Energy conservation indicators in Southern Mediterranean countries

Country report for Syrian Arab Republic (SAR)

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plan bleu

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Content

Preface

The design, the implementation and the monitoring of national energy policies require relevant indicators reflecting the energy use performances at macro and sector level. Moreover, for developing countries the implementation of information systems on energy and greenhouse gas emissions indicators will be a key condition for the development of new mitigation financing mechanisms (NAMAs, sectoral mechanism, etc.) currently under negotiations for the new international climate governance regime. In fact these mechanisms will need Measures, Reporting and Verification systems (MRV) to prove the integrity of these actions. Also, for the Arab League States Energy Efficiency Directive, such indicators are crucial for the monitoring and the assessment of the National Energy Efficiency Action Plans (NEEAPs).

For these reasons and based on European experiences (ODYSSEE), PLAN BLEU, in cooperation with RCREEE and with the support of MED-ENEC, has launched the current Energy Efficiency Indicators Project in ten MENA countries, namely: Morocco, Algeria, Egypt, Lebanon, Syria, Jordan, Libya, Palestine, Tunisia and Yemen as a tenth member state of RCREEE. This project is aiming at i) strengthening the capacities of these countries in monitoring their energy policies by using the energy efficiency indicators approach ii) building and interpreting a range of basic common indicators for the region.

The project was carried out according to a two years process based on specific methodology including:

- A Participative approach associating national public and private experts
  - 4 workshops and working sessions held in Tunisia, Egypt, France and Morocco,
  - Selection, by the participants, of the common indicators to be developed in the project, based on the data availability and the relevancy for the country,
  - Technical assistance throughout the project provided by the regional coordination.
- Capacity building through " learning by doing" and experience exchanges
  - Data collection by the national experts with the support of RCREEE focal points, strengthening the cooperation between public and private experts,
  - Common development of a simplified calculation tool for data collection and indicators' calculation used by the experts,
  - Development of capacity for analysis and interpretation of energy indicators by national experts,
  - Country reports developed by the national teams.
- Dissemination of the results and the learned lessons
  - Organization of final seminar for the decision-makers in June 2012,
  - Publication and wide dissemination of the results recorded in flyers, national and regional reports.

The project was coordinated by:

- Plan Bleu: Ferdinand Costes, El Habib El Andaloussi
- RCREEE: Amel Bida
- MED-ENEC: Florentine Visser
- ALCOR: Rafik Missaoui, Hassen Ben Hassine, Adel Mourtada

Collecting data and developing indicators in Syria was performed in close collaboration with the Syrian focal point of RCREEE Eng. Jolonar Tanbakji to whom we are very grateful for her close collaboration. The Syrian national expert (Dr. Mohamad Kordab) and the focal point formed the core of an Energy Indicators Network. This network will ensure the continuity in the EE indicators calculation, the use of the best practices for developing the energy efficiency in the area and the evaluation of energy efficiency policies.

List of abbreviations

EDR	Energy dependence Ratio
IPE	Intensity of Primary Energy
IFE	Intensity of Final Energy
RFEPE	Ratio of final energy consumption to primary energy
REB	Ratio of National Energy Bill to GDP
RPSE	Ratio of public subsidies for energy to GDP
AEF	Average emission factor
ICO_2	Intensity of CO_2
AECH	Average Primary Energy Consumption per habitant
AELCH	Average Electricity Consumption per habitant
SREC	Share of installed RE electricity capacity
URIC	Usage rate of the installed power generation capacity
AETS	Apparent Efficiency of Energy Transformation Sector
PGEFF	Power generation efficiency of thermal plants
SCFFP	Specific Consumption of thermal power plants
PGF	Power generation efficiency
SCPG	Specific Consumption of Power Generation
TDEE	Transmission and Distribution Electricity system Efficiency
PGEF	Power Generation Emission Factor
ESEF	Electricity Sector Emission Factor
FEIIS	Final Energy Intensity of Industry Sector
IEBR	Ratio of Industry sector Energy Bill to Added Value
IESR	Ratio of public subsidies to added value
IESRGB	Ratio of public subsidies for energy to Government Budget
EUCC D	Average Energy Unit Consumption of diesel Cars
IELSR	Ratio of public subsidies for electricity to added value
$IICO_2$	Intensity of CO_2
IAEF	Average emission factor of industry sector
FEITS	Final Energy Intensity of Tertiary Sector
TDRSHR	Diffusion Rate of Solar Water Heaters in tertiary sector
TEBR	Ratio of energy bill to added value in tertiary sector
TELSR	Ratio of public subsidies for electricity to added value
TESRGB	Ratio of public subsidies for energy to Government Budget
HECNG	Energy Consumption per night guest
$TICO_2$	Intensity of CO_2
TAEF	Average emission factor
UCED	Unit Consumption of Energy per Dwelling
SCEM	Specific Consumption of Energy per area unit
UEICD	Unit Consumption of Electricity per Dwelling
SCEIM	Specific Consumption of Electricity per m^2
RIPE	Intensity of Residential Sector
RELSR	Ratio of public subsidies for energy to private consumption
RESRGB	Ratio of public subsidies for energy to Government Budget
RAEF	Average emission factor
$RICO_2$	Intensity of CO_2
RDRSHR	Diffusion Rate of Solar Water Heaters in Residentialsector
SYP	Syrian Pound
GDP current price	Gross Domestic Product current price
GDP 1998	Gross Domestic Product constant price 1998
HH&S	Household & Service

AEFTS	Average emission factor of transport sector
MR	Motorization rate
ICO_2	Intensity of CO_2
SCRW	Specific consumption for Rail ways
SCAT	Specific consumption for air transport
SCMT	Specific consumption for maritime transport
SEAT	Specific emission factor for air transport
SEMT	Specific emission factor for maritime transport
FEIA	Final Energy Intensity of agriculture
FEIF	Final Energy Intensity of fishing
SCF	Specific consumption for fishing
SDCA	Share of Dry cultivated area
SICA	Share of Irrigated cultivated area
SEWMP	Share of equipped wells with Moto pumps
SEWEIP	Share of equipped wells with electro pumps
Ktoe	Kilo tone of oil equivalent
GWh	Gigawatt hour
$TeCO_2$	Tonne of CO_2 equivalent
ERACR	Equipment Rate of Air conditioning in Residential sector
ERFR	Equipment Rate of refrigerator in Residential sector
TrFEI	Final Energy Intensity
STEHE	Share of household expenditure for transport
EUCC	Average Energy Unit Consumption of Cars
EUCC G	Average Energy Unit Consumption of gasoline Cars

I. Country general background

1. Population and economy

Syria is an Eastern Mediterranean country with 23 million inhabitants of which almost 20% live in the capital Damascus. The annual per capita income on a purchasing power parity basis was 3,300 € in 2009 and 1,700 € in nominal terms. The GDP growth has slowed to 2.2% in 2009 from 5.1% in 2008 and yet higher values before. The population is growing at an annual rate of 2%. The following Table 1 presents the evolution of the population and GDP at current & constant prices during the period 2003-2009, while Figure 1 presents the contribution of different sectors to GDP at constant prices in 2009.

Table 1 - Evolution of the population and GDP at current & constant prices during the period 2003-2009

	Unit	2003	2004	2005	2006	2007	2008	2009
Population	1000 Hab	17765	18200	18356	18941	19405	19880	20367
GDP at current prices	Million SYP	1074163	1266891.0	1506440	1704974	2017825	2445060	2519151
GDP at constant prices 1998	Million SYP	1018708	1089027.0	1156714	1215082	1284035	1341516	1422178

Source: Central Bureau of Statistics, Syria, Statistical Reports 2003-2009

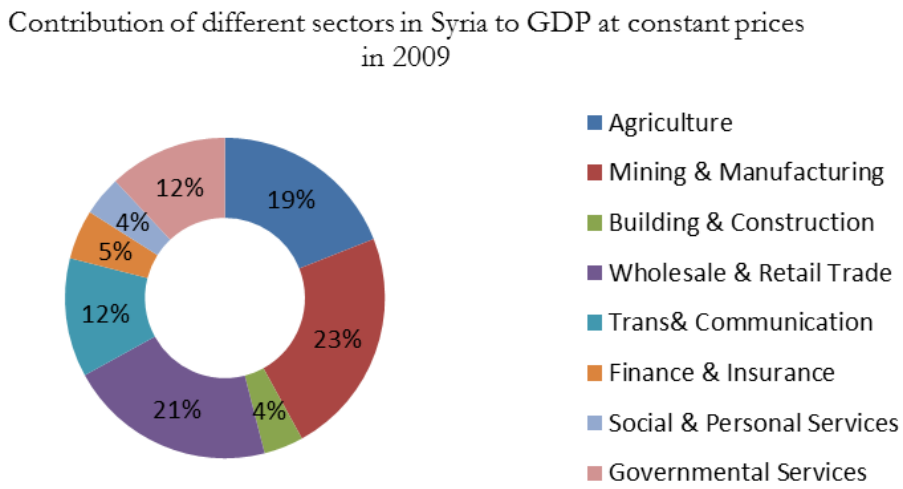
The total area of the Syrian Arab Republic is 18,517,971 hectares, of which 6 million hectares consist of cultivated land, the remainder being steppe and Rocky Mountains. The Syria steppe land is suitable for sheep and camel grazing, especially when rainfall is sufficient.

Geographically, Syria is divided into four regions:

- **The coastal region**: it lies between the mountains and the Mediterranean,
- **The mountainous regions**: they run from the north to the south of the country and include all mountains and hills parallel to the Mediterranean Sea,
- **The interior or plains region**: It includes the plains of Damascus, Homs, Hama, Aleppo, Hassakeh and Dera'a. All these plains are situated to the east of the mountainous region,
- **The desert region**: it consists of the desert plains situated in the south-eastern part of the country, along the Jordanian and Iraqi borders.

The climate in Syria is Mediterranean, characterized by cold and rainy winters and hot and dry summers. The two main seasons are separated by relatively two short transitional ones: spring and autumn.

Figure 1 - Contribution of different sectors to GDP at constant prices in 2009



2. Energy demand and energy supply

The energy sector in Syria is represented by oil and its derivatives, natural gas and electricity. This sector is strategic due to its importance for the Syrian economy: it reached 27%, 26% and 25% of total overall local production in 2004, 2005 and 2006, respectively. In fact, oil exports (crude oil and oil derivatives) constituted almost 65% of government income in foreign currency in recent years. Due to increased demand on diesel and the need to import huge quantities because of high prices, the contribution of crude oil in the foreign currency balance is bound to decrease significantly.

Figure 2 presents the evolution of primary energy consumption during the period 2003-2009; Figure 3 presents the total final energy consumption during the same period. In 2007 about 94% of the total final energy consumption was based on oil (71.4%) and gas (22.4%), the rest being supplied by hydropower (3.7%) and biomass (2.5%). The exports of crude oil and petroleum products (in 2007 amounting in total to 7.6 million tons) contribute significantly to the state budget, but they are offset by the import of 7.4 million tons of petroleum products. The Syria pursues the policy to increase the share of natural gas in domestic consumption in particular in power generation in order to maximize the export of crude oil and oil products.

In 2009, the total installed power generation capacity in Syria was 8322 MW, 1528 MW of which is hydropower capacity. The electricity generation amounted to 43.31 TWh. Hydropower contributed 7% to electricity generation in 2008. Low electricity prices during the past years have contributed to the rapid growth in electricity demand and to some extent to inefficient electricity use. The average price paid for electricity by household clients in 2009 was 1.26 SYP/kWh, which is 0.02 €/kWh. For industrial customers the average price was 2.8 SYP/kWh, equivalent to about 0,045 €/kWh.

Oil production in 2009 in Syria was at about 370,000 barrels a day. Two state owned refineries have a capacity of about 240 thousand barrels per day. This is not sufficient for the current levels of consumption, so considerable amounts of petroleum products (in particular diesel oil) are imported, while crude oil

is exported. Significant gas deposits which at present rates of production would last for more than 35 years. Roughly one quarter of the natural gas production is re-injected for enhanced oil recovery; the remaining three quarters are used in power production and in industry.

Figure 2 - Primary Energy Consumption during 2003-2009 (Ktoe)

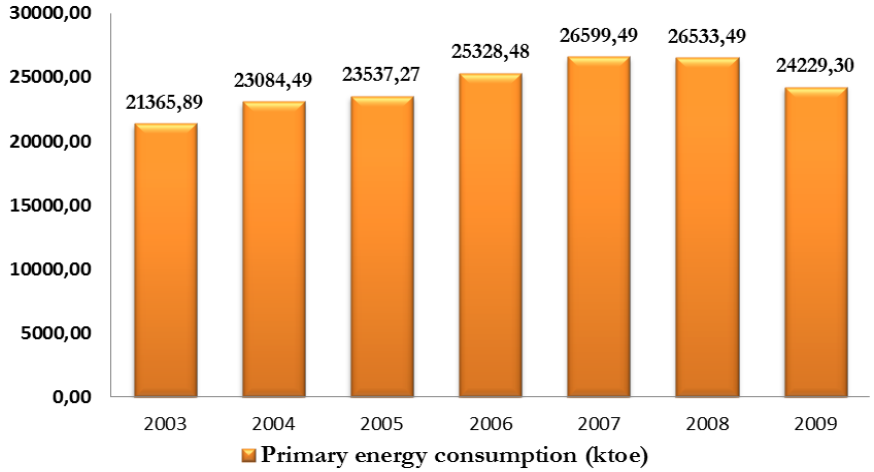
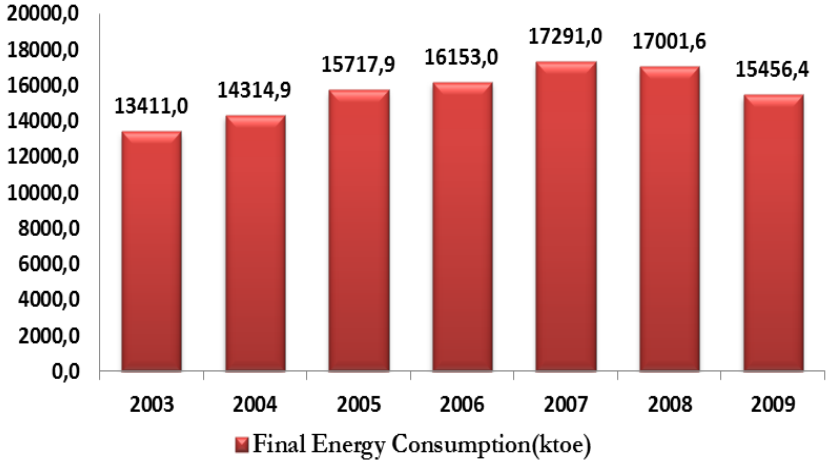


Figure 3 - Total Final Energy Consumption during 2003-2009 (Ktoe)



3. Energy efficiency and Renewable energy strategy

Renewable Energy Sources: In the year 2001, UNDP sponsored the elaboration of a Renewable Energy Master plan in Syria. It developed a roll out plan for RE investments over the time period up to 2011 amounting to 4.31% of total energy demand by RE & EE. The roll out plan has been implemented only to a very limited extent. As a consequence of rising prices for traditional heating fuels, a market for solar thermal collectors has been spontaneously developing during the past three years. The very favourable meteorological conditions in Syria make solar energy applications in general and solar photovoltaic in particular an interesting source of electricity in particular for remote and isolated areas.

Energy Efficiency: Syria has a large potential for improvements in energy efficiency. The subject has been on the political agenda for some time and in 2007 the thermal insulation code for buildings was issued. Arrangements for its implementation are underway**.** Syria is further strengthening the government's ability to enforce the code. In October 2008, the Energy Efficiency Labels and Standards for Household Appliances Law was issued. The Energy Conservation Law was issued in February 2009. Under this law, NERC is entrusted with coordinating the implementation of energy efficiency measures. NERC has the duty to prepare energy conservation-related regulations, codes and guidance in consultation with the concerned parties. Regulations and codes for energy conservation in residential, commercial, public and private service buildings will be promulgated subsequently by a Decision of the Council of Ministers on the proposal of NERC. The law requires that every such entity, public or private, must establish an energy conservation unit headed by an Energy Liaison Officer In the construction sector, building permits will be issued conditional on:

- Provision for the use of renewable energy in all private and public buildings; in particular, new building design must facilitate use of solar water heating, optimal design of buildings to improve thermal performance as well as thermal insulation of buildings to prescribed standards, adoption of energy-saving lighting systems and adoption of natural lighting.

The "UNEP/MAP - Plan Bleu publication on Energy Efficiency and Renewable Energy in the Syrian Arab Republic" has been issued in March 2007 by the National Energy Research Centre (NERC). It gives (among other important information) an overview on RE sources' potential and lists different policy measures to promote the use of renewable energy sources and the efficient use of energy. It contains summarizing figures on the potentials for EE and RE. For instance, the potential for energy demand reduction by energy efficiency measures up to the year 2020 is amounted to 8.5% of the total energy demand as follows: 2.5% through energy efficient building, 2% through energy efficient home appliances, 2% electricity grid efficiency improvement & 2% energy auditing.

The Syrian Arab Republic Master plan for Energy Efficiency and Renewable Energies (MEERE) project consists an energy conservation scenario (ES). It has been formulated to evaluate the possible final energy saving compared to the reference case (RS). Energy conservation measures and efficiency improvements have been considered in all consumption sectors i.e. HH, service, industry, agriculture and transport sectors and their various end-use categories. Increased solar energy penetration has been considered mainly for substituting fossil fuel in space and water heating in the HH and service sectors. The results indicate that the total final energy saving in 2030 will amount to more than 15% of the final energy consumption of the RS. The increased contribution of solar energy for heat application will amount to about 5.3% of final energy demand of HH&S and about 8% of thermal energy demand in HH&S in 2030. The substituted fossil fuel by solar, biomass and traditional fuel in 2030 will amount to 2 Mtoe corresponding. Over the period 2010-2030 the proposed accumulated use of renewable energy on the demand side (i.e. soft solar, biomass and traditional fuel) will substitute about 22 Mtoe of conventional fuels. Besides, the expected accumulated total energy saving over the period 2010-2030 will amount to 97 Mtoe. The results of this analysis indicates the importance of energy saving for thermal use in HH&S and industry which should give this energy form the first priority among the implementation of energy saving measures.

II. Data collection process

1. Main sources of data

Data are collected by field from several sources:

- ENERGY BALANCE: National Energy Research Center (NERC) , Ministry of Electricity,
- SOCIO ECONOMIC DATA: Central Bureau of Statistics, Statistical Reports 2003-2009.

Electrical Information from the Public Establishment for Electricity generation and transmission Statistical Reports 2003-2009

- Natural gas, oil & oil Products information are from Ministry of Oil & Mineral resources,
- Oil & oil prices are from the Office of Oil Marketing/ Prime Ministers Council,
- Other data: Ministry of Agriculture, Ministry of transport, Electricity Company, Ministry of Industry and Ministry of Tourism.

Significant difficulties are encountered in specific data for end-use sectors especially in the industrial & tertiary sectors. The main difficulties are:

- Data availability
- Incomplete annual data set
- Approximation of unavailable data

The simplified method adopted to calculate subsidies require average annual prices often complicate to calculate with good accuracy. The main sources of data collection are summarized in the following Table 2:

Table 2 - The main sources of data collection

Institution name	Address	Tel and fax	Email and Website
Central Bureau of Statistics Syria Statistical Reports 2003-2009	Adnan Al Malki Street, Damascus, Syria		**www.cbssyr.org**
National Energy Research Center (NERC/ Ministry of Electricity/Syria) Syrian Energy Balance for the years 2003-2009	Kafer Sousseh Square, Damascus, Syria		**www.nerc.org.sy**
Public Establishment for Electricity generation and transmission Statistical Reports 2003-2009		2133972 - 2133973 2131259 - 2133955	**www.peegt.gov.sy/**
Ministry of Industry			www.syrianindustry.org/
Ministry of Transport			www.mot.gov.sy/
Ministry of Agriculture			www.syrianagriculture.org/
Ministry of Tourism			www.syriatourism.org/
Ministry of Oil & Mineral resources			www.petroleum.gov.sy/
Office of Oil Marketing/ Prime Ministers Council			

2. Data availability

Data for different sectors are generally available and particularly data on energy. In Syria data collection is often routinely collected. Each Ministry has its own statistics and sends the main information to the Central Bureau of Statistics. The National Energy Research Center is officially nominated to prepare the energy balance for the country. Table 3 presents the energy data, socio- economic data and the environment data in SAR during the period 2003-2009.

Table 3 - Presets the energy data, socio- economic data and the environment data in SAR during the period 2003-2009

Sector	Energy data			Socio-economic data			Environmental data		
	Total* number of data	Available data**		Total number of data	Available data		Total number of data	Available data	
		Number	%		Number	%		Number	%
Macro	56	56	100	42	42	100	7	7	100
Transformation sector	98	91	92.8						
Transport sector	49	49	100	105	91	86.6	21	21	100
Tertiary sector	28	14	50	35	21	60	7	7	100
Residential sector	21	21	100	49	42	85.7	7	7	100
Industry sector	56	28	50	91	70	76.9	7	7	100
Agriculture & fishing	14	7	100	56	49	87.5	0	0	
Total	322	273	84.8	378	315	83.3	49	49	100

*: Total number of data expected by the sheet "Energy & socioeconomic data"
**: Total number of data (collected or estimated) filled in the sheet "Energy & socioeconomic data". One value for one year is considered as a data.

The overall availability of data was 85% where a total 637 data item out of a total of 749 were collected.

3. Major difficulties met during the data collection

In collecting the needed data, some difficulties were encountered such as:

- Lack of statistics in private & public sectors especially in industry and tertiary sectors,
- The level of analyses that require very specific available data,
- Some indicators need great standards of analysis and they require analytical data, which many times are not available and sometimes even unreliable,
- Significant gaps in the completeness and quality of required data are existing.

III. Indicator's calculation

1. Macro level indicators

The following Table 4 presents the indicators calculated for the macro level:

Table 4 - Macro Level Energy Indicators during 2003-2009

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
EDR	Energy dependence Ratio	%	-73%	-36%	-26%	-12%	-2%	-4%	-14%
IPE	Intensity of Primary Energy	toe/1000 LC	0,021	0,021	0,020	0,021	0,021	0,020	0,017
IFE	Intensity of Final Energy	toe/1000 LC	0,013	0,013	0,014	0,013	0,013	0,013	0,011
RFEPE	Ratio of final energy consumption to primary energy	%	63%	62%	67%	64%	65%	64%	64%
REB	Ratio of National Energy Bill to GDP	%	20%	24%	30%	33%	30%	31%	18%
RPSE	Ratio of public subsidies for energy to GDP	%	11%	15%	15%	19%	18%	20%	3%
AEF	Average emission factor	teCO2/toe	2,71	2,73	2,73	2,75	2,73	2,75	2,73
ICO2	Intensity of CO2	teCO2 / 1000 LC	0,057	0,058	0,055	0,057	0,057	0,054	0,047
AECH	Average Primary Energy Consumption per habitant	ktoe/1000 hab	1,203	1,268	1,282	1,337	1,371	1,335	1,190
AELCH	Average Electricity Consumption per habitant	MWh/hab	1,183	1,276	1,383	1,623	1,696	1,667	1,789

Comments on MACRO Energy Indicators

- The energy dependency ratio changed from -0.729 in 2003 to -0.135 in 2009 with average annual change=-24.5% as illustrated in Figure 4,
- There was a slight drop in intensity of primary energy & of final energy[1] by an average of 3.5 % & 4.2 %per year, i.e. 19% & 23% of the whole variation respectively during 2003 – 2009 as illustrated in Figure 5,
- There was a slight drop in per capita primary energy consumption by an average of 0.18% per year, while there was an increase in per capita electricity by an average of 7.1% per year as illustrated in Figure 6,
- The ratio of national energy bill to GDP increased from 20% in 2003 to 33% in 2006 then decreased to 31% in 2008 and to 18% in 2009. while the ratio of public subsidies for energy to GDP increased from 11% in 2003 to 20% in 2008 then decreased to 3% in 2009 in Figure 7;
- The average emission factor changed between 2.71, 2.75and 2.73 $teCO_2$/toe, while the CO_2 intensity decreased slightly between 0.057 $teCO_2$/ 1000SYP in 2003 to 0.047 $teCO_2$/ 1000SYP in 2009.

[1] Calculated by using a GDP constant price 1998

However the sudden drop of the energy intensities, the primary energy consumption per capita and also the intensity of CO_2 in 2009 can be explained by the reduction of informal export of fuel (diesel and gasoline) to Lebanon by smuggling, due to the consequent increase in the prices of these products in Syria in 2008. This illicit export was seen in previous years as final consumption in Syria.

Figure 4 - The Energy Dependency Ratio

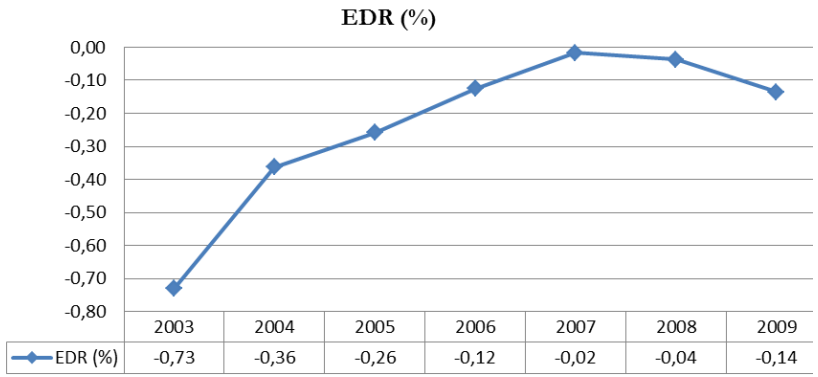


Figure 5 - Primary and Final Energy Intensity during 2003-2009

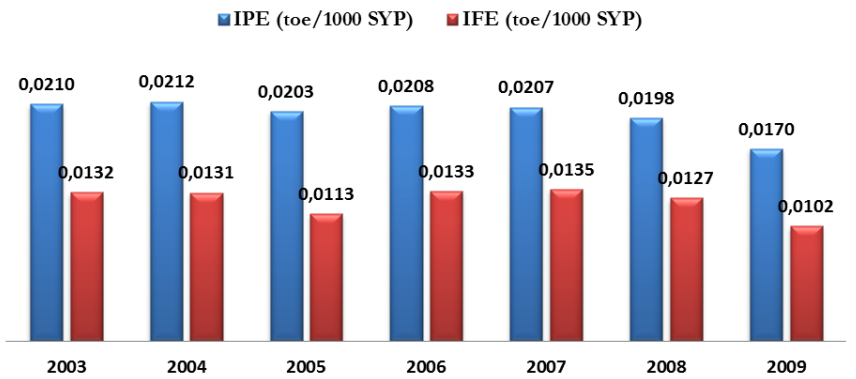


Figure 6 - Average Primary Energy & Electricity Consumption per Capita during 2003-2009

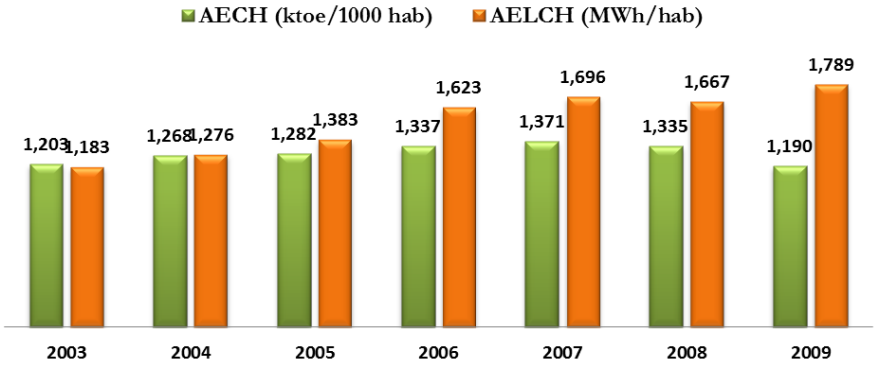


Figure 7 - Ratio of National Energy Bill to GDP &Ratio of public subsidies for energy to GDP(at const. price)

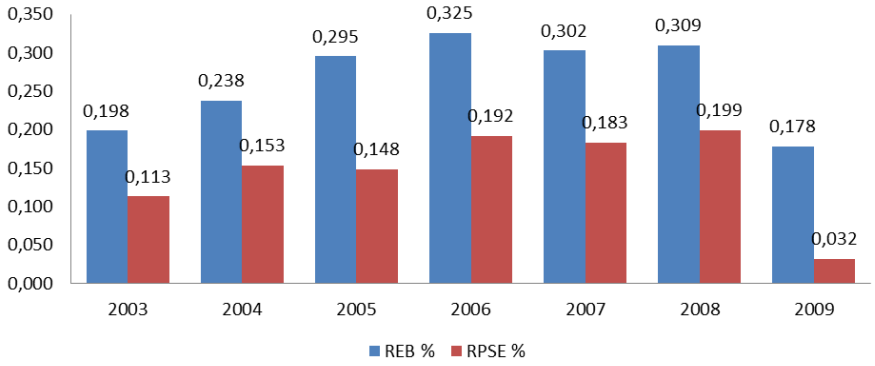


Figure 8 - Average emission factor

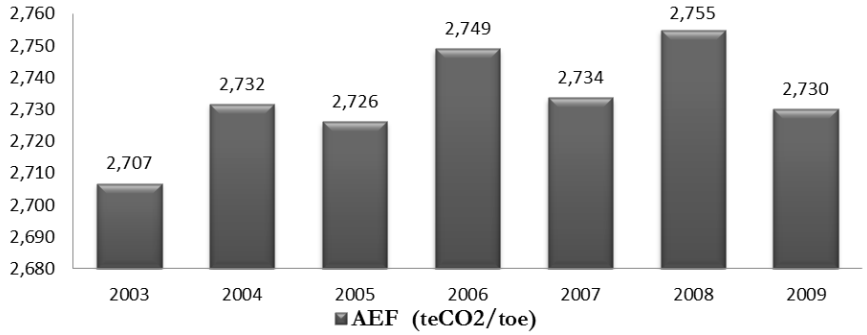
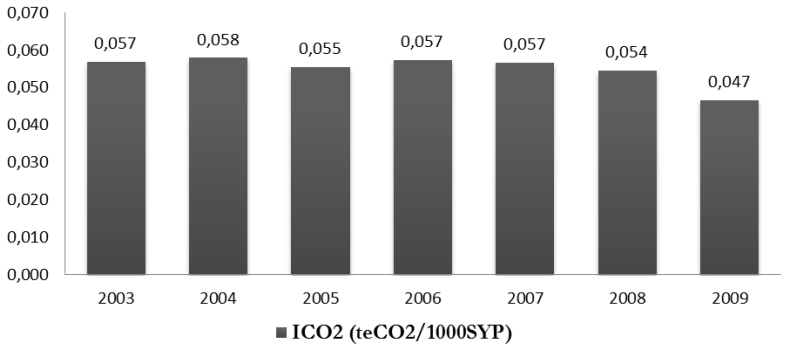


Figure 9 - Intensity of CO_2 during 2003-2009



2. Transformation sector

Table 5 - Energy Transformation Sector Indicators during 2003-2009

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
SREC	Share of installed RE electricity capacity	%	0%	0%	0%	0%	0%	0%	0%
URIC	Usage rate of the installed power generation capacity	%	48%	52%	56%	60%	61%	60%	59%
AETS	Apparent Efficiency of Energy Transformation Sector	%	73%	73%	72%	70%	68%	68%	68%
PGEFF	Power generation efficiency of thermal plants	%	37%	37%	38%	37%	37%	38%	36%
SCFFP	Specific Consumption of thermal power plants	toe/GWh	229,64	234,50	227,37	230,38	230,94	225,68	236,30
PGF	Power generation efficiency	%	0,37	0,37	0,38	0,37	0,37	0,38	0,36
SCPG	Specific Consumption of Power Generation	toe/GWh	207,84	203,45	204,95	205,84	209,86	209,88	225,80
TDEE	Transmission and Distribution Electricity system Efficiency	%	0,80	0,78	0,79	0,79	0,82	0,81	0,81
PGEF	Power Generation Emission Factor	teCO2/GWh	535,30	533,75	543,84	548,68	565,60	566,65	594,87
ESEF	Electricity Sector Emission Factor	teCO2/GWh	699,51	713,29	724,13	727,52	719,81	730,38	769,31

Comments on Transformation Energy Indicators:

- The share of renewable energy electricity till the date of this report is zero,
- Significant increase of apparent efficiency of energy transformation sector with 9 % of efficiency gain,
- Slight improvement of the usage rate of the installed power generation capacity from 48% in 2003 to 59% in 2009,
- The Specific Consumption of Power Generation stay around 207 to 209 goe per kWh except in 2009 it increased to 225 goe per kWh may be because the commissioning phase of 750 MW of Der Ali power plant added to the power generation system at the beginning of 2009,
- A decrease in apparent efficiency of energy transformation sector from 73% in 2003 to 68% in 2009,

- The transmission and distribution electricity system efficiency stayed around 80% to 81% during 2003-2009,
- Fairly good correlation between consumption power plants and environment indicators.

The transformation sector has registered significant gains in efficiency. The electricity production has been improving during the period 2003-2009 because of more electricity is being generated by using natural gas.

3. Industry sector indicators

The industrial sector consists of mining & manufacturing, which contributed to the GDP in 2009 by 23%, and building & construction, which contributed to GDP in 2009 by 4%. Figure 10 presents the final energy consumption in the industrial during 2003-2009. Table 6 presents the energy Indicators in the industrial sector.

Figure 10 - Final Energy Consumption in the Industrial Sector during 2003-2009 (Ktoe)

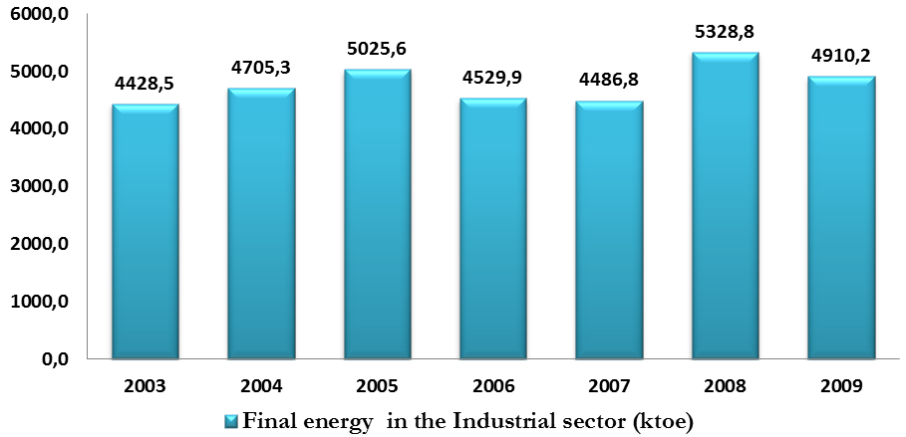


Table 6 - Energy Indicators in the Industrial sector during 2003 -2009

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
BSEC	*Specific energy consumption for the Cement*	toe/t	0,024	0,045	0,028	0,040	0,038	0,042	0,036
	Specific energy consumption for the Sugar		0,108	0,058	0,090	0,067	0,068	0,056	0,071
FEIIS	Final Energy Intensity of Industry Sector	toe/1000 SYP	0,015	0,014	0,015	0,013	0,013	0,015	0,013
IICO2	Intensity of CO2	teCO2/ 1000 SYP	0,023	0,021	0,024	0,020	0,019	0,024	0,020
IAEF	Average emission factor of industry sector	teCO2/toe	1,483	1,502	1,610	1,492	1,470	1,606	1,530

Figure 11 - The Specific energy consumption for the Cement industry during 2003-2009

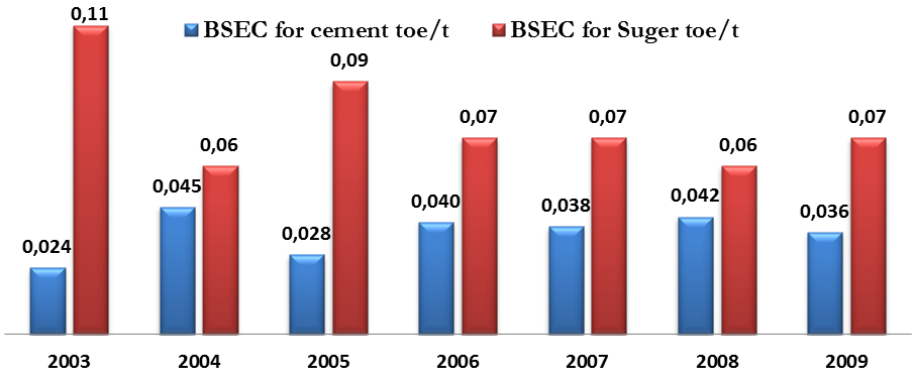
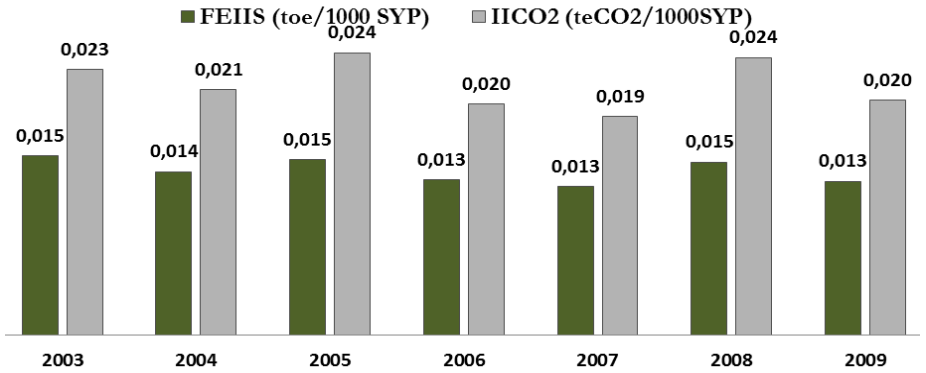


Figure 12 - The Final Energy Intensity & the CO_2 Intensity of Industry Sector during 2003-2009



Comments on Industry Sector Indicators

- Figure 11 illustrates the specific energy consumption in the cement industry during 2003-2009. It seems that these values are low if that compared by the values of the specific energy consumption for the cement industry in the best technology,
- Figure 12 illustrates the final Energy Intensity & the CO_2 intensity of industrial Sector during 2003-2009,
- The specific energy consumption for the Phosphate, the specific energy consumption for the Phosphoric acid, the specific energy consumption for the Three. Super Phosphate, the specific energy consumption for the Steel and the specific energy consumption for the paper are not available and it was difficult to obtain these information from the private &as well as from the public sectors.

4. Tertiary sector indicators

The Figure 13 presents the final energy consumption in the tertiary sector and Table 7 illustrates the energy indicators in this sector during 2003-2009.

Table 7 - The energy Indicators in the tertiary sector during 2003-2009

Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
Final Energy Intensity of Tertiary Sector	toe/1000 SYP	0,00134	0,00121	0,00117	0,00114	0,00131	0,00164	0,00164
Intensity of CO2	teCO2/ 1000 SYP	0,001806	0,001441	0,001546	0,000917	0,001718	0,003114	0,002793
Average emission factor	teCO2/toe	1,343	1,195	1,319	0,802	1,307	1,904	1,700

Figure 13 - Final Energy Consumption in the Tertiary Sector during 2003-2009 (Ktoe)

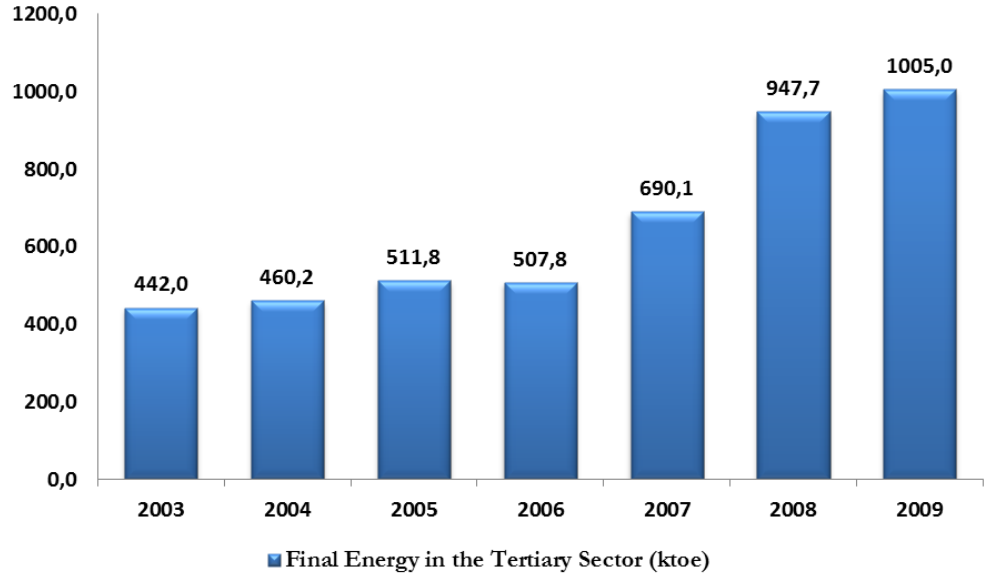
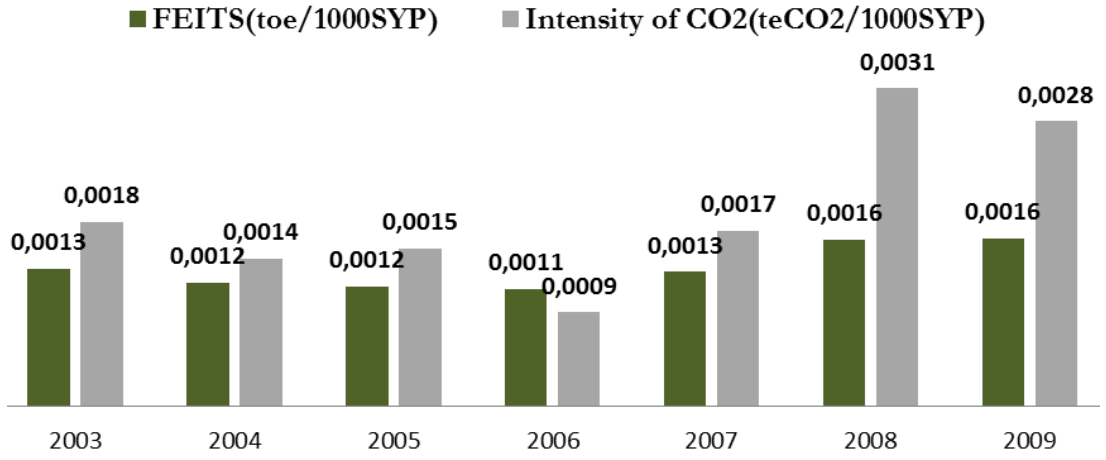


Figure 14 - Final Energy Intensity & CO_2 Intensity of the Tertiary Sector during 2003-2009



Comments on Tertiary Sector Indicators

- Final Energy Intensity & Intensity of CO_2 in the Tertiary Sector increased from 0.0013 toe/ 1000 SYP & 0.0018 $teCO_2$/1000SYP in 2003 to 0.0016 toe/1000 SYP & 0.0028 $teCO_2$/1000SYP in 2009 respectively as illustrated in Figure 14;
- The diffusion Rate of Solar Water Heaters in tertiary sector started to increase in 2008;
- The ratio of energy bill to added value in tertiary sector, the ratio of public subsidies for electricity to added value, the ratio of public subsidies for energy to Government Budget and the Energy Consumption per night guest are not available;
- Additional work should be done in this field to obtain reliable data and information.

5. Residential sector indicators

Figure 15 presents the final energy consumption in the residential sector while Table 8 presents energy indicators in this sector during 2003-2009.

Figure 15 - Final Energy Consumption in the Residential Sector during 2003-2009 (Ktoe)

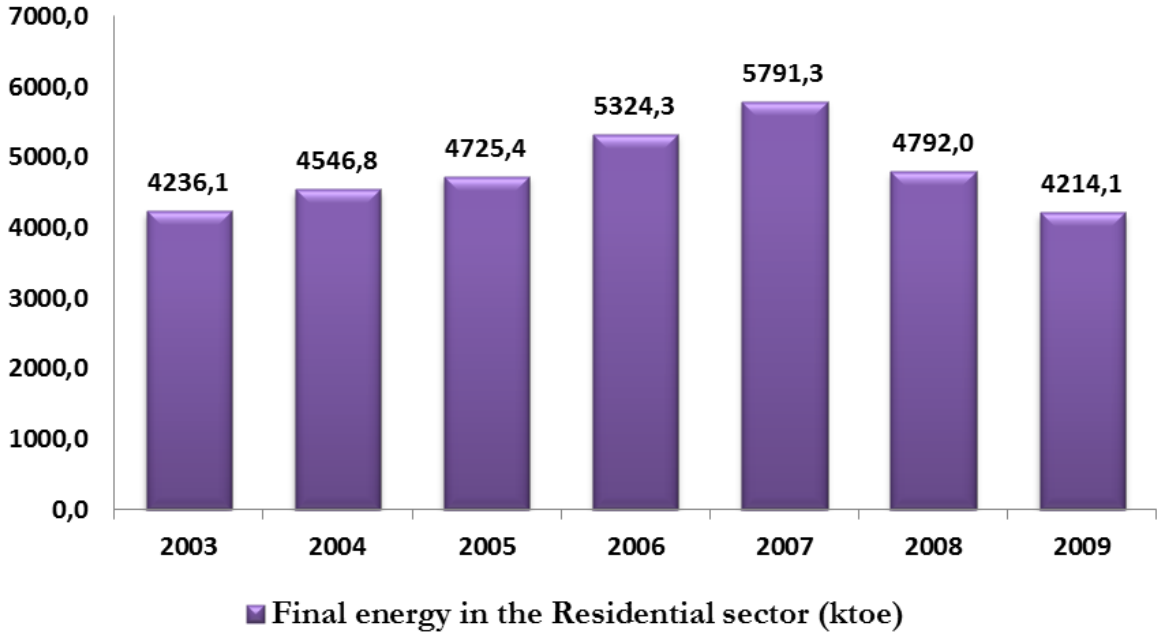


Table 8 - Energy Indicators in the Residential Sector

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
UCED	Unit Consumption of Energy per Dwelling	kgoe/Dw	1 445	1 350	1 358	1 474	1 548	1 238	1 056
SCEM²	Specific Consumption of Energy per area unit	kgoe/m²	14	14	14	15	15	12	10
UEICD	Unit Consumption of Electricity per Dwelling	kWh/Dw	3 031	2 951	3 160	4 133	4 356	3 972	4 460
SCElM²	Specific Consumption of Electricity per m²	kWh/m²	29	30	31	41	43	39	43
RIPE	Intensity of Residential Sector	toe/ 1000 LC	0,006	0,005	0,005	0,005	0,005	0,003	0,003
RAEF	Average emission factor	teCO2/toe	0,658	0,661	0,679	0,612	0,608	0,498	0,567
RICO2	Intensity of CO2	teCO2/ 1000 LC	0,004	0,004	0,004	0,003	0,003	0,002	0,002
RDRSHR	Diffusion Rate of Solar Water Heaters in Residential sector	m2/1000 hab	2,8	4,1	5,4	6,6	7,7	8,8	9,8
ERACR	Equipment Rate of Air conditioning in Residential sector	Unit/Dw	0,038	0,038	0,038	0,062	0,062	0,092	0,092
ERFR	Equipment Rate of refrigerator in Residential sector	Unit/Dw	0,227	0,227	0,227	0,311	0,311	0,370	0,407

Figure 16 - Unit Consumption of Energy & Electricity per Dwelling for the period 2003-2009

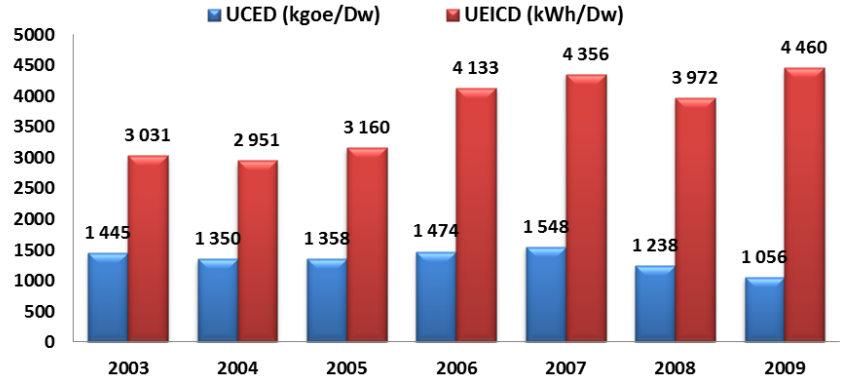


Figure 17 - Specific Consumption of Energy & Electricity per m² during 2003-2009

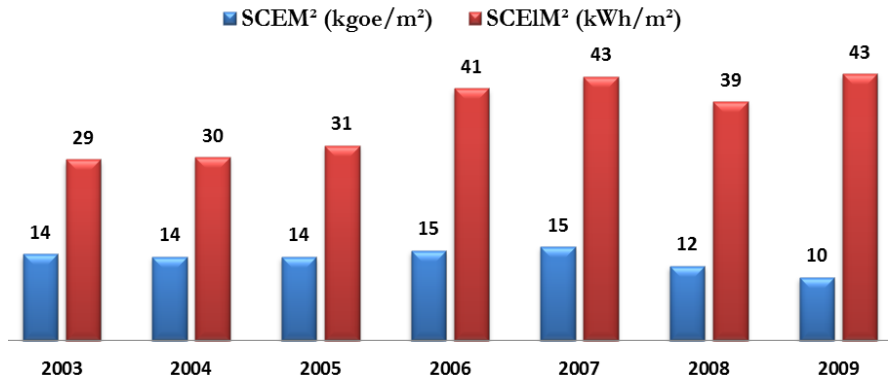


Figure 18 - Energy Intensity & CO_2 Intensity of Residential Sector during 2003-2009

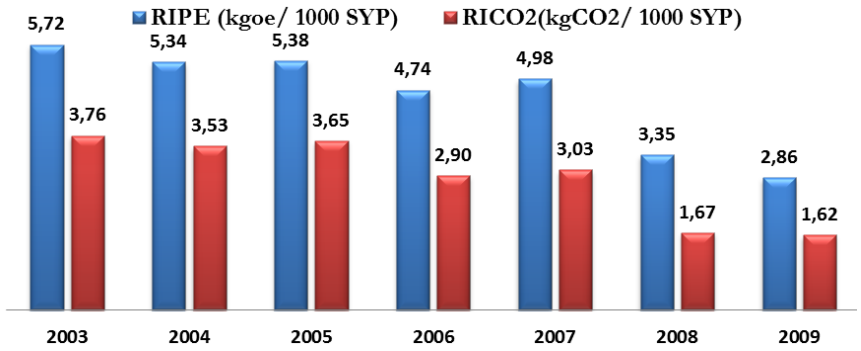


Figure 19 - Diffusion Rate of Solar Water Heaters in Residential sector during 2003-2009

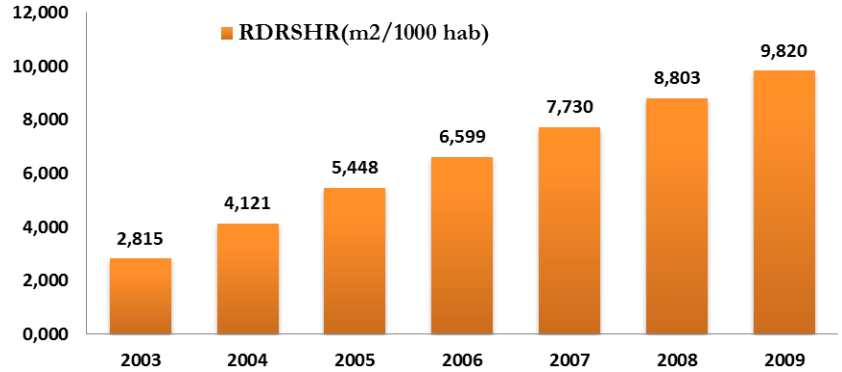


Figure 20 - Rate of refrigerator & Air conditioning in Residential sector during (2003-2009)

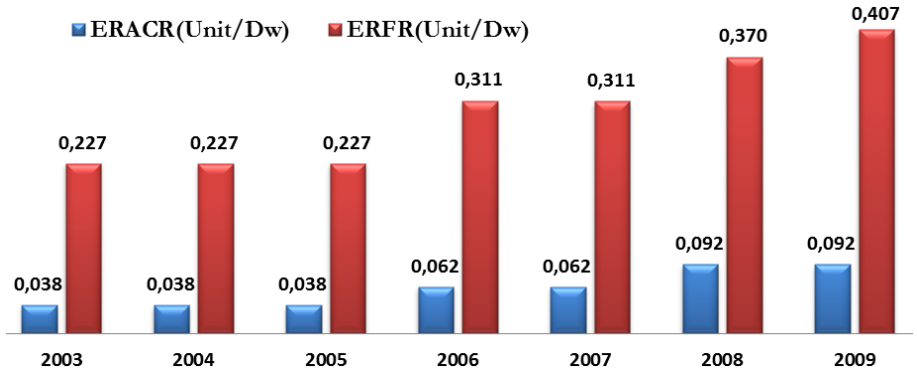
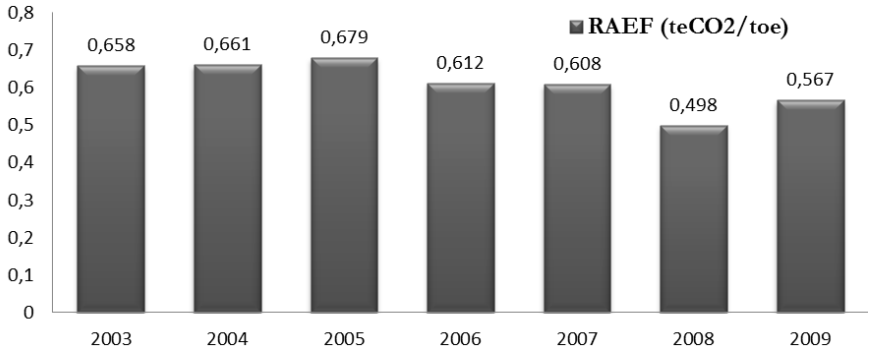


Figure 21 - Average emission factor during 2003-2009



Comments on residential Sector indicators

- The Energy Consumption per Dwelling & the specific consumption of energy per m² decreased from 1445kgoe/dwelling & from 13.9 kgoe/ m² in 2003 to 1056 kgoe/ dwelling & to 10.2 kgoe/ m² in 2009 as illustrated in Figure 16. While the electricity consumption per dwelling & the specific electricity consumption per m² increased from 3031 kWh/dwelling & from 29.2 kWh/m² in 2003 to 4460 kWh/ dwelling & to 43kWh/ m² in 2009 as illustrated in Figure 17;
- The energy intensity & the CO_2 intensity in the residential sector during 2003-2009 illustrated in Figure 18.

6. Transport sector indicators

Figure 22 presents the final energy consumption the transport sector & Table 9 presents energy indicators in this sector during 2003-2009. This sector contributed to the Syrian GDP in 2009 by 12%.

Figure 22 - Final Energy Consumption in the Transport Sector during 2003-2009 (Ktoe)

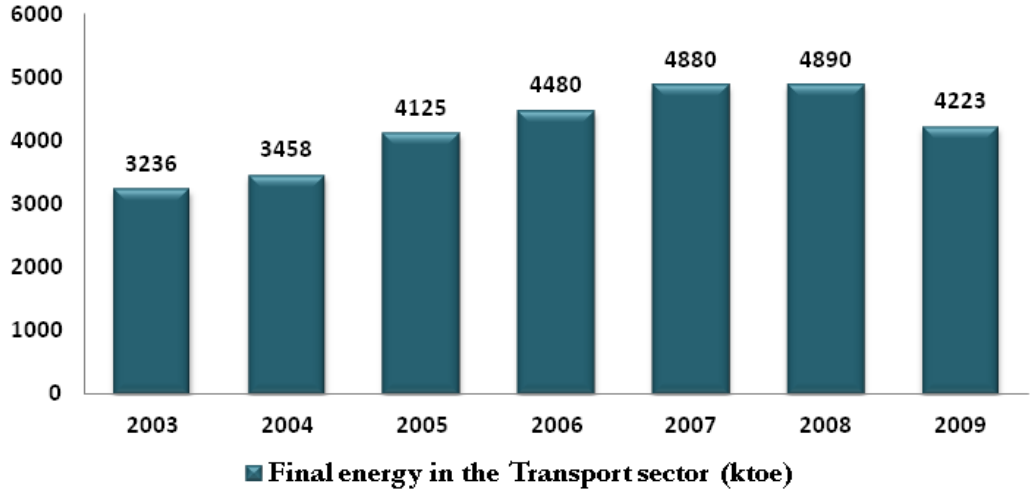


Table 9 - Energy Indicators in the Transport Sector during 2003-2009

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
TrFEI	Final Energy Intensity in Transport Sector	kgoe/1000SYP	3.18	3.18	3.57	3.69	3.80	3.65	2.97
STEHE	Share of household expenditure for transport	%	10.798	10.108	20.727	8.782	9.125	7.975	8.324
EUCC	Average Energy Unit Consumption of Cars	kgeo/car/year	2518.2	2486.5	2451.1	2187.1	1916.9	1860.5	1639.6
EUCC G	Average Energy Unit Consumption of gasoline Cars	kgeo/car/year	4711.9	4800.0	4968.8	4212.9	3462.4	3107.1	2922.6
EUCC D	Average Energy Unit Consumption of diesel Cars	kgeo/car/year	2006.7	1924.7	1816.4	1626.2	1457.7	1467.6	1229.2
AEFTS	Average emission factor of transport sector	$teCO_2$/toe	2.91	2.91	2.91	2.91	2.91	2.91	2.91
MR	Motorization rate	persons / Vehicle	18.91	18.01	15.64	13.15	11.23	9.63	8.55
ICO_2	Intensity of CO_2	$teCO_2$/1000 SYP	9.245	9.241	10.379	10.730	11.061	10.609	8.642
SCRW	Specific consumption for Rail ways	kgoe/ 1000 p.km	0.26	0.20	0.22	0.21	0.18	0.12	0.11

Figure 23 - Final Energy Intensity & CO_2 intensity in Transport Sector during 2003-2009

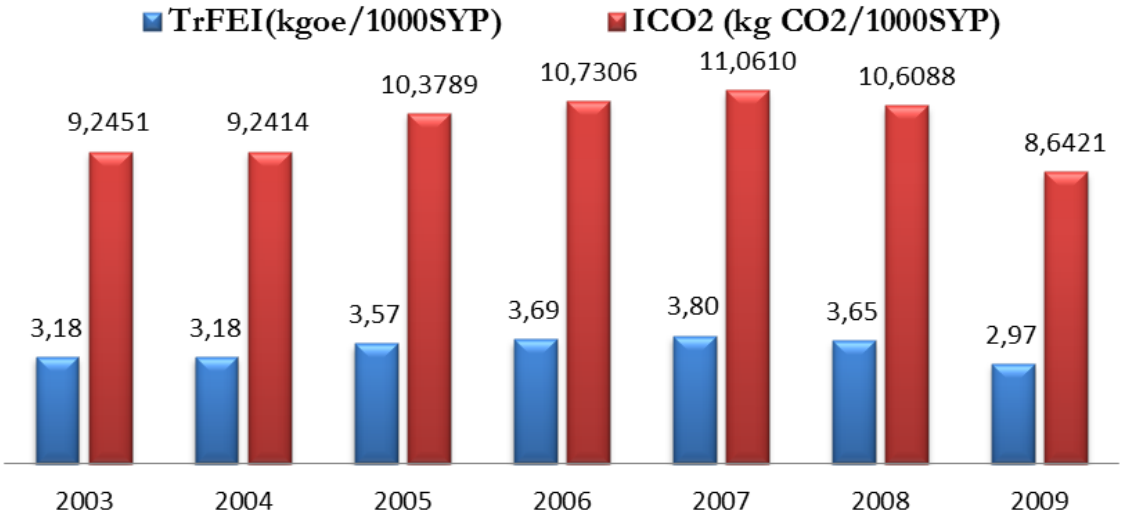


Figure 24 - Average Energy Unit Consumption of Cars during 2003-2009

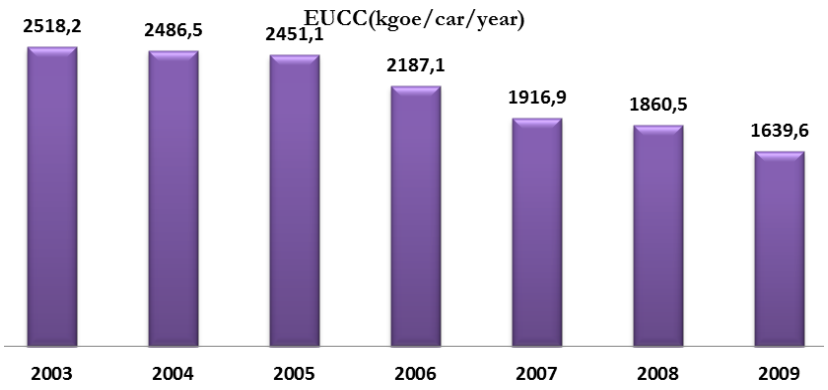


Figure 25 - Average Energy Unit Consumption of gasoline & Diesel Cars during 2003-2009

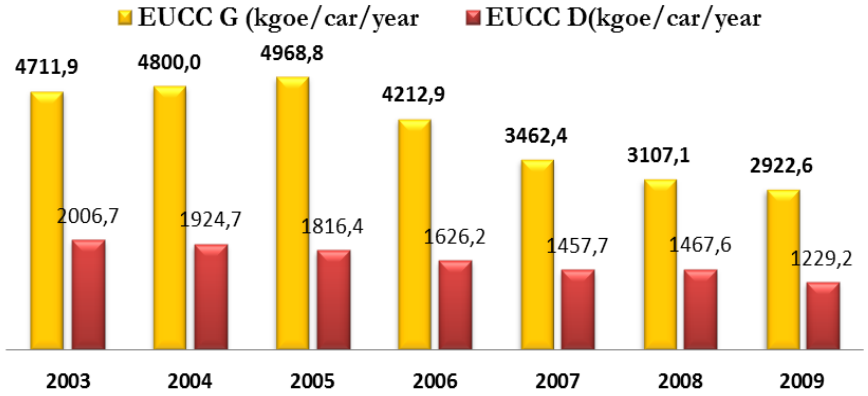


Figure 26 - Specific consumption for rail ways during 2003-2009

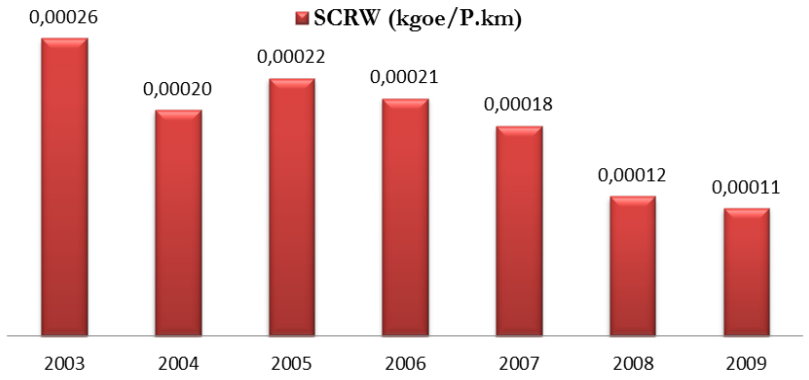
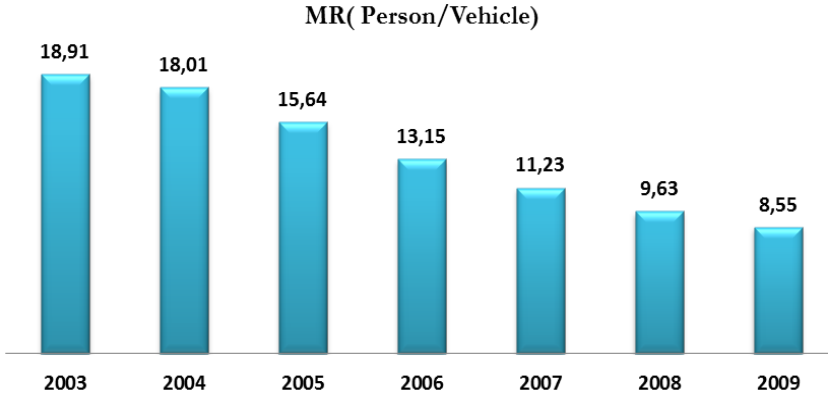


Figure 27 - Motorization rate during 2003-2009



Comments on Transport Sector indicators

- There was an increase in the Final Energy Intensity & in the intensity of CO_2 in transport Sector between 2003-2007 then that decreased during 2007-2009 because of the innovation of the transport fleet, as illustrated in Figure 23,
- There was a decrease of households expenditure for transport; that decreased from 10.8% in 2003 to 8.3% in 2009,
- There was a significant decrease of the average energy consumption of cars per year from 2518 kgoe/car/year in 2003 to about 1640 kgoe/car/year in 2009 as illustrated in Figure 24,
- The motorization rate decreased from 18.9 person / vehicle in 2003 to 8.55 person / vehicle in 2009 as illustrated in Figure 27,
- The average energy consumption of gasoline & diesel Cars during 2003-2009 decreased from 4712 kgoe/car/year & 2006.7 kgoe/car/year in 2003 to 2922.6 kgoe /car/year & 1229.2 kgoe/car/year in 2009 respectively as illustrated in Figure 25,
- The Specific consumption for rail ways during decreased significantly from 0.26 goe/P.km in 2003 to 0.11goe/p.km in 2009 as illustrated in Figure 26.
- These indicators require auxiliary information especially the following aspects:
  - Fuel mix in transport sector
  - Transport mode
  - Share of public transport in all transport modes
- The pressure made by transport expenses on the household's budget.,
- Low impact of transport policy to encourage people to use cars less and other mode more,
- Improvement of household income level,

- These indicators require auxiliary information about following aspects:
  - Fuel mix in transport sector
  - Transport mode
  - Share of public transport in all transport modes
  - Structure and activity of each energy-using and carbon emitting sub-sector in transport sector
  - Energy used in passenger travel and by mode.

7. Agriculture and fishing sector indicator

The agriculture and mining sectors form of overall local production, since their contribution in 2000 fixed prices reached 42% in 2009 from the GDP. The agricultural sector consumes around 90% of water resources, while around 8% are used for drinking purposes and 2% for the industrial sector. The actual calculated amount of water resources per person in Syria is around 1,000 cubic meters a year, and this amount is decreasing with the population growth. The data from the Ministry of Agriculture explains the decrease in the quota of available water per person to a rate inferior to the limit of water deficiency in all years, since it plummeted from 1,015 cubic meters per person to 747 cubic meters per person per person a year, and reached in periods of drought 577 cubic meters a year. Figure 28 illustrates the final energy consumption in the agriculture sector during the period 2003-2009. Table 10 presents the final energy intensity of agriculture sector, the share of dry cultivated area and the share of irrigated cultivated area during the period 2003-2009 as illustrated in Figure 29 and Figure 30.

Figure 28 - Final Energy Consumption in the Agriculture Sector during 2003-2009 (ktoe)

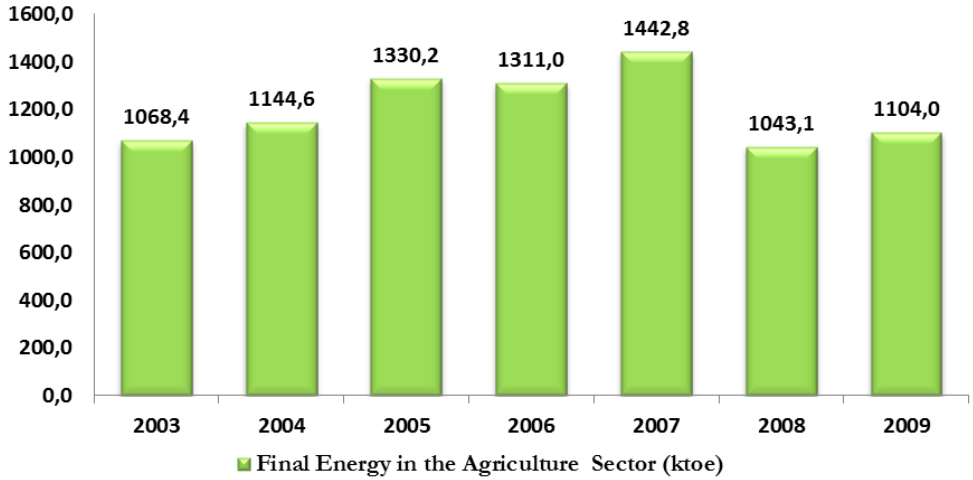


Table 10 - Energy Indicators in Agriculture sector in SAR for the period 2003-2009

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
FEIA	Final Energy Intensity of agriculture	toe/ 1000 SYP	0.0042	0.0046	0.0050	0.0045	0.0057	0.0044	0.0042
SDCA	Share of Dry cultivated area	%	0.708	0.696	0.707	7.542	0.704	0.706	0.715
SICA	Share of Irrigated cultivated area	%	0.292	0.304	0.292	3.165	0.296	0.294	0.285

Figure 29 - Final Energy Intensity of agriculture for the period 2003-2009

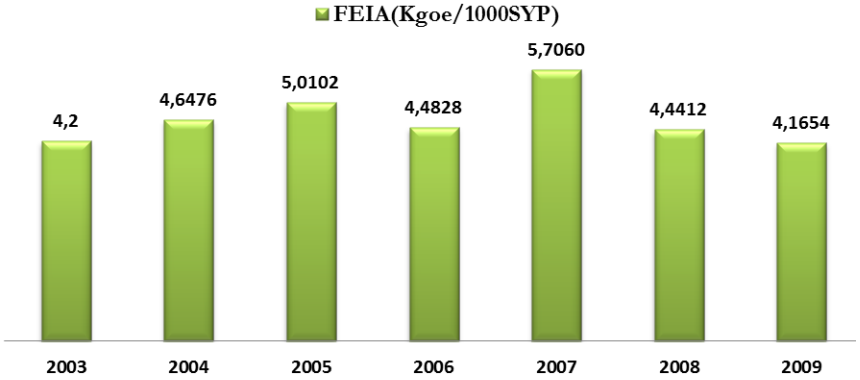
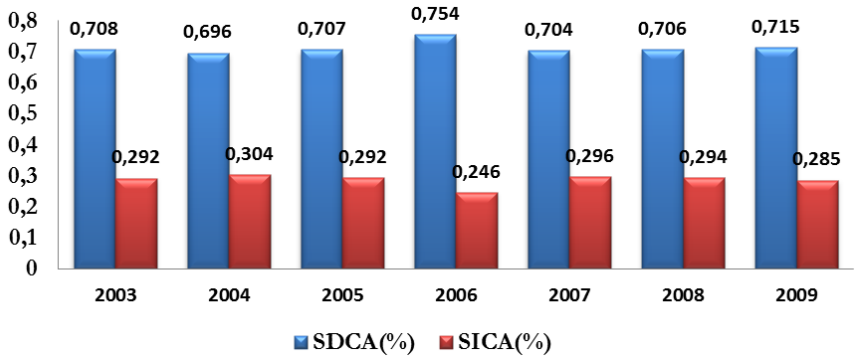


Figure 30 - Share of Dry & irrigated cultivated area in SAR during the period 2003-2009



Comments on Agriculture Sector indicators

- The Final energy intensity of agriculture sector increased from 4.2 kgoe/1000SYP in 2003 to 5.7 kgoe/1000SYP in 2007 then decreased to 4.16 kgoe/1000SYP in 2009,
- The Share of Dry cultivated area increased from 70.8% in 2003 to 75.4% in2006 then decreased to71.5% in 2009, while the Share of Irrigated cultivated area decreased from 29.2% in 2003 to 24.6% in 2006 then increased to 28.5% in 2009,
- The final energy intensity of fishing, the specific consumption for fishing, the Share of equipped wells with Moto pumps and the share of equipped wells with electro pumps were not available.

IV. Conclusion

The work on this project was challenging and productive. It helped in understanding the different parameters involved in the data collection and analysis process and the problems that is facing such task and how to overcome them. It showed that things are not as easy as they seem. Knowing where the data is and which agency is responsible for what and what individuals have the needed information relied heavily on personal contacts.

Main comments on the overall exercise

- The exercise was an important first step toward establishing a unified regional indicators for energy efficiency,
- Participating in the three workshops were very helpful to discuss and exchange knowledge on the subject,
- The regional project team were very helpful in guiding the national experts in developing the different tools and indicators.

Learned lessons

- Data collection is not as easy as it seems,
- A unified calculation tool makes the job easier,
- Cooperation between the different institutions in the country is necessary obtain accurate & measurable indicators,
- A single entity should be responsible for maintaining/updating energy data and EE indicators.

Recommendations

- It will be strongly recommended to the government to establish local indicators with regional standards and build on what was accomplished in this study,
- It is concluded from the energy balance and energy situation in SAR there is an essential needs for energy saving, efficiency improvement and increased use of renewable energies on the supply side & and on the demand side. That will help to reduce primary energy consumption and maximize the energy dependency,
- As more than 38% of primary energy consumption is consumed in the power generation sector it is very important to concentrate on energy efficiency in this sector,
- Accurate data and precise information on energy production and consumption in all sectors help to develop measurable energy efficiency indicators at different levels of the energy system in the country,
- It is very important to train national experts & engineers in different sector how to develop measurable energy indicators,
- There is a real need to follow up the different industrial establishment (public or private) in order to obtain accurate data to be able to develop real energy efficiency indicators in the industrial sector,
- There is still a real need to obtain accurate data on air and maritime transport to be able to develop energy indicators in these tow sub –sectors,
- There is a real need to follow up on tertiary sector information in order to develop accurate energy indicators in this sector and to advise concerned people how to conserve energy in this sector.

V. References and relevant websites

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Public Establishment for Electricity generation and transmission, Statistical Reports 2003-2009, www.peegt.gov.sy

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Table of illustrations

Figures

Tables