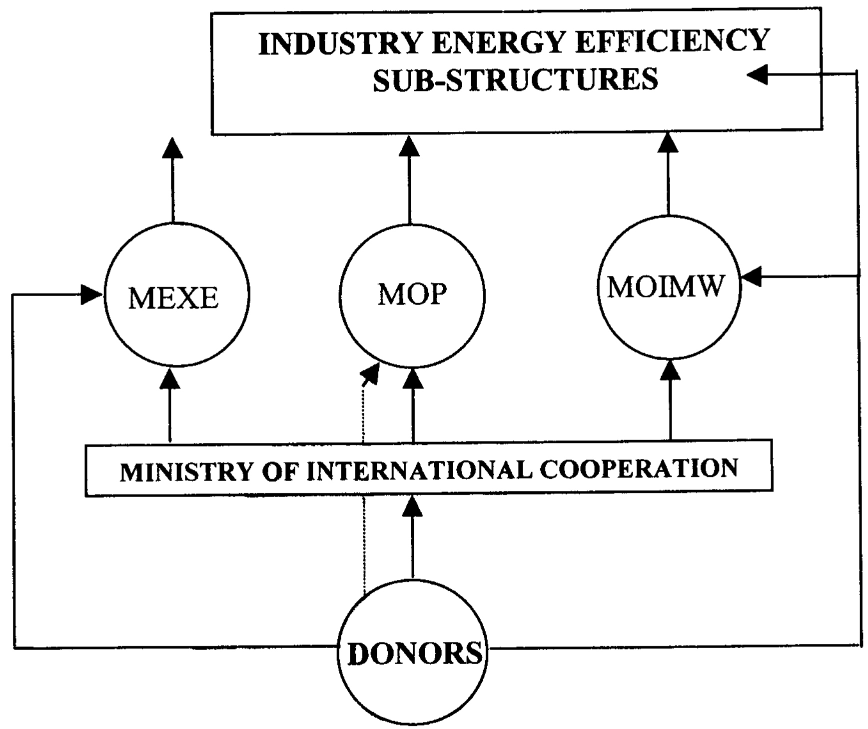
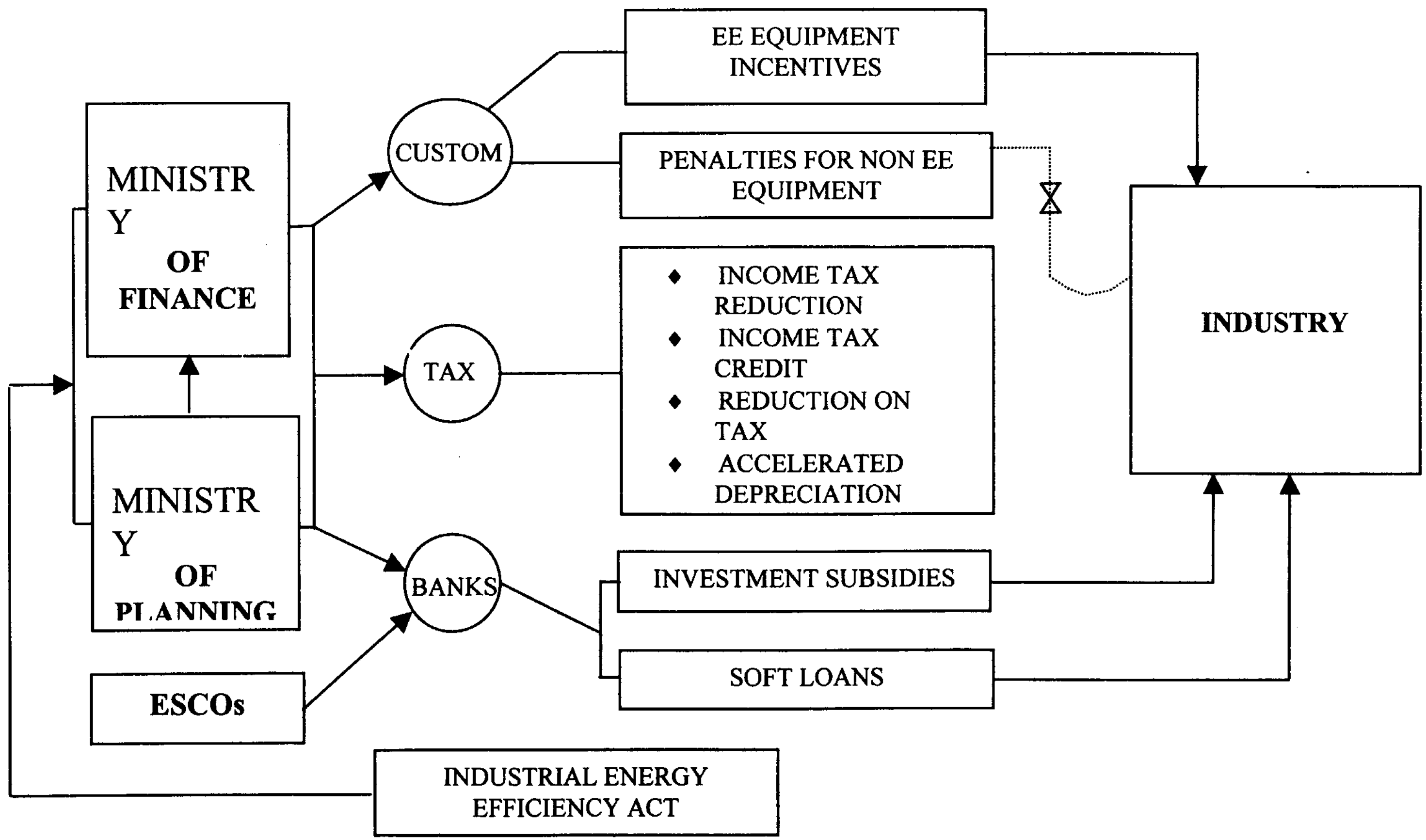


FIG. 4.8 STRUCTURE OF FISCAL / ECONOMIC INCENTIVES SYSTEM



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