Energy conservation indicators in Southern Mediterranean countries

Country report for Yemen

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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.

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Finally I would like to thank Yemeni partners starting with focal point Mr. Basalah, my subcontractor Mr. Abdussalam Mansoor Al-Janad, Mr. Sam Al-Bashiri General Manager for Statistical Censuses & Surveys in COS, Mr. Mohamed Shonaif Vice Chairman and Dr. M. A-Haifi Planning Director in YCC, Dr. Amin Al-Kholidi, Member of Yemen Extractive Industry Transparency Initiative, and all others who help during preparation of this work.

List of abbreviations

DB	Data Base
COS	Central Organization of Statistics
GDP current price	Gross Domestic Product current price
GDP1990	Gross Domestic Product constant price 1990
EI	Energy Intensity
ESMAP	Energy Sector Management Assistance Program
LPG	Liquid Petroleum Gas
MBbls	Million Barrels
MEE	Ministry of Electricity and Energy
MOM	Ministry of oil and Minerals MOM
MPIC	Ministry of Planning and International Cooperation
PDRY	People's Democratic Republic of Yemen
PEC	Public Electricity Corporation
RER	Renewable Energy Resources
ROY	Republic of Yemen
tcf	Trillion cubic feet
Toe	Ton Oil Equivalent
YAR	Yemen Arab Republic
YCC	Yemen Cement Corporation
YR	Yemeni Real (Local Currency)
LC:	Local Currency = Yemeni Real

I. Country General background

22 May, 1990 Yemen Arab Republic (YAR) and People's Democratic Republic of Yemen (PDRY) merged to create Republic of Yemen (ROY). This unification has led to dramatic political and economic reforms in Yemen. YAR till 1962 was an isolated kingdom with theocracy regime. The 1962 Revolution opened the country to greater contact with the rest of the world. YAR had generally market economy with some influence of Arab countries like Egypt and Syria at that time. PDRY, a former British colony, took since 1967 socialist principles of economy.

However, since 1990 a number of occasions have led to a serious setback of the national economy, namely:

- Process of unification and the merging of two completely different systems have resulted in high costs necessary for governmental and social restructuring.
- Gulf war and ROY political position from this war has led to :
  - Return of most of Yemeni workers from Gulf States, who were more than one million.
  - Termination of around 80% of the foreign aid.
  - Suspension of Soft loans from Gulf States.
- Civil War broke out March, 1994 with its well-known consequences and impacts on the various aspects, e.g. economic, political, social, etc.

All these factors have caused great economic difficulties, e.g. the exchange rates of USD were at 1990: $1=YR12.5. Since then till 1996 Yemeni Rail value was going down and the exchange rate reached $1 = YR 165 by 1996. Now $1 = YR 244.

By 2011 Population of Yemen could exceed 23 million, as GDP for 2009 is YR6, 070 Billion [US$25.3Billion], i.e. US$1054 per capita which is very low.

Geographically, Yemen is situated between 13□ -16□ latitude and 43.2-53.2 longitude. The country consists of three major zones. (a) A coastal plain extends inland 30 to 60 km. (b) The rugged foothills of the central mountain range rise from the plain, eventually forming the mountains and plateaus of the central highlands. Mountains in the central highlands often exceed elevation of 3000 m. Most of the rural population inhabits this region. (c) The central highlands give way to the rolling countryside of the arid eastern plateau, which drops to an elevation of approximately 1000 m or less.

Other than petroleum and gas reserves, Yemen is not well-endowed with natural resources. Soil and climatic conditions, as well as the mountainous topography found in much of the country, are not conducive to agriculture.

Energy demand was in 2009; 7,423 ktoe. This demand is met by local production and imported oil products of 4,550 ktoe. However Yemen exports crude oil and natural gas which reached 12,694 ktoe in 2009.

The Figure shows energy profile of the country.

The grand energy production in 2009 reached an amount of 15,567 ktoe, as given in Aggregated Energy Data Sheet.

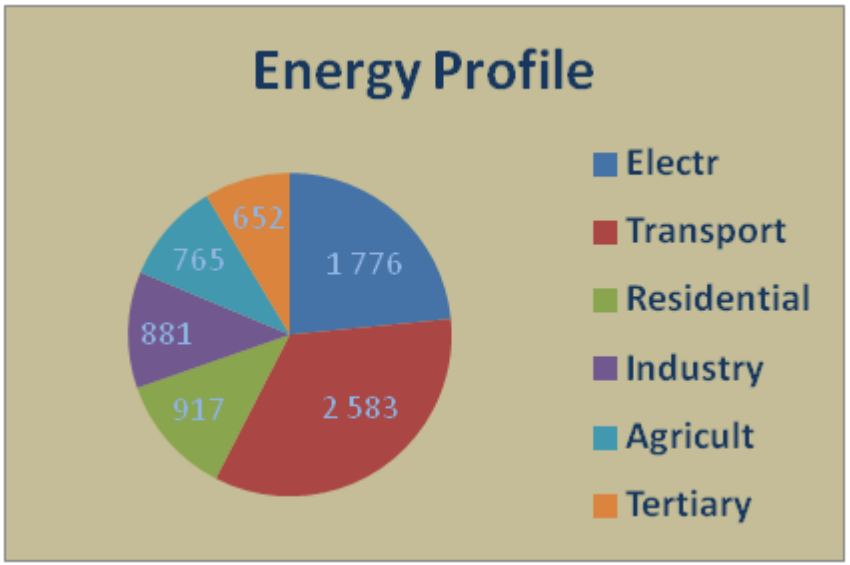
Also it should be noticed from this Sheet that energy demand is monotonically increasing as production is decreasing. This situation indicates that the depletion of oil could take place within 10 to 15 years.

The energy resources in Yemen consist of the following:

Oil is the main source of energy. Yemen exports oil since nineteen eighties. The amount of produced crude oil reached in nineteen nineties 400,000 barrel/day but in 2009 it is 284 barrel / day.

Gas: Currently, the certified gas reserved 10.5 tcf. From this amount only 1 tcf is allocated for domestic market to be used in electricity generation which would generate around 3000 GWh, Taking 2009 year as base year, yearly consumption can be estimated, hence number of years which 1 tcf could cover 20 years to generate required electricity using gas power stations. Other uncertified gas reserves are estimated for an amount of 6.5 tcf.

Renewable Energy Resources (RER) are potentially high. A study done by the Consultant Lahmeyer International, Germany assessed these potentials [1] and reached the following figures:



Wind: preliminary estimates show that around 14,214 MW can be developed at wind farm sites assessed [1]. Economically attractive sites are however those with more than 3500 full load hours per year. A capacity of about 2,507 MW could be developed at these sites which could generate around 8,293 GWh of electricity per year.

Solar: The annual average solar insulation in Yemen ranges from 5.2 – 6.8 kWh/m^2/day. The resource assessment study estimated a technical potential for these applications to reach around 2210 MW.

Geothermal: Yemen is situated near three tectonic boundaries which are among the most active areas of the world. These are the Gulf of Aden, the Red Sea and the Eastern African Rift System. These three tectonic plates meet in a triple junction creating high geothermal gradient, and subsequently geothermal energy potential are estimated to be 28.5 GW [1].

Recently a long term rural electrification strategy using photovoltaics, was approved having, total costs about US$ 300 million, of which US$120 million are now available via funding from the World bank, the Islamic Development Bank and other donors.

Also the Yemeni government decided to increase contribution of renewable energy sources in the electricity generation up to 15%, target by 2025. This is a realistic time frame and such a target is also compatible with the future electricity system requirements and capabilities.

II. Data collection process

1. Main sources of data

In order to meet project requirements regarding data many sources were used, mainly:

- Yearly Book issued by Central Organization of Statistics
- Census of year 2004
- Records of many ministries, entities, corporations and organization in Yemen
- Records of some international agencies

Unfortunately in Yemen there is no National Data Bank operated by database software. Such a source could be the main one. Table 1 shows Major institutions holding data and information:

Table 1 - Major Data Sources' Initiations

Institution name	Address, Email and Website	Tel and fax
Central Organization of Statistics (COS)	MPIC Building, Almethaq Street, Sana'a, Republic of Yemen	Tel./ Fax: +9671 253089
Ministry of oil and Minerals (MOM)	MOM Complex, Zubairy Street, Sana'a, Republic of Yemen	Tel: +967 1 202309
Ministry of Electricity and Energy (MEE)	175 Airport Road, Sana'a - P.O. Box No.178, Republic of Yemen	Tel./ Fax: +9671326205, 207
Public Electricity Corporation (PEC)	175 Airport Road, Sana'a - P.O. Box No.178, Republic of Yemen	Tel: + 967 1 328141, + 967 1 328142 Fax: + 967 1 328151
Ministry of Agriculture	Kuwait Street, Sana'a, Republic of Yemen	Tel: +967 1 250934
Yemen Cement Corporation (YCC)	Office Complex Haddah Road, Sana'a, Republic of Yemen	Tel: +9671 264139
National Traffic Department	Ministry of Interior Complex, Khawlan Street, Sana'a, Republic of Yemen	Tel: +967 1 619595

2. Progress and Major difficulties met during the data collection

Unfortunately the unrest and extraordinary situation in Yemen has started during data collection phase which negatively affected data collection progress. However, great amount of raw data was collected. Overall administrative system in Yemen can be considered immature. This fact has badly influenced data structure, data documentation, data reliability and discrepancy, data availability and data types. Accordingly, some difficulties were faced during data collection phase, which may be summarized as follows:

- The Access to data sources is not easy more over some data is considered as secret;
- The Political situation is very critical which made data collection more difficult ;
- There is no sectors specific data;

- General Data is quite available but detailed data is not available ;
- There is no data history ;
- Required data is so detailed and not available;
- The available Data contains discrepancies ;
- Complex routine and bureaucracy in all ministries and even private sector entities;
- Involvement of various entities for the same task, for example transport sector; beside the Ministry of transport there is a lot of entities involved like Traffic Department, Ministry of Public Works, National Fund for Road Maintenance, etc.;
- The existing databases are so limited in number, in capability and have different languages, and there is no common DB manager, which led to inconsistencies in the data.

3. Data availability

In spite of the difficulties listed above one can see that a high level of availability was achieved. This is shown in the Table below. However it should be mentioned that some data items are not relevant to Yemen, namely:

- Railway socio-economic 14 items ;
- Railway energy equal 7 items ;
- Maritime transport socio-economic 21 items ;
- Maritime transport energy equal 7 items ;
- Some industries do not exist or just started, e.g. phosphate, steel, paper and sugar. Then non applicable data items are: for industry socio-economic equal 49 items and for industry energy equal 42 items.

Thus the total non-applicable data items equal 140, which mean total required number of data items is 560, as the available number is 455 leading to Grand data availability of energy and socio-economic data items is 81.25%

Table 2 - Data Availability

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	98	100						
Transport sector	49	35	72	105	70	66.7	21	21	100
Tertiary sector	28	7	25	35	7	20	7	0	0
Residential sector	21	14	66.7	49	35	71.5	7	0	0
Industry sector	56	14	25	91	21	23	7	0	0
Agriculture & fishing	14	14	100	56	49	87.5	-		
Total	322	238	74	378	224	59.2	49	28	57

*: 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.
***: Highlighted numbers do not apply to Yemen as some Industries do not exist (see attached Ind. Calc. Tool)

III. Indicator's calculation

Energy Indicators calculated for Yemen Energy Sector appear sometimes irrational. This is so because Yemen has specific circumstances, which are listed below:

1) Subsidies to electricity and oil products are heavy so that they reached around US$1 Billion per year. This situation affects Energy Intensity Indicators. For example energy intensity could be high because the fuel is cheap (subsidized).

2) Shortage of power generation to meet demand estimated as 1200 MW. This shortage is around 30%. In addition more than 30% of the country territory is not covered by electricity supply and many industries have their own power station separated from the national grid. Therefore the average electricity consumptions is so low.

3) Biomass (wood, firewood and/or charcoal, dang, etc.) has substantial participation in rural household energy consumption this form of energy is not recorded and varies from one year to another depending on some factors like LPG availability, rainfall, unemployment in rural areas, etc.

4) GDP of Yemen is considered at lower level as Yemen position is in the region of poor countries as it listed 144 by International Monetary Fund.

1. Macro level indicators

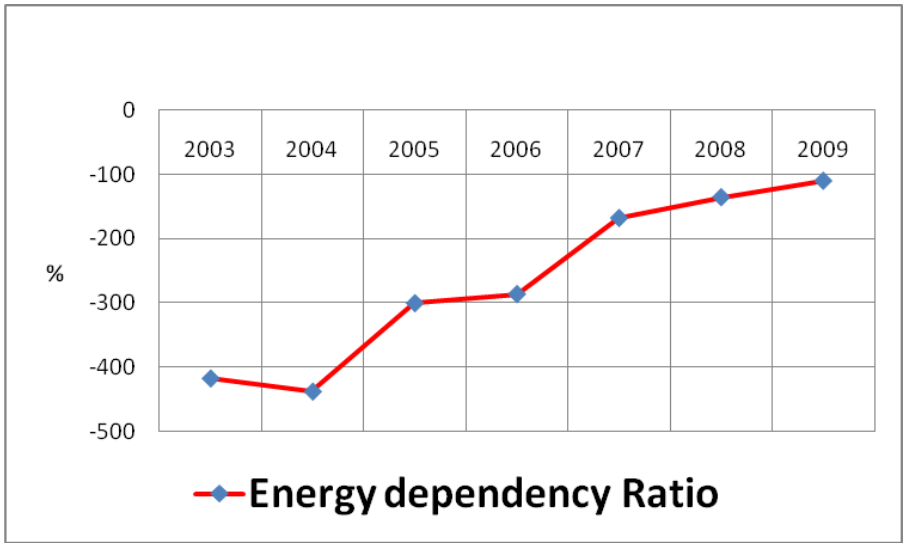
The importance of Macro Level Indicators of energy of the Country comes from the fact they reflect its level of economic and social development. In addition Macro Level Indicators expose other aspects like environmental, energy efficiency, etc.

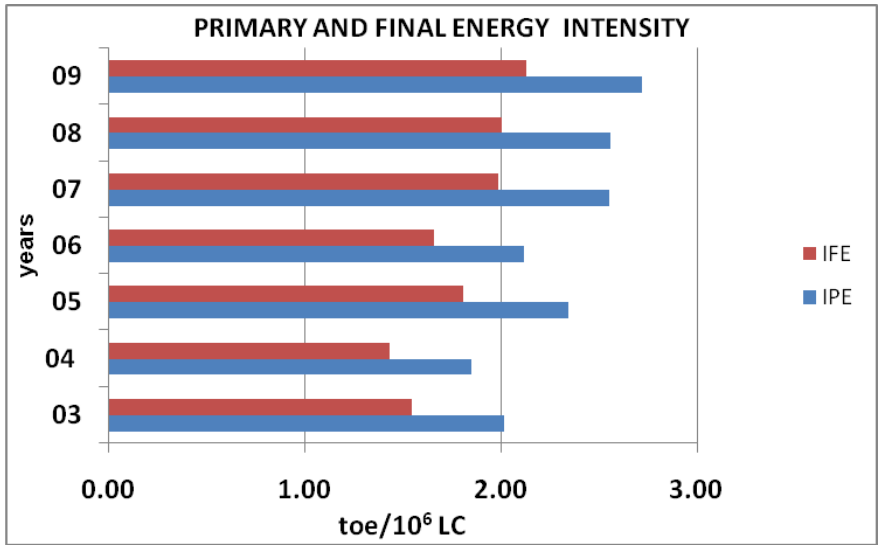
Table 3 - Indicators of Macro Level

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
EDR	Energy dependence Ratio	%	-417%	-438%	-300%	-286%	-168%	-135%	-110%
IPE	Intensity of Primary Energy	toe/MYR	2,01	1,85	2,34	2,12	2,55	2,56	2,72
IFE	Intensity of Final Energy	toe/MYR	1,54	1,43	1,81	1,66	1,98	2,01	2,13
RFEPE	Ratio of final energy consumption to primary energy	%	77%	77%	77%	78%	78%	78%	78%
REB	Ratio of National Energy Bill to GDP	%	8%	9%	13%	12%	14%	16%	11%
RPSE	Ratio of public subsidies for energy to GDP	%	0%	0%	0%	0%	1%	3%	0%
AEF	Average emission factor	teCO2/toe	3,06	3,05	3,03	3,02	3,02	3,00	3,00
ICO2	Intensity of CO2	teCO2/MYR	6,15	5,65	7,09	6,40	7,71	7,68	8,16
AECH	Average Primary Energy Consumption per habitant	ktoe/1000 hab	0,218	0,203	0,263	0,241	0,296	0,300	0,325
AELCH	Average Electricity Consumption per habitant	MWh/hab	0,143	0,149	0,162	0,173	0,190	0,203	0,203

From Table 3 one can see that first indicator (EDR) was in 2003 -417%, but in 2009 reached -110% which means that Yemen is independent country in its energy resources till 2009. Furthermore Yemen exports energy products (oil & gas). However EDR indicator goes down which makes one estimates that Yemen could go into energy dependency phase within few years unless new energy strategy involving renewable resource is developed.

Second and Third Indicators related to Intensity of primary and final Energy (IPE &IFE)[1] which have small values because the energy consumption is comparatively low.



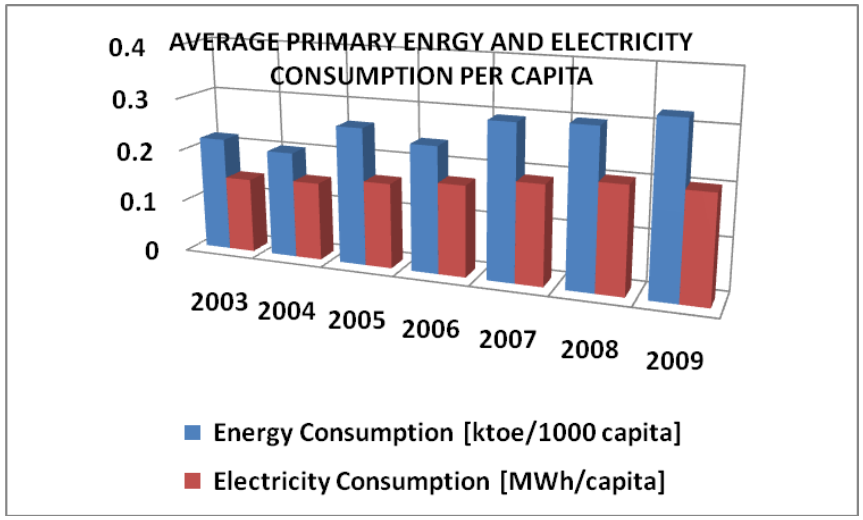


Third Indicator (RFEPE) represents the overall energy efficiency of energy transformation which fluctuates from 77% to 78%. Such value can be considered within acceptable level for a country like Yemen. It should be noted here that efficiency of electricity industry is combined with refinery.

Ratio of Energy Bill (REB) to GDP indicator shows that small percentage of GDP goes to energy, because average energy consumption is comparatively low. This can be also explained by the fact that when the international energy prices increase and consequently the energy bill goes up, the GDP of the country increase in the meanwhile making the ratio energy bill to GDP stable.

Unitary energy and electricity consumption indicators show low level compared to other countries which reflects overall the low level of the country economic development. Also it indicates that high demand for energy should be expected in the future as development programs are implemented.

[1] GDP constant price 1990



2. Energy transformation sector indicators

Electricity sector suffers from serious problems, mainly: shortage of available generating capacities to meet demand, low efficiency as shown by next Table, low coverage of supply, low reliability, bad quality of services and mismanagement.

Table 4 - electricity generation and consumption

	Units	2003	2004	2005	2006	2007	2008	2009
Consumed Electricity	ktoe	235	253	283	312	351	387	399
Generated Electricity	ktoe	355	375	410	459	519	563	581
Efficiency of Trans. & Distr.	%	66.3%	67.4%	69.1%	67.9%	67.7%	68.7%	68.8%

The Sector needs to be reformed and the investment plans to be implemented.

In Yemen there are two oil refineries. One was installed in Aden when it was British Colony, in the middle of last century. The monthly average crude oil refined in Aden Refinery is 2.161 MBbls. The yearly production profile is shown in Table 5:

Table 5 - Petroleum products production

Product	LPG	Nephtha	Kerosine	Gasoline	Diesel	Fuel oil	Asphalt
M. Ton	50,144	59437	533,197	918,271	918,105	571,308	925,38

The other oil refinery is located in Mareb which was installed in nineteen eighties. The monthly average of crude oil refined in Mareb Refinery is 250,000 Bbls, i.e. around 10% of the capacity of Aden refinery and having almost the same spectrum of oil products.

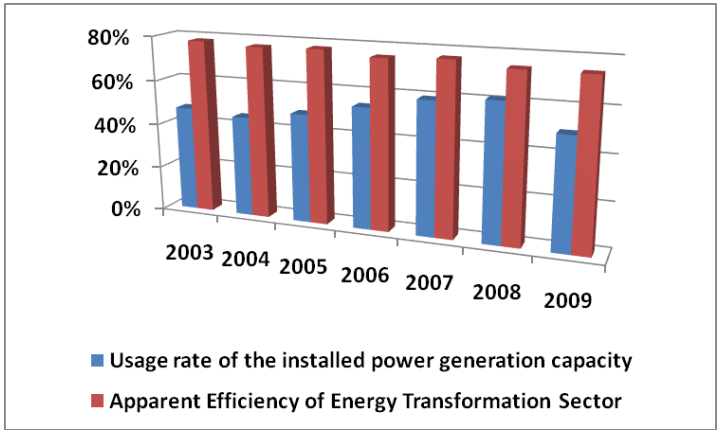
The following table presents the main indicators calculated for transformation sector:

Table 6 - Indicators of Energy Transformation

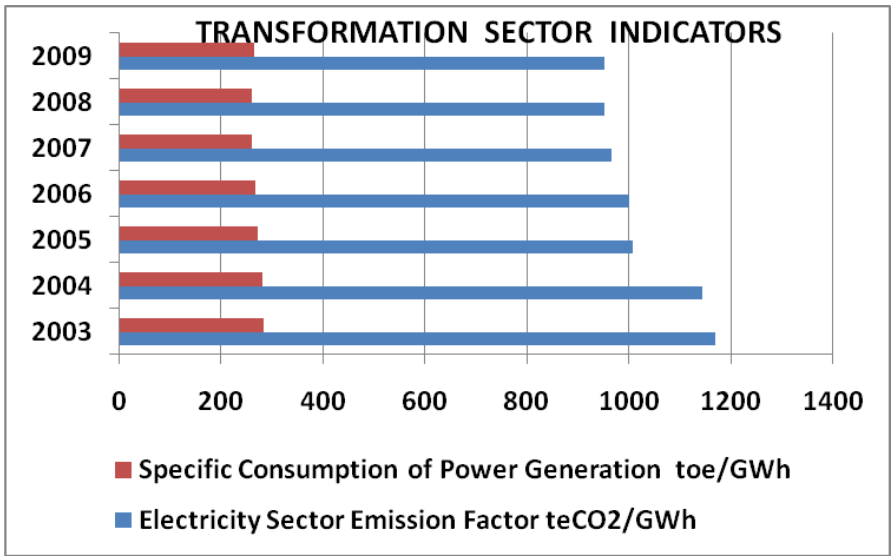
Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
SREC	Share of installed RE electricity capacity	%	0%	0%	0%	0%	0%	0%	0%
URIC	Usage rate of the installed power generation capacity	%	47%	45%	49%	54%	59%	61%	50%
AETS	Apparent Efficiency of Energy Transformation Sector	%	78%	77%	78%	75%	77%	74%	74%
PGEFF	Power generation efficiency of thermal plants	%	30%	31%	32%	32%	33%	33%	33%
SCFFP	Specific Consumption of thermal power plants	toe/GWh	283.1	281.1	270.1	265.7	259.1	258.6	263.2
PGF	Power generation efficiency	%	30	31	32	32	33	33	33
SCPG	Specific Consumption of Power Generation	toe/GWh	283.1	281.1	270.1	265.7	259.1	258.6	263.2
TDEE	Transmission and Distribution Electricity system Efficiency	%	78%	80%	83%	82%	83%	83%	85%
PGEF	Power Generation Emission Factor	$teCO_2/GWh$	821	815	783	770	751	750	763
ESEF	Electricity Sector Emission Factor	$teCO_2/GWh$	1169	1142	1006	999	965	950	951

SREC indicator (share of RE) shows that no Renewables are utilized in spite of the high potentials as shown earlier.

URIC indicator reflects power station availability and utilization. It ranges between 47% and 61%, which is significantly low. Noticeable sharp reduction of this indicator in 2009 is due to the fact that PEC started in this year electricity purchase from private electricity producers.



Apparent Efficiency of Energy Transformation Sector (AETS) indicator shows low efficiency for energy transformation which encourages concerned entities to work out initiatives to upgrade the efficiency.



Generation Emission (PGEF) indicator shows slight improvement of emission reduction factor. However one should compare this indicator with identical one in similar countries in the region. Specific Fuel Consumption (SCFFP) indicator shows reduction of fuel consumption up to 2008. In 2009 it slightly increased possibly due to power shortage increase which led to run thermal plants with lower efficiency.

Indicators PGF and SCPG are replica of PGEFF & SCFFP indicators respectively, because power generation types in Yemen is limited to thermal power stations.

3. Industry sector indicators

Industrial sector in Yemen is still in low level of development, as the contribution of Industry Sector in GDP for 2009 is around 24%. This fact is clearly seen from the amount of energy consumed by Industry Sector which reached 15.2% (881 ktoe) of final energy consumption for 2009 year. As mentioned earlier, industries like steel and some cement plants just have been commissioned last year. But other industries like phosphate, sugar, paper and aluminium do not exist.

Table 7 - Indicators of Industry

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
BSEC	*Specific energy consumption for the Cement*	toe/t	0,101	0,099	0,115	0,103	0,110	0,110	0,109
FEIIS	Final Energy Intensity of Industry Sector	toe/Million YR	5,335	5,086	6,548	6,233	7,977	8,358	9,120

Final Energy Intensity for Industry has increased almost doable between 2003 and 2009. But this increase has happened due to less increase rate of value added of the sector. Specific consumption for cement seems to be within the average in other similar countries.

4. Tertiary sector indicators

Due to unavailability of most of data for this sector, the indicators were not calculated except Energy Intensity which shown below:

Year		2003	2004	2005	2006	2007	2008	2009
Energy Intensity	Toe/MYR	2.66	2.43	2.91	2.72	3.18	3.23	3.36

Here we notice slight increase in energy intensity because value added increasing was less than energy consumption which indicates less efficiency.

5. Residential sector indicators

The importance of residential sector consists in the fact that around 40% of electricity output of distribution is consumed by household customers. But the number dwells using electricity supply represents less than seventy per cent. In order to meet habitants' demand of lighting, cooking, heating, cooling, etc. this sector consumes other forms of energy: gas, kerosene, wood, etc. in addition to electricity. Examining of Table 8 results in the following comments:

Table 8 - Indicators of Residential Sector

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
UCED	Unit Consumption of Energy per Dwelling	kgoe/Dw	183,40	179,39	226,09	216,54	257,68	266,74	283,16
UEICD	Unit Consumption of Electricity per Dwelling	kWh/Dw	398,78	415,80	447,32	486,02	532,88	561,83	562,52
RIPE	Intensity of Residential Sector	toe/ Million YR	2,66	2,57	3,21	2,84	3,14	3,14	3,04
ERACR	Equipment Rate of Air conditioning in Residential sector	Unit/Dw	0,111	0,111	0,113	0,112	0,114	0,123	0,120
ERFR	Equipment Rate of refrigerator in Residential sector	Unit/Dw	0,217	0,230	0,244	0,254	0,275	0,288	0,303

- The unit consumption of energy (kgoe/Dw) Indicator is generally low but its average increase rate is high, almost 6% per year. This low level is explained by the low economic development of the country.

- Electricity Consumption of household indicator is also low but its average increase rate is high, almost 4.8% per year. It should be noticed that during these years and up to now there is power shortage; hence daily power cut off is at least 30% of maximum demand at best. Therefore shown figures are lower than what it should be.
- Energy Intensity has increased probably because of the increase of household which were connected to electricity supply which is heavily subsidized.
- Although the energy products are subsidized, Energy Intensity Indicator seems too low. This is so because other forms of fuel were not included (biomass) which are used extensively in rural areas. In addition some dwells included in the total number may use negligible amount of energy and some dwells may be not occupied by households. This is applied to unit energy consumption per dwell.
- Air-conditioning diffusion rate shows low figures, i.e in 100 dwells there are only 11 air-conditions for year 2003. This figure increases up to 12 air-conditions for year 2009. There is number of reasons behind this result, namely:
  - Electricity Coverage is around 70%
  - Around 70% of dwells are located in rural areas where this equipment is considered luxury.
  - High percentage of population lives in the mountainous area, i.e. high lands having elevation higher than 1000 m above sea level and higher, where there is no need for air-conditions
- Refrigerator Indicator (ERFR), compared with other countries in the region, shows low rate, i.e in 1000 dwells there are only 217 refrigerators for year 2003 and 304 units for year 2009. This situation is explained partially by above mentioned reasons of Air-conditioning Indicator. But these rates are higher than air-condition rate because:
  - Refrigerator is considered basic need for urban household
  - Electricity consumption of refrigerator is little compared with air-condition.
  - Refrigerators are needed in all areas of Yemen

6. Transport sector indicators

It is worth to notice that Transportation Sector consumes around 45% of Final energy consumption for 2009. This fact depicts the importance to initiate and develop energy saving policy in this sector.

Table 9 - Indicators of Transport Sector

Abbreviation	Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
TrFEI	Final Energy Intensity of transport sector	toe/Million YR	0,684	0,629	0,805	0,729	0,882	0,889	0,947
STEHE	Share of household expenditure for transport	%	16%	17%	19%	19%	18%	19%	18%
EUCC	Average Energy Unit Consumption of Cars	kgeo/car/year	1 518	1 518	1 518	1 518	1 518	1 518	1 518
EUCC G	Average Energy Unit Consumption of gasoline Cars	kgeo/car/year	1 755	1 755	1 755	1 755	1 755	1 755	1 755
EUCC D	Average Energy Unit Consumption of diesel Cars	kgeo/car/year	734	734	734	734	734	734	734
AEFTS	Average emission factor of transport sector	teCO2/toe	2,9	2,9	2,9	2,9	2,9	2,9	2,9
MR	Motorization rate	persons / Vehicle	61	57	53	51	49	47	45
ICO2	CO2 intensity of transport sector	teCO2/1000 YR	1,984	1,825	2,335	2,115	2,557	2,578	2,747

Referring to overall Intensity of final Energies, Transport Energy intensity indicator reflects the high energy consumption level of this sector (44%). Share of Household Expenditure for Transport Indicator shows significant increase from less than 40% to greater than 50% which negatively impacts household living quality. Motorization Rate (MR) indicator shows that increase rate of vehicles is higher than population increase rate which reflects hazard of vehicles increase so fast.

7. Agriculture and fishing sector indicator

Agriculture and Fishing Sector is the most important sector of National Economy because more that 70% of population live in rural areas where agriculture and fishing are the main activities. Furthermore great efforts are paid to restrict population flow from rural areas to urban areas. This goal can't be achieve unless there is sustainable development in rural areas and the main aspect should be the agriculture development. Therefore Energy Indicators of Agriculture and Fishing Sector have particular importance to rural development and to National Economy.

Table 10 - Agriculture and Fishing Sector Indicators

Indicators	Unit	2003	2004	2005	2006	2007	2008	2009
Final Energy Intensity of agriculture	toe/MilLC	6.96	6.76	8.85	8.11	9.73	9.79	10.71
Final Energy Intensity of fishing	toe/ Million LC	0.785	0.773	0.676	0.688	0.861	1.020	1.009
Specific consumption for fishing	toe/ tone	0.066	0.067	0.072	0.078	0.118	0.166	0.113
Share of Dry cultivated area	%	47%	47%	48%	49%	50%	49%	47%
Share of Irrigated cultivated area	%	53%	53%	52%	51%	50%	51%	53%
Share of equipped wells with Moto pumps	%	93%	93%	93%	93%	93%	93%	93%
Share of equipped wells with electro pumps	%	7%	7%	7%	7%	7%	7%	7%

- Final Energy Intensity for agriculture has increased more than 53% between 2003 and 2009. But this increase has happened due to less increase rate of added value of the sector.
- Energy Indicators of fishing depict high economy of this sector in respect to energy consumption and energy intensity.
- More than 90% of wells are equipped with diesel engine pumps rather than electrical pumps because most of rural areas are not covered by electricity supply.

IV. Conclusions and recommendations

This work is concerned with energy conservation indicator calculation. For the first time such exercise is performed in Yemen. Although Yemen needs many things to be done, but this task can be considered one of most important due to possible expected impact of this study to energy sector in particular and to the country development in general. Going through this exercise a number of observations may be pointed out, for example:

- Most of entities concerned are not enthusiastic about energy conservation and conservation indicators
- Data availability and data structure do not meet the requirements of energy conservation indicator calculation as formulated by the Project Designers.

Lessons Learned

Reaching final phase of this Project, one can point out four lessons were learned, namely:

- Highly important experience was gained in methodology and techniques in building information systems on energy efficiency and environment
- Successful implementation of this project shows that regional projects may be successfully performed leading to more mutual cooperation in the region and experience exchange. In addition transfer of technologies, methodologies and techniques among participant could effectively take place.
- Unless patience, desperateness and consistency were conducted, in addition to continues and valuable help from Plan Blue Staff and Project Advisors, all the way since start, this project could not be successfully finalized
- Close communication and high responsiveness of Project Team has helped to achieve Project objectives.

Perspectives

The importance of the Project lies in the hope that the outcomes would help to establish long term policies on energy conservation required to meet the future challenges of energy security, dependency and fight against global warming in the region.

Conclusions based on Indicator Calculation Results

- Energy dependency curve shows that breakeven point could take place within 4 to 5 years when the export and import of energy will be balanced. This result should warn decision makers to develop policies to meet the future of energy dependency; taking into account that oil production is monotonically decreasing as the consumption is increasing hence the amount of exported oil is decreasing. The depletion of oil may be estimated to take place within 10 to 15 years.
- Low level of energy consumption and electricity consumption compared with similar countries should warn decision makers about possible significant increase in energy demand of the country in the coming years;
- Calculated low energy efficiency in different energy sectors imposes a necessity to initiate energy conservation studies in these sectors.

Recommendations

Having observed Report findings, including difficulties and learned lessons one may recommend:

- Design comprehensive reform program for data and statistics in Yemen. The Reform Program should include but not limited to following:
  - National wide Data Base
  - Coordinated access to various data
  - Data restructuring to meet needs of indicator calculations
  - Implement a unified software for data management
  - Secure information flow between different concerned entities and stakeholders
- Establish an Inter-ministerial Department (Corporation) to take care of Energy Conservation and Energy Efficiency issues with clearly defined vision and mission, which should enable designing policies and monitoring energy conservation and transformation.
- Establish a "Research and Study Centre for Energy and Sustainable Development" issues

V. References and relevant websites

Lahmyer Study "Renewable Energy Resource Assessment and Renewable Energy Opportunities", LI/GE5 240212, May 2006

Yearly Statistical Books issued by Central Organization of Statistics

Records of PEC

Records of Traffic Department

Annual Reports of Ministry of Agriculture

Annual Reports of Ministry of Fishing

Annual Report of YCC

Annual Reports of MOM

ESMAP Report issued by World Bank, 2005 "Household Energy Supply and Use in Yemen

VI. Table of illustrations