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INVESTIGATION OF SOCIO-ECONOMIC AND ENERGY INDICATORS IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT: EGYPTIAN CASE STUDY

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ABSTRACT

Egypt is characterized by high rate of population growth and increasing rate of urbanization as efforts to build new communities expanded to several regions. Egypt area is about 1 M km^2 of which almost 30000 km^2 cultivated land. Urban population constitutes 46% and 54% rural population. As, electricity demand is growing rapidly in Egypt, so efforts are directed at developing the use of renewable energy technologies in rural and remote areas. Renewable energies in Egypt are planned to reach 20% penetration by 2020, mostly from wind farms. In terms of energy indicators for sustainable development, Egypt maintains high electric accessibility, safe production and almost satisfied end use. Some social, economic and environmental energy indicators are studied and general evaluation of different energy sources is presented. This research is carried out through MEDRES project which is funded by EC[1]. The required data is collected, validated and analyzed to reach some formal indicators of energy environmental impacts. All over the world there is a very strong potential for using renewable converters such as wind energy converters, photovoltaic generators, hydro power, etc. under favourable conditions. The use of renewable energy is one of the most promising methods to reduce CO_2 and other greenhouse emissions. Estimated CO_2 emissions in year 2004 were found to be 37% of CO_2 emissions due to energy, 35% due to industry, 14% due to transportation and 14% due to other sectors. In 2020 it is expected that 40% will occur due to energy.

تتميز مصر بارتفاع معدلات النمو السكاني وازدياد معدل التحول إلى الحضر في التجمعات السكانية، نتيجة الجهود المبذولة لبناء مجتمعات جديدة والتي امتدت إلى أنحاء عديدة من مصر. ومساحة مصر حوالي مليون كم٢ المزروع منها حوالي ٣٠٠٠٠ كم٢. وتشكل التجمعات الحضرية حوالي ٤٦% من السكان بينما تحظى التجمعات الريفية بالنسبة الباقية (٥٤%). ولما كان الطلب على الطاقة الكهربية متزايدا في مصر، فإن الجهود توجهت إلى تطوير استخدام تقانات الطاقة المتجددة في التجمعات الريفية والمناطق النائية. ومن المخطط له أن تصل نسبة استخدام الطاقة المتجددة في مصر إلى حوالي ٢٠% بحلول عام ٢٠٢٠م، وذلك من طاقة الرياح بصورة رئيسية. وبلغة مؤشرات الطاقة للتنمية المستدامة، فإن مصر تتمتع بقدرة وصول عالية إلى مصادر الطاقة الكهربية، وفرص إنتاج آمن لها ومستوى استخدام مرض في معظم الأحوال تقريبا. وقد تمت دراسة بعض المؤشرات الاجتماعية والاقتصادية والبيئية الخاصة بالطاقة، كما تم تقديم وعرض التقييم العام لمختلف مصادر الطاقة في مصر. وقد تم إجراء هذا البحث كجزء من مشروع MEDRES الذي تموله السوق الأوروبية المشتركة. وقد تم جمع البيانات اللازمة، والتحقق من صحتها وتحليلها وصولا إلى بعض المؤشرات الرسمية للآثار البيئية للطاقة واستخداماتها. وتسود العالم أجمع الآن موجة قوية من الاتجاه إلى استخدام محولات الطاقة المتجددة مثل محولات الرياح، ومعدات التوليد الضوئي الفولطي، ومولدات طاقة المياه، ... إلخ، وذلك بالاستفادة من المصادر المتاحة. ومن المعلوم أن استخدام الطاقات المتجددة يعد من أفضل الطرق الواعدة لتقليل انبعاثات ثاني أكسيد الكربون وباقي الانبعاثات الغازية المتعلقة بظاهرة الصوبة الزجاجية. وقد تم تقدير انبعاثات ثاني أكسيد الكربون في عام ٢٠٠٤م، فوجد أن ٣٧% منها ناتج عن الطاقة، و ٣٥% بسبب الصناعة، و ١٤% بسبب وسائل النقل، بينما يعود ١٤% منها إلى قطاعات أخرى. ومن المتوقع أن تصير نسبة انبعاثات ثاني أكسيد الكربون في عام ٢٠٢٠م الناشئة عن الطاقة حوالي ٤٠%.

Keywords: Socio-economic indicators, Energy indicators, CO_2 emissions, Renewable Energy

[1] "Cost Effective Renewable Energy for rural areas in Mediterranean region". EU Contract No. INCO-CT-2006-032020

1. INTRODUCTION

Sustainable development is a global objective that aims to respond to the needs of current generations without compromising the abilities of future generations to meet their needs. This emphasizes the need to change unsustainable production and consumption patterns to optimize the management of the natural resources sustainably for economic and social development, and help in reducing the gaps between developed and developing countries. The implementation of a sustainable energy strategy is a challenge and an opportunity to make joint progress in the field of human and economic development, using environmentally safe technologies. The strategy focuses on the integration of both energy and environmental aspects into key economic development sectors. To follow up the implementation of the strategy, a set of indicators will be discussed and investigated.

The energy policy in Egypt gives priority to the diffusion of natural gas through the substitution of oil by gas, for electricity production as well as for private and public transportations. Nearly all Egypt's electric generating capacity is powered by natural gas (NG), while the rest comes from hydroelectric power plants (around 14% of the total generated electricity) from the Aswan High Dam and small hydro along the river Nile [1]. Thermal power plants which are fired by NG supply 84% and about 1% from RE. A privatisation plan of the energy sector is on the way, provided that the sector remains under governmental control. Egypt has some privately owned power plants currently under construction that are financed under BOOT financing schemes.

Renewable energies have played an important role for energy supply purposes since the beginning of the last quarter of the 20th century, especially after the rapid increase of oil prices and trials to minimize the emission gases arising from fossil fuels for electrical power generation. The use of renewable energy sources in Egypt has distinct advantages from economical and ecological points of view. Furthermore, it could help to reduce the dependency on conventional energy sources.

Renewable Energy in different forms like solar thermal in the form of Domestic Solar Water Heater (DSWH), wind as wind farms, especially at Gulf of Suez and Red Sea Coast, and different PV applications are receiving more attention. Different biogas projects are scattered in some villages across the country, and small pilot projects for biodiesel fuels extracted from Jatropha are undergoing.

2. Renewable Energy in Egypt

Greenhouse gases, which contribute to global warming and climate change, are of major concern. In Egypt, the coastal areas and Nile Delta are particularly vulnerable to a rise in the level of the oceans-one of the most likely results of global warming.

2.1. Renewable Energy and CO_2 Emissions

Carbon constrains were imposed globally on energy systems without any limits on the amount of reduction in emissions that would originate from one country or one sector. The only criterion used was that of economic efficiencies. The economic system can respond to the imposition of the carbon constraint by reducing its energy intensity and/or by changing the fuel mix to reduce the carbon intensity of its energy system. This means that moving into the future the economic system finds more cost effective fuels, reducing the carbon intensity rather than reducing the overall energy use [2].

Taking external costs of conventional generated electricity which is due to the impact of the emissions and pollutants would show that renewable energy could be competitive in many cases. For Egypt, the environmental costs of CO_2 from 1991-2004 is about 103.7 Billion US Dollars, according to the study prepared by an English consultation office and Egyptian Organization for Energy Planning funded by the Norwegian Government and the International Bank [3].

In 2004 it was estimated that 37% of CO_2 emissions were due to energy, 35% due to industry, 14% due to transportation and 13% due to other sectors. In 2020 it is expected that 40% will occur due to energy, 35% due to industry, 14% due to transportation and 11% due to other sectors. Table (1) shows the direct greenhouse gas emissions in Egypt due to Petroleum products and natural gas from 1994 to 2004.

2.2. Renewable Energy for Remote Applications

Water access is a critical need in rural Egypt nowadays. The Egyptian economy depends highly upon agricultural production, which accounts for over 15% of its GDP. Water is essential for agriculture, but some villages do not receive sufficient water from the Nile. Diesel fuel was being used to pump water out of the ground. As these communities are remote and transporting diesel fuel is costly, wind power can be an economical option.
Two projects, implemented by the Egyptian Solar Energy Society (ESES), involve the use of wind energy to meet water access and electricity needs. The goal is to build several turbines for small-scale use to demonstrate and refine the technology, and eventually to lower the cost of technology for larger-scale use.

The first project, carried out from September 1995 to September 1997, resulted in the design and manufacture of four small-scale wind mills for water

pumping. The four small-scale versions were built and installed in four village areas between September 1996 and June 1998, pumping from 700-2400 litres of water per hour for agricultural use. After the funded project ended, several more turbines were manufactured at a lower per unit cost. These operate at greater capacities; one pumps 3000 litres of water per hour which is used for drinking, and another pumps 9800 litres/hour for agricultural use [5].

Generally, Egypt has fairly good electricity access rates (in terms of energy indicators it has high accessibility), as an estimated 94% of the population has access to electricity (year 2006), but this still leaves an estimate of about 4 million Egyptians, mostly living in remote areas, without access to electricity. Renewable energy could be an effective way to provide electricity in areas that may not receive grid connection any time soon.

Domestic Solar Water Heater (DSWH)

Over 65% of the total energy saving by renewable energies in the last decade was due to the commercialisation of solar thermal technologies, mainly domestic solar water heaters. More than seven local manufacturers are now working in the field. In 1980, in order to introduce the technology to the Egyptian market, the Ministry of Electricity & Energy imported 1000 DSWH systems, using flat-plate collector technology. In the same year, the first private sector local manufacturing was started. Since then DSWH systems are manufactured locally.

According to legalization in the eighties, new communities were obliged to use Solar Water Heaters. Thus about 220000 Domestic Hot Water Collectors (DHWC) were constructed and mounted in the new cities such as: 6th October, 10th Ramadan, New Minia, Port Said, and Sadat Cities [6].

As for industrial solar water heating two systems are applied in the following factories:

- Automatic Slaughter house near Cairo, capacity of 28 m^3/day hot water.
- Misr-Helwan Spinning and Weaving Company, 48 m^3/day hot water.

Wind Energy

Wind energy has a large potential along the Red sea. Egypt is planning to have, by the year 2010, about 3% of its annual production of electricity from Wind Farms. Since 1995, a progressive increase in wind energy utilization started by installing grid connected wind farms, the first of which is a wind farm of 4.8 MW in operation in Hurghada and followed by 230 MW in Zaafarana that was planned to be installed on several phases classified as follows:

i) Wind Farms completed and currently in operation: 60 MW built in cooperation with Denmark, 80 MW in cooperation with Germany and 85 MW in Cooperation with Spain.

ii) Wind Farms currently ongoing and under construction: These are in cooperation with Germany with a capacity of 80 MW.

iii) Projects in the phase of prequalification: Capacities of which are 120 MW in Cooperation with JBIC (Japan) and 120 MW in Cooperation with Denmark.

It is planned to reach 850 MW at 2010. Table 2-a demonstrates the renewable energy sources production while Table (2-b) summarizes the details of wind farms in Egypt.

Photovoltaic (PV) Applications:

The U.S. National Renewable Energy Laboratory (NREL), New & Renewable Energy Authority (NREA) of Egypt and other international organizations took the first step in the effort to initiate renewable energy programs in Egypt [7]. The present use of PV in Egypt is characterized by few traditional and/or professional applications financed on commercial terms and numerous donors.

Most of PV applications are directed to telecommunication systems, water pumping, clinical cold boxes, village electrification demonstration units, highway advertising, street-lighting, navigation, and airport aid lights. In 2002 a collaborative project for placing PV system in Sinai region was executed [8] while another solar community was installed in Ras Sidr [9]. A community centre including a clinic, classroom and satellite communications is also installed at the Arab Academy outside Alexandria [10]. In 1995, total installed capacity of PV applications was estimated to be around 1MWp [11].

There is no statistical information found about the capacity of the PV power but it is estimated to be around 4 -5.2 MW peak all over Egypt, especially in remote areas far from the national electricity grid.

Hydropower

Main hydroelectric power is limited to the following:

- High Dam consisting of 12 turbines 175 MW each.
- Aswan Dam1 consisting of 7 turbines 40 MW each.
- Aswan Dam2 consisting of 4 turbines 67.5 MW each.

Small hydropower- plants are distributed along the Nile River:

- Esna Dam consisting of 6 turbines 15 MW each.
- Najaa Hammadi 1 consisting of 3 turbines 1.7 MW each.
- Najaa Hammadi 2 gives 64 MW.

Biomass

The production of biomass is essentially from agriculture, animal, human, and solid wastes. Over 23 million tons of agricultural residues are produced in Egypt annually as well as very large quantities of urban waste, which varies between 0.5-0.7 kg/capita/day. With few exceptions, biomass activities in Egypt have been focused mainly on small-scale biogas plants with a digester volume ranging between 5 and 50 m^3. Application of larger systems has been limited and unsuccessful.

On a large-scale, biogas activities have not moved away from the laboratory or pilot stage, so only few larger plants were constructed. One of them was a 170 m^3 digester in EL-Giza Army Camp, constructed in the beginning of the 1980 by Food & Agriculture Organization (FAO). Presently, General Organization is constructing a huge biogas plant for Sewage Treatment (GOST) not related to the Biogas programs [13].

Biofuels

A rapid transition to energy efficiency and renewable energy sources, and clean alternative transportation fuels will combat global warming, protect human health, create new jobs and ensure a secure, affordable energy future.

Jatropha Biodiesl Fuel (BDF) is drawing attention as non-edible beans that have high potential source of BDF. There are several advantages of Jatropha plantation; non-agricultural land, primary treated waste water, new jobs opportunities, creation of new industries, and CO_2 reduction. There are several available areas in Egypt for this plantation, and there is an experimental farm in Luxor. One of the targeted areas is in upper- Egypt, cultivation in Assyiut, Safaga, Qena, Luxor and Aswan, while Safaga Port is used for BDF' Export [14].

3. Human Indicators: Socio- Economic Growth

The Egyptian population grew 2.4% on average from 1960 to 1996, rising from 25.9 to 59.4 millions. The rate of increase was lower during the period from 1996-2001, it reached 2.1%, and population became 64.7 million in 2001, and it was almost 78 millions in 2008 [13].

3.1. Human-Growth

The population of Egypt, as shown in Table 3, reached 71.348 million in 2006 (Egyptians abroad are not included and estimated to be approximately 2.3 M) [13], increasing annually by 1.8% approximately. To cope with the changing environment, Egypt took great strides aiming to exploit the opportunities, establish new communities as well as to improve the old valley's environmental conditions [14].

The number of famillies reached 15.6 million in 2006 with an average number of 4-5 persons per family. This number increases with about 0.3 million yearly [13].

The rate of urbanization reached 15.15 in the year 2005, according to the publications of the UNDP. Egypt is divided into 4 major regions, Urban, Upper Egypt, Lower Egypt, and Frontier Governorates. Urban governorates include Cairo, Alexandria, Port Said & Suez and the rest of the country is considerd rural [12].

3. 2. Economic Growth

GDP had reached US$ 118 billion in 2006 according to the Economical Indicators published by the Egyptian Ministry of Finance, as shown in Table 4. For purchasing power parity (PPP), the US$ is exchanged at LE 1.83 (Egyptian pounds) [1]. The remittances from Egyptian workers abroad have risen with higher oil prices in the past few years and in a normal year tourism revenues account for about 5% of Egypt's GDP. The rate of increase of the GDP/capita reached 4.04% in the year 2004, 4.45% in 2005, and 6.9 % by 2006, approximately [15]. The GDP in the fiscal year (2007/2008) is US$ 110 billion, in the current prices [16]. The rate of increase of the GDP/capita ppp had increased from 1.2 % in the year 2003, to 4.9% in 2006, as calculated from Table 4.

3.3. Inflation and Unemployment

Egypt is an increasingly attractive choice as a location for trans-national corporations, with its natural resources, skilled and competitively priced workforce, geographical location, advanced infrastructure and opportunities for combining trade and investment strategies. Opportunities are also abound in manufacturing, high technology sectors, food processing, textiles, mining and services. Despite all the afore-mentioned incentives and policies aiming at increasing private and foreign investment that were introduced over the past decade as a means of stimulating economic growth and employment opportunities, unemployment is still high, especially among the youth and women. Egypt's unemployment rate was around 10.9% in the year 2006, as shown in Figure 1. The government plans to accelerate its program for the privatisation of State-Owned Enterprises, though to date the privatisation program is going on, unemployment rate is still increasing. It is one of the most serious problems confronting the economy.

In addition to the above, under comprehensive economic reforms Egypt has relaxed many price controls, reduced subsidies, reduced inflation till 2002 (2.7%). The inflation rate has then started to increase in 2003 (4.2%) due to Egyptian pound floating. The inflation reached a peak of 16.5% in

2004 as shown in Figure 1. The prices started to re-increase since 2005 although the Foreign Direct Investment (FDI) started to increase in 2004. FDI inflows to Egypt increased from about 701 to 2107 million US$ in 2003/2004, and from 3902 to 6111 in 2005/2006. In 2008 the prices increased rapidly and the inflation rate reached 14.4% in March 2008 [8].

4. Energy Indicators and Sustainability

Oil and gas exports have a big share of Egypt's main sources of foreign currency, as the country began exports of liquefied natural gas (LNG) in January 2005, adding to its hydrocarbon revenues.

The energy sector represents a substantial share of economic development in Egypt, fulfilling domestic energy demands from petroleum products, natural gas, and electricity. The sector contributes indirectly to macroeconomic variables such as: Gross Domestic Product (GDP), Balance of Payments, Investments, State Budget, and Employment.

4.1 Role of Energy Sector in the Economy

The primary energy consumption per capita is considered one of the economic welfare-indicators, while energy intensity is an economic efficiency indicator, defined as the energy units required to add one unit (in real money terms) to the GDP. Table 5 shows the contribution of the energy sector in total GDP, which is increasing from 17.12 % in 2003 reaching 21.1 % in 2006. These figures include petroleum, natural gas and electricity according to the monthly report of the ministry of finance. Egypt exports crude oil, semi-refined, refined oil products, and NG ranging from 38.6% to 54.6% of the total exports in the years 2000 to 2006, respectively.

Egypt imports of diesel fuel, liquefied petrol gases (LPG) and coal amounted to 4.5% in the year 2000, and 9% in 2004 and 10.5% in the year 2006 as a result of the change in the international oil prices as a percent of the total imports as shown in Table 5 and Figure 2 [15,16].

Table 6 shows that primary energy consumption per capita did not change between 2003 and 2004. In the same period, energy intensity did not change as well as in electricity generation per capita. The energy intensity had reached 0.56 Kgoe/GDP 2001, while the energy consumption per capita is 0.84 ton oil equivalent (toe) in year 2005. The electrification rate had increased from 97.2 in year 2000 to 98.3 in 2005, of which the rural electrification rate is 97.7% while urban is 99.1%. The emissions due to energy use are proportional to the consumption. This was estimated as 138.14 million ton CO_2 in 2006 as shown in Table 7.

4.2. Energy Utilization and Sustainable Environment

Primary energy demand in Egypt depends on oil, natural gas, coal and hydro power stations. There are a small share of solar and wind power generation. Most of the coal is imported and directed mainly to the industrial sector. Oil products are substituted progressively by natural gas for electricity generation, household uses and transportation. The increase in hydropower is limited to installing a number of mini-hydro projects along the Nile.

4.2.1. Total Primary Energy Consumption:

Egypt's power sector is currently managed by the Ministry of Petroleum and Ministry of Energy and Electricity. Different biogas projects are scattered in some villages across the country, and wind farms in Gulf of Suez area.

The production and, hence, the consumption is always increasing except for hydropower, which depends on the level of water storage behind Aswan High Dam and irrigation requirements. The total consumption increased from 41.9 Mtoe in the year 2000 to 68.67 in 2006, as shown in Table 7.

4.2.2. Electricity Generation and Consumption in Egypt

Electricity Generation

The electrical generating capacity at 2007 is 21.56 GW, and estimated to reach 29.94 GW by mid-2012 as planned. EEHC-owned projects currently under construction include the 1,500-MW plant planned to be at Nobariya in the western Nile Delta near Alexandria. Another 1,500 MW capacity expansion at the Cairo North power complex came online in mid-2004. Additional capacity of 700 MW is to be funded by the World Bank. Another World Bank partly financed project is the 150 MW solar thermal power station at Kurayimat.

Electrical Consumption:

The Egyptian Electricity grid is connected to Libya and Jordan since 1998. There are plans to increase interconnection with the creation of the Mediterranean power pool, a project that will connect the power grid of North Africa (Algeria, Egypt, Libya, Morocco, and Tunisia), Spain, the Middle East (Jordan, Syria, Iraq, and Turkey) [5].

In Egypt the final electric consumption increased from 60805 GWH in the year 2000, to 92828 in the year 2006, of which 36.8% is household consumption, 6.5% commercial and 35.5% industry. The transportation consumprtion, Governmental & Utilities is 17.1%, as shown in Figure 3-a, b. This overall consumption of the country is equivalent to 40.03 Mtoe (2006). This consumption has progressed by an average of 4% /year since 1990; oil and gas represent 49%. The share of industry is around

40.7%, 31.2% transportation, 3.26% commercial, 22.02% household and the 2.92% for agriculture, in the year 2005.

5. CONCLUSIONS AND RECOMMENDATIONS

As the population rate in Egypt is increasing rather rapidly, it is normal that the urbanization rate increases relatively. This means that there is an increasing energy demand to sustain development. Thus, it is vital to break the links between economic-growth and increased environmental pressure. So changes must first be promoted in consumption and production patterns through the use of renewable sources of energy, clean technologies, suitable infrastructure, and more efficient public transport.

- The gross domestic product (GDP/capita) expanded from 46% in the Sixties and reached a peak growth of 139% in the Seventies. But this proved unsustainable and growth consequently scaled back to 48% in the Eighties rising smartly to 89% in the Nineties due to successful diversification.
- The rate of the GDP/capita ppp increased from 1.2 % in the the year 2003, to 4.9% in 2006. Egypt's unemployment rate is around 10.9% in year 2006.
- Egypt has a very high percentage of young population. Nearly 65% of the population is under 30 years of age and more than 30% is less than 15 years of age and will soon join the ranks of those seeking work.
- FDI inflows to Egypt increased from about US$ 701 to 2107 million in 2003/2004, and from US$ 3902 to 6111 in 2005/2006.
- The electrification rate had increased from 97.2 in the year 2000 to 98.3 in 2005, of which the rural electrification is 97.7% while urban is 99.1%. The emissions due to energy use are proportional to the consumption it was estimated as 137.11 million ton CO_2 in 2005.
- Final consumption had increased from 60805 GWH in the year 2000, to 92828 in 2006, of which 36.8% is household consumption, 6.5% commercial, and 35.5% industry. The transportation consumption, Governmental & Utilities is 17.1%.
- In 2004 it was estimated that 37% of CO_2 Emissions occurred due to energy generation, 35% due to industry, 14% due to transportation and 13% due to other sectors. In 2020 it is expected that 40% will occur due to energy generation, 35% due to industry, 14% due to transportation and 11% due to other sectors.
- It is important to manage the energy demand and mitigate the effects of climate change through:
  a) Using energy rationally, for each sector, by setting up global objectives which leads to an increase in the energy intensity indicator.
  b) Controlling, stabilizing or reducing emissions of gas
  c) Using the Keyoto Protocol flexibility mechanisms for the sustainable development of the developing Mediterranean countries

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Table 1: CO_2 Emissions due to Petroleum Energy Consumption in Egypt

Data / Years	Consumption of petroleum products & natural gas Million Metric Ton	*CO_2 Emissions Million Ton	**Cost of Environmental Impacts on the National Economy Million US$
1993/94	27	73	5831
1994/95	28	77	6141
1995/96	30	83	6632
1996/97	31	85	6821
1997/98	34	94	7520
1998/99	35	97	7760
1999/20000	38	102	8160
2000/01	40.6	110.0	8800
2001/02	41.2	110.7	8856
2002/03	43.9	118.3	9461
2003/04	46.0	123.2	9857
The Grand Total of Emission cost on the National Economy 1993/94 – 2003/2004			85839

* Excluding the consumption of natural gas in industry sector for non energy use
** The cost of the environmental impacts from CO_2 emissions was estimated by 80US $/Ton [4]

Table 2-a: Renewable Energy Sources Production

	unit	2000	2001	2002	2003	2004	2005	2006
PV	M W	Estimated to be≅ 4 -5.2 Mwp						
Wind	M W	35	68	68	98	145	145	230
Hydro	GWH	14659	13697	15130	12859	13019	12644	
Biomass[11]		Estimated to be over 23 Mt agricultural waste + 0.5-0.7 kg/capita/day urban wastes						
Solar Water Heating		Estimated to be 220000 DSWH, 28 m^3/day + 48 m^3/day Industrial						

Source: Energy resources and renewable energies-survey about the energy sector in Egypt, Oct. 2005, GTZ

Table 2-b: Renewable Energy Sources Production [12]

Project name*	Source of RE	Capacity	Starting date	Financing source and type
Hurghada**	Wind	5.2 MW	1993	
Zaafarana 1 & Zaafarana 2**	Wind Wind	33 MW 30 MW	2001 2002	Egypt& Denmark Egypt& Germany
Zaafarana 3**	Wind	30 MW	2003	Egypt& Denmark
Zaafarana 4**	Wind	47 MW	2004	Egypt& Germany
Zaafarana 5**	Wind	85 MW	2005	Egypt & Spain
Zaafarana 7**	Wind	80 MW	Ongoing	Japan (JBIC)
Zaafarana 6**	Wind	120 MW	Ongoing	Egypt & Germany
Zaafarana 8**	Wind	120 MW	Ongoing	Egypt& Denmark
Gabal el Zeit** Gabal el Zeit**	Wind Wind	200 MW 220 MW	Planned Planned	Denmark& Germany Japan
Kurimat SC CPP	Solar Thermal	150 MW		Japan, World Env.

Table 3: Growth of Population, No. of families and Rate of Urbanization

	unit	2000	2001	2002	2003	2004	2005	2006	2007
Population [i]	million	63.30	64.652	65.986	67.313	68.648	69.997	71.348	73
Number of famillies[ii]	million	13.9	14.2	14.5	14.8	15.1	15.3	15.6	17.3
Rate of urbanization[iii]	%	--	13.484	14.447	14.562	14.889	15.152	--	--

Table 4: Time Series of GDP

	Unit	2001	2002	2003	2004	2005	2006
GDP [(i),(ii)] /10^6	$2000	83.2	98.4	101.6	105.7	110.4	118
GDP/capita[(iii)]	$2000	1286.9	1491.2	1509.3	1539.7	1577.2	1653.8
GDP/capita[(iv)]	PPP	2707.8	31375	3174.7	3239.7	3318.7	3480

Sources: [(i)] IDSC (data in Egyptian LE current rates divided by 2000 exchange rate)
[(ii)] GDP Fixed market prices 2001/2002, Ministry of Finance, www. mof.gov.eg
[(iii)] www. UNDP.org
[(iv)] www. Planbleu.org

Table 5: Role of Energy Sector in the Economy

	Unit	2000	2001	2002	2003	2004	2005	2006
GDP [(i)]	$2000 Billion	83.2	90.2	98.4	101.6	105.7	110.4	118
GDP growth [(i)]	%	5.1	3.5	3.2	3.2	4.1	4.5	6.8
Share of energy in GDP	%	9.5	11.24	13.34	17.12	18.41	24.24	21.1
Import dependency[(ii)]	% of imports	4.5	3.5	4.8	7.9	9	7.8	10.5
Weight of energy export[(iii)]	% of exports	38.6	32.6	39.6	40.3	49	38.8	54.6

Sources: [(i)] www.capmas.org. (Central Agency for Public Mobilization and Statistics)
[(ii)] www.idsc.gov.eg (Information & Decision Support Center)
[(iii)] www.UNDP.org

Table 6: Energy Indicators

	unit	2000	2001	2002	2003	2004	2005	2006
Energy intensity[i]	Kgoe/GDP $2000	0.55	0.56	0.49	0.5	0.49	0.53	0.5
Energy intensity	Kgoe/GDP in PPP $2000	0.27	0.27	0.23	0.24	0.23	0.25	0.25
Electricity intensity	Kgoe/GDP $2000	0.06	0.07	0.06	0.06	0.06	0.07	0.07
Electricity intensity	Kgoe/GDP in PPP $2000	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Energy consumption per capita[(ii)]	toe/hab.	0.70	0.72	0.73	0.75	0.75	0.84	0.844
Electricity consumption / capita	toe/hab	0.08	0.09	0.09	0.09	0.10	0.10	0.11
Electrification rate[(iii)]	%	97.2	98.2	98.2	98.2	98.2	99	99.1
Energy related CO_2 emissions[(iv)]	Mt	102.47	109.98	110.68	118.26	123.22	137.11	138.14

Source: [(i)] Calculated as electricity consumption/GDP
[(ii)] Calculated as electricity consumption/ population (Annual Report 2004/5 EEA)
[(iii)] www.capmas.org.
[(iv)] www. Planbleu.org., and Rural Electrification Authority (REA), report 2006
Note: 1 toe = 41.868 GJ = 1.625 MWh

Table 7: Primary Energy Consumption

	Unit	2000	2001	2002	2003	2004	2005	2006
Oil	Mtoe	23.49	22.79	22.26	22.95	23.11	26.45	26.53
Natural gas	Mtoe	14.6	18.4	19.5	21.3	23.6	25.5	38.4
Coal	Mtoe	0.59	0.56	0.94	0.87	0.94	0.94	0.94
Hydro	Mtoe	3.24	3	3.28	2.82	2.86	2.78	2.78
Renewables	Mtoe	0.005	0.031	0.049	0.045	0.082	0.117	0.117
TOTAL	Mtoe	41.9	44.78	46.03	47.98	50.59	55.79	68.67

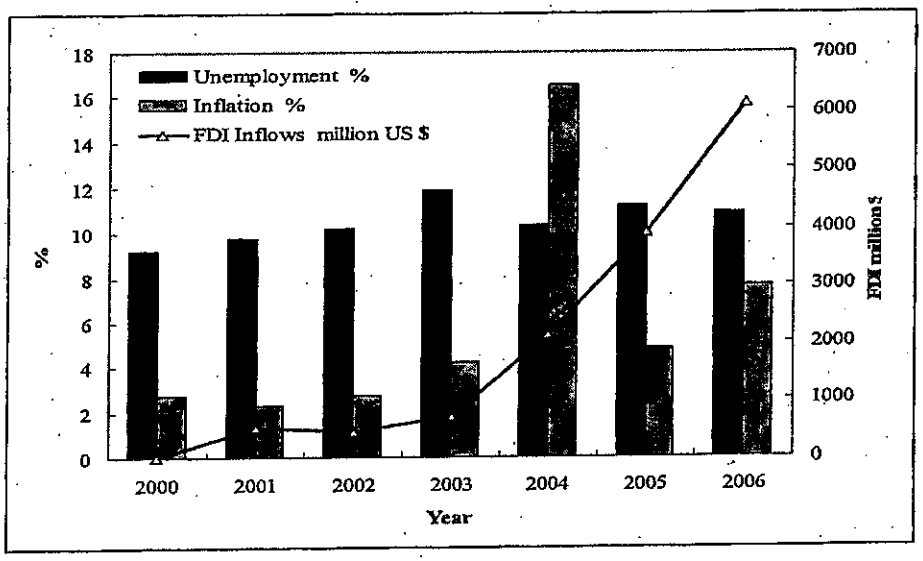


Figure 1: Unemployment%, Inflation Rate% and FDI in million $ 2000-2006

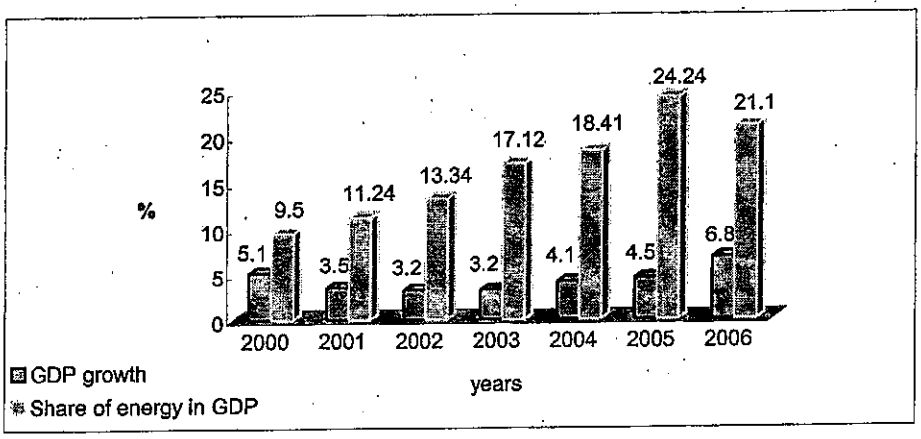
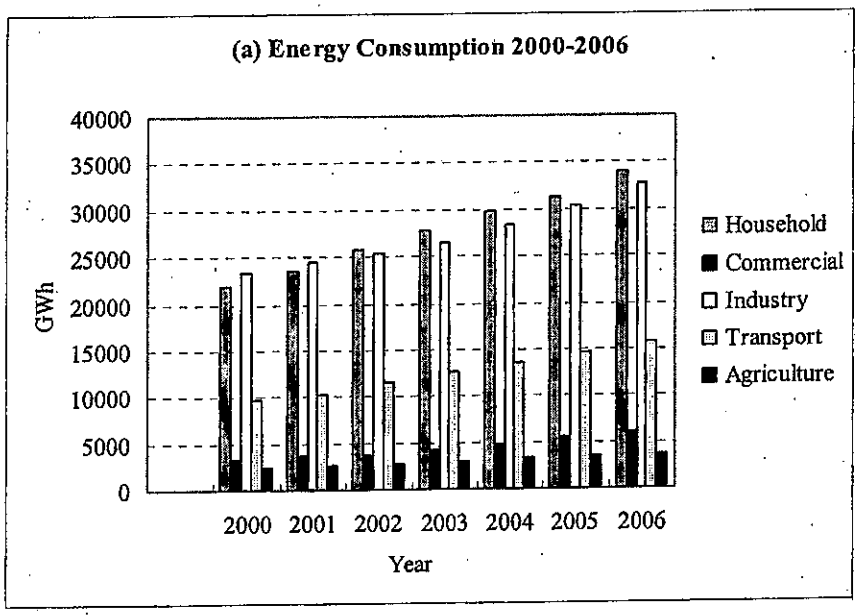


Figure 2: Contribution of Energy Sector in G



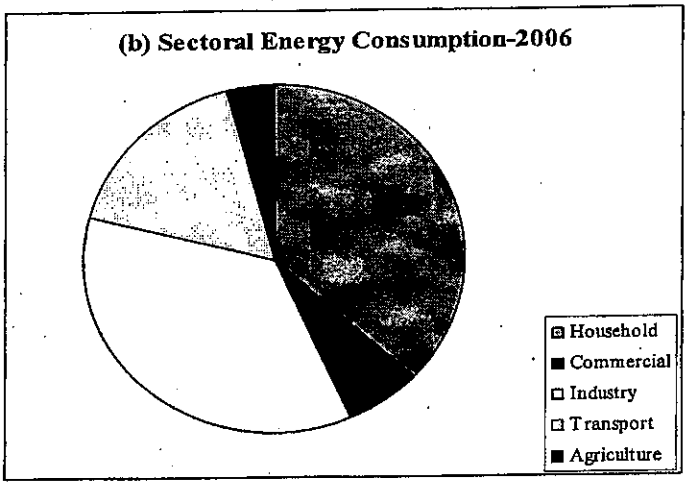


Figure 3: Evolution of total final energy consumption