Energy conservation indicators in Southern Mediterranean countries

Country report for Tunisia

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RCREEE
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Plan Bleu
UNEP/MAP Regional Activity Center

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 BLUE, 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

The report authors would like to express their gratitude to Plan Blue and RCREEE for supporting this important work which is long overdue and will serve as a first step toward having reliable and comprehensive EE indicators for the region. We also would like to thank the ANME for providing technical support and allowing dada access, particularly Mr. Nejib OSMAN, Head of Studies and planning Department and his collaborator Ms. Leila BEJAOUI for their valuable cooperation.

List of abbreviations

Units of measurement

GWh: Gigawatt hour

MW: Megawatt

Kg: kilogram

Km: kilometer

p.km: passenger-kilometer

t.km : ton-kilometre

t: ton

toe: ton of oil equivalent

Kgoe: kilogram of oil equivalent

TCO2e: Ton of CO2 equivalent

Currency and related symbols

TND: Tunisian Dinar

US$: US Dollar

TND 1990-: TD base year 1990

LC: Local currency

Other abbreviations

GDP: Gross Domestic Product

STEG: Tunisian electricity and Gas Company

ETAP: Tunisian Petroleum Activities Company

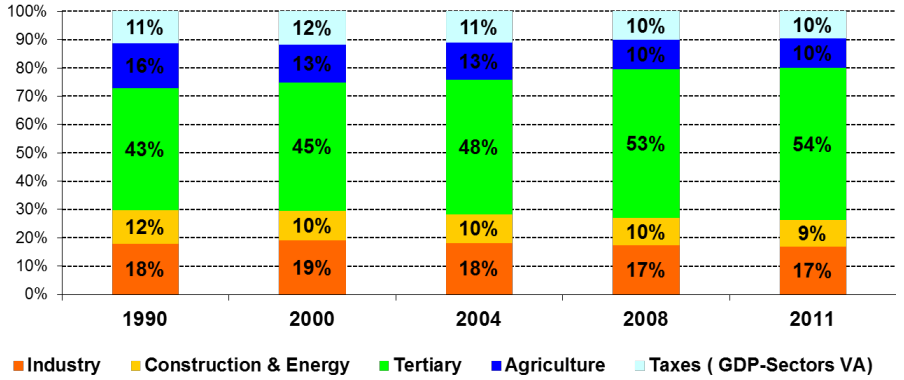
ANME: National Agency for Energy Conservation

I. Country General background

Tunisia occupies the eastern portion of the great bulge of North Africa. It is bounded on the west by Algeria, on the north and east by the Mediterranean Sea, and on the southeast by Libya. Tunisia is at the crossroads of Europe, the Middle East and Africa

Covering a surface of 162,155 Km², Tunisia has an impressing coastline of 1300 km open on the Mediterranean. The country offers various landscapes, which considerably differ, ranging from mountainous regions in the North and West, steppes in the Centre, wide plains in the North East (Sahel) to a desert zone in the South. The climate is Mediterranean in the North and on the East coast, semiarid in the inland and Saharan in the South. Average temperatures vary between 11.4°C (December) and 29.3°C (July). Rainfalls are irregular and concentrated during the cold season (3/4 of the total yearly rainfall): North 800 mm, South 50 to 150 mm.

Tunisia is inhabited by almost 10.5 million inhabitants of whom 80% is living in the coastal regions where most of economic activities are concentrated. This population, which increases at a well-controlled rate (1.37%/year), is more and more urbanized (with a current percentage of more than 65.8%).



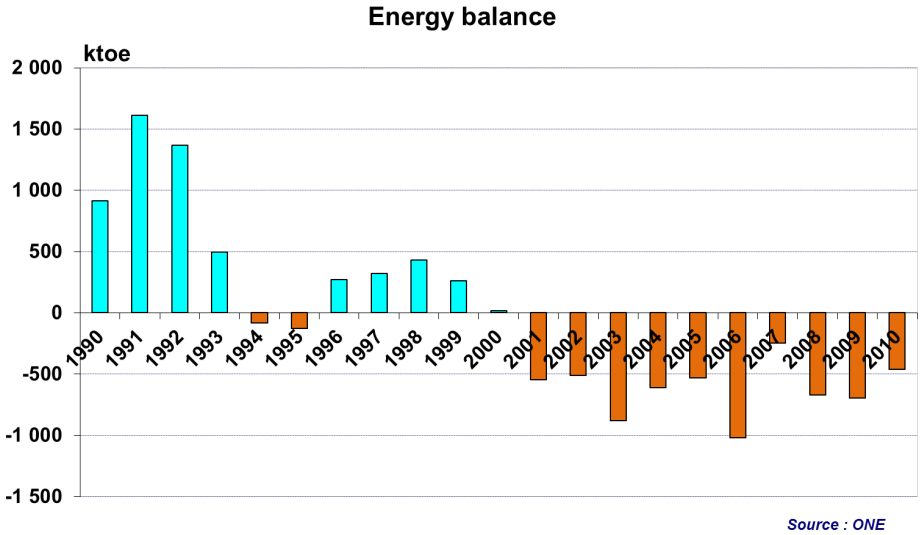
With a GDP reaching about 39.6 billion US$ and 3,792 current US$ per capita, Tunisia is considered among the intermediate income countries.

Tunisia has a diverse economy, including agricultural, mining, tourism, and manufacturing sectors. However, the Tunisian economy is more and more based on services which represents around 54% in 2011, as shown by the chart.

Real growth, which averaged almost 5% over the past decade, declined to 4.6% in 2008 and to 3-4% in 2009-10 because of economic contraction and slowing of import demand in Europe - Tunisia's largest export market.

On 14th January 2011, the popular revolution (called Jasmine Revolution) allowed to change the dictatorial regime of Ben Ali toward a democratic political system. A transitional government should govern the country until 23th October 2011, when election for a new government will take place. However, during this transition phase, the Tunisian economy declined, because of the socio-political events. In 2011, this decline was around -2%.

II. Strategies and objectives for renewable energies and energy efficiency



Since the early 2000s, Tunisia has entered fully into the category of net importer of energy, under the double effect of the depletion of oil reserves and the rapid growth of domestic demand. This has made it increasingly vulnerable to fluctuations in international oil prices. Indeed, Tunisia has experienced the full price increases experienced by the international market for energy in 2005 and continued until today.

The energy bill of Tunisia now exceeds 13% of its GDP. Moreover, given the disconnection of domestic prices from international prices, the Tunisian government has paid very large amounts of subsidies to energy prices, estimated at nearly 5% of current GDP in 2011.

The effect of the international situation has been relatively mitigated by the long-term energy efficiency and renewable energy policy adopted in Tunisia since the 80s. This policy is based mainly on three types of instruments:

- The institutional instrument: consists essentially in the National Agency for Energy Management, created in the early 80s to promote energy efficiency and renewable energy and implement the state policy in this field.
- The regulatory tool: essentially governed by the laws 2004-72 and 2009-7 and the implementing regulations attached to them. They define the obligations of Energy Consumers (obligation of energy audit, etc.) as well as the benefits granted to the energy efficiency and RE measures.
- The incentive tools consisting of a part in the National Fund for energy conservation that provides partial subsidies for EE and RE projects and other fiscal benefits on efficient devices.

As result of this policy coupled with economic choice moving towards the service sector and the development of industries with high value added, primary energy intensity has declined steadily since the 90s with more than 2.5% year. In particular, large public efforts have been made since the mid-2000s with the sudden increase in international energy prices. The ex-post assessment of the three-year plan 2005-2007 and the four-years plan 2008-2011 for energy conservation has shown that the cumulative energy savings over the period 2005-2010 was estimated to around 2700 ktoe, mainly in industry sector.

For the future, Tunisia has decided to strengthen its policy of energy conservation by setting more ambitious targets for energy efficiency and renewable energy, under the Tunisian Solar Plan. This plan projects a primary energy savings of about 24% in 2016 and 40% in 2030.

III. Data collection process

1. Data sources

Data are collected from several sources, mainly:

- **National Energy Observatory** (Ministry of Industry and Technology): Energy balance including energy supply, transformation and final consumption by sector. One has to underline that energy balance in Tunisia is available since 1980.
- **National Agency for Energy Conservation (ANME):** The ANME, created early 80's, has a large set of updated information since it is managing an information system (SIM2E) which includes the main socio-economic, energy en GHG emission data. Particularly energy consumption data by branch, by use and by type of energy are available in ANME thank to surveys and studies it carries out on regular base.
- **Tunisian Company of Electricity and Gas (STEG):** STEG publishes on early base all data concerning insulated capacity, power generation, primary energy consumption for electricity generation, electricity consumption by voltage and tariff level, etc. Furthermore, since 1989, STEG carry out each 5 years a large survey on energy consumption of its household customers. This survey is very helpful for the analysis of energy consumption in residential sector.
- **National Statistics Institute (INS):** It is the main source for socio-economic (GDP, Private Consumption, etc.) and demographic data.
- **Other sources: it is like** Ministry of Environment, Ministry of Agriculture, Ministry of transportation, Specific large industries that has provided specific sector data

The main sources of data collection are presented in the following table:

Institution name	Address	Tel and fax	Email and Website
National Agency for Energy Conservation	3 Rue Chott Meriem - Montplaisir - 1002 Tunis	Tel: (216) 71 906 900 Fax : (216) 71 904 624	e-mail: boc@anme.nat.tn Website:www.anme.nat.tn
Tunisian Ministry for Industry and Technology	Immeuble Beya, 40 Rue 8011 Montplaisir 1002 Tunis	Tel: 216 71 905 132 Fax: 216 71 902 742	Website: www.industrie.gov.tn e-mail : contact@mit.gov.tn
Tunisian electricity and gas company	38 rue Kamel Attaturk 1080 Tunis	Tel: +216 71 341311 Fax: +216 71 341311	www.steg.com.tn e-mail : dpsc@steg.com.tn
National Institute of Statistics	70, Rue Ech-cham BP 265 CEDEX	Tel :(216) 71 891 002 Fax : (216) 71 792 559	Ins@mdci.gov.tn _ Ins.nat.tn
Tunisian national office of tourism	1, Av. Mohamed V - 1001 Tunis	Tél.: (+216) 71.341.077 Fax: (+216) 71.350.997	Email : ontt@ontt.tourism.tn WebSite: www.tunisietourisme.com.tn
Tunisian central bank	25, rue Hédi Nouira-BP 777-1080 Tunis-cedex-Tunisie	Tél: (216) - 71 254 000. Fax: (216) - 71 354 214	Email : ontt@bct.gov.tn WebSite:www.bct.gov.tn
Ministry of finance	Government square la Kasbah 1006 Tunis	Tel: +216 71 565 400 Fax: + 216 71 341 077	Email:pcontenu@finances.gov.tn www.portail.finances.gov.tn

2. Data availability

The following table presents the data required by the indicator model and the rate of data availability through this work:

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	80	80	100	60	60	100	10	10	100
Transformation sector	140	140	100	0	0		0	0	
Transport sector	70	70	100	150	130	87	30	30	100
Tertiary sector	30	30	100	60	40	67	10	10	100
Residential sector	20	20	100	80	70	87	10	10	100
Industry sector	80	80	100	130	100	77	10	10	100
Agriculture & fishing	20	20	100	80	80	100	0	0	0
Total	440	440	100	560	480	86	70	70	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.

Data for different sectors are generally available and particularly data on energy and environment. In Tunisia data collection is often regularly collected by national or local monitoring networks, surveys and universities and research institutes. Socio-economic data are less available; this is mainly due to the variety and complexity of covered sub-sectors. Around 990 items out of a total of 1070 were collected within this project, giving and overall data availability of more than then 90%.

3. Major difficulties met during the data collection

For the case of Tunisia, the data collection was largely facilitated because of the availability of the Information System SIM2E of the ANME which includes the main energy, socio-economic and GHG emission data.

However, some difficulties were encountered particularly for the collection of specific data concerning transport sector and more precisely road transport. This sector is suffering from an important lack of data availability that should be addressed in priority.

IV. Indicator's calculation

1. Macro level indicators

The following table presents all the indicators calculated at the macro level.

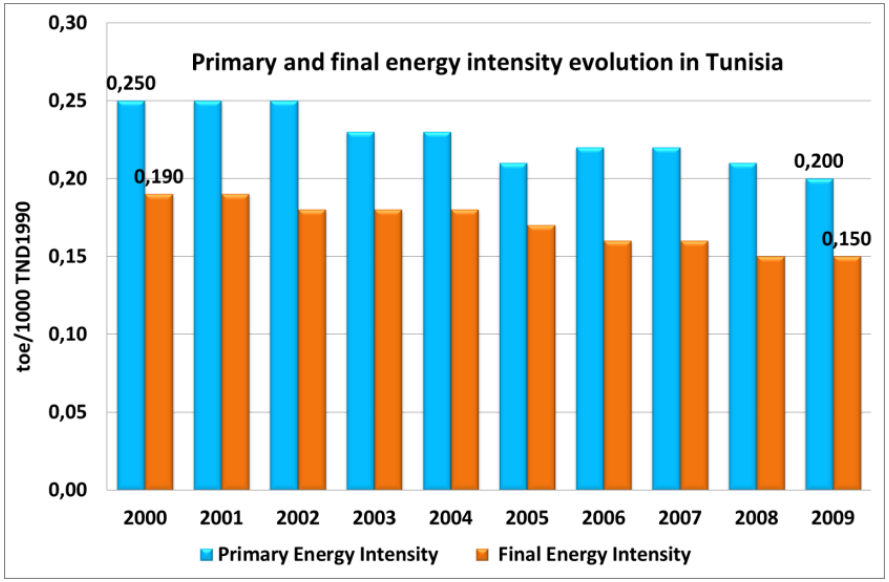
Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
EDR	Energy dependence Ratio	%	17%	23%	21%	26%	26%	23%	31%	19%	25%	22%
IPE	Intensity of Primary Energy	toe/1000 TD2000	0,39	0,39	0,38	0,36	0,36	0,33	0,34	0,34	0,32	0,31
IFE	Intensity of Final Energy	toe/1000 TD2000	0,30	0,29	0,29	0,28	0,28	0,26	0,25	0,25	0,24	0,23
RFEPE	Ratio of final energy consumption to primary energy	%	76%	74%	75%	77%	77%	81%	75%	73%	73%	74%
REB	Ratio of National Energy Bill to GDP	%	8%	7%	7%	6%	7%	9%	12%	11%	13%	9%
RPSE	Ratio of public subsidies for energy to GDP	%	0,78%	0,44%	0,00%	0,00%	0,62%	2,14%	3,33%	2,59%	4,01%	0,10%
AEF	Average emission factor	teCO2/toe	2,76	2,74	2,77	2,72	2,71	2,73	2,70	2,72	2,68	2,68
ICO2	Intensity of CO2	teCO2 / 1000 TD	1,076	1,080	1,056	0,982	0,975	0,889	0,912	0,912	0,872	0,835
AECH	Average Primary Energy Consumption per habitant	ktoe/1000 hab	0,701	0,736	0,718	0,712	0,743	0,695	0,750	0,787	0,789	0,770
AELCH	Average Electricity Consumption per habitant	MWh/hab	0,855	0,907	0,932	1,058	1,092	1,127	1,158	1,183	1,227	1,248

The indicator of energy dependency has progress with around 29% between 2000 and 2009. As mentioned before, Tunisia is more and more dependent for its energy supply from import under the double effect of the internal energy demand increase and the exhaustion of its oil fields.

The figures show also a slight improvement of both the primary and the final energy Intensities with an average rate of respectively 2.4 % and 2.7% per year, between 2000 and 2009. The final energy improvement is essentially due to the effort made by the Tunisian Government in term of energy efficiency program, particularly since 2005 after the international energy price increase. In fact the National Agency of Energy Conservation estimates by using the bottom up approach that the final energy saving made the EE programs between 2005 and 2011 is around 3550 ktoe[1]. Of course, such energy saving imply the reduction of the final energy intensity.

[1] Maîtrise en l'énergie en Tunisie, Chiffres clés (Energy efficiency in Tunisia : Main statistics), ANME, 2012.

The reduction of the primary energy intensity can be explain in one hand by the improvement of the efficiency of the energy consumption at end use level, and the progress of the transformation sector efficiency in another hand. The energy intensity of the transformation sector has been improved of an average of 1.7% per year between 2000 (0.09 toe/1000 TND) and 2009 (0.08 toe/1000 TND). The ANME estimates that the primary energy saved between 2005 and 2011 is around 5825 ktoe[2].



The primary energy consumption per capita has increased by around 1% per year from 2000 to 2009, against 4.3% for the electricity consumption. The electricity consumption is increasing, mainly because of the level standard rinsing of the households, implying more and mode appliances owning. This increase could be greater, if there were public effort for energy efficiency promotion in all sectors.

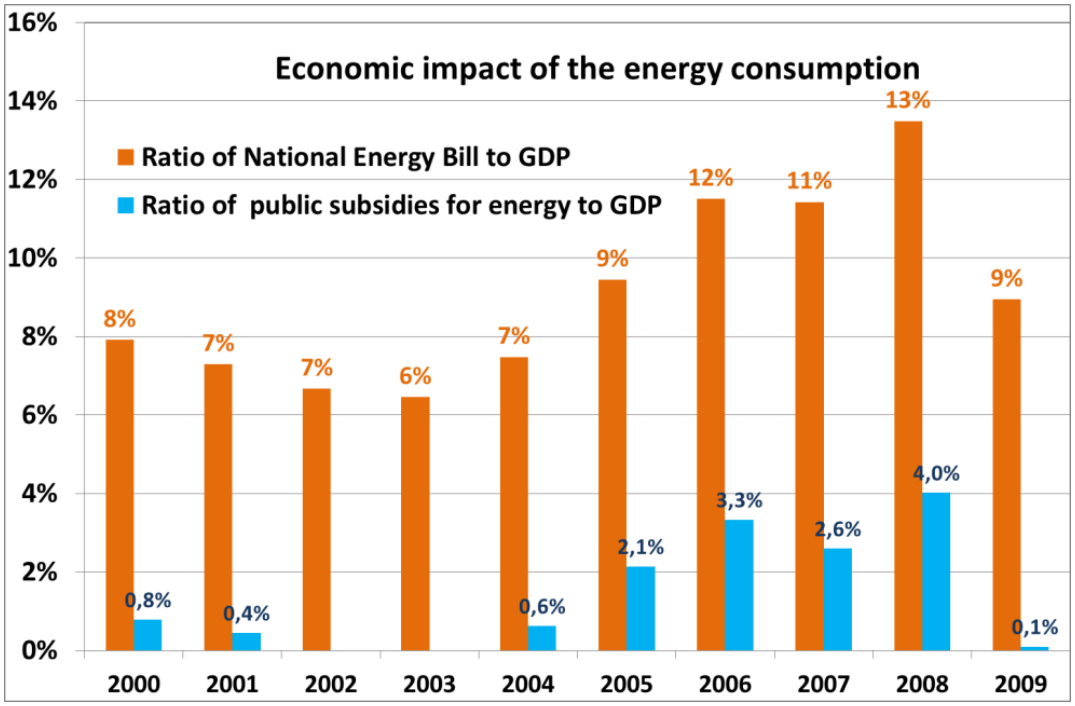
Finally, the energy bill of the country is calculated in a theoretical way as the aggregation of the primary energy consumption of each product multiplied by its international price. In the same approach, the total public subsidies to energy are calculated as the energy bill of the country minus the local revenue of the energy sector (sales in the country). The subsidies are coming from the fact that internal energy prices are disconnected from the international prices and the Government has to pay the gap.

The following chart shows the evolution of the ratios of energy bill and energy subsidies to GDP (current prices) within the period 2000-2009. The ratio of energy bill has reach its maximum in 2008 (13% of the GDP) when the crude oil has reach a pick of 140 $/barrel. In the same year the subsidy ratio has

[2] Maîtrise en l'énergie en Tunisie, Chiffres clés (Energy efficency in Tunisia : Main statistics), ANME, 2012.

reach around 4%. In 2009 the ratio of the subsidy has decreased under the double effect of international energy prices decrease and the significant increase of internal prices.

The high ratio of energy bill can show the socio-economic vulnerability of the country to international energy prices (economic competiveness, social pressures, etc.). The high ratio of energy subsidy can translate the pressure on the energy system on the public finance.



2. Energy transformation sector indicators

Tunisia's oil and gas sector is supported by the efforts of a number of small companies. The Tunisian Government created the State-owned oil company, Entreprise Tunisienne d'Activites Petroliéres (ETAP), in 1972. ETAP's mission is to manage oil and natural gas exploration and production activities, and it has been active in attracting foreign firms to fund oil exploration.

Tunisia has to import more than half of its requirements of petroleum products. The country has one refinery, with a capacity of 35,000 b/d, and this sector has not seen changes for decades. But now there is a firm plan for a 120,000 b/d grassroots refinery to be built on BOOT basis at Skhira oil terminal center.

The natural gas represents currently around 50% of the primary energy consumption of the country and come mainly from 3 sources:

- The national production essentially from the fields of Miskar (British Gas) and Ghergui in the south of the country
- The royalties on the Algerian pipeline to Italy
- A long term supply contract from Algeria

The electricity sector in Tunisia is operated by a public monopole utility (STEG). The large majority of power generation comes from thermal sources, essentially from natural gas. In fact, more than 97% of electricity is generated from natural gas power plants, leaving less than 3% of power being generated from hydroelectric and wind plants in 2009. In 2011, Tunisia has launched a study with the support of the German Cooperation in order to define the energy mix strategy for electricity generation aiming at reducing the dependency to natural gas by diversifying the mix. This study proposes a share of 30% of renewable electricity by 2030.

The following table presents the main indicators calculated with in the current project for transformation sector.

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SREC	Share of installed RE electricity capacity	%	0%	0%	0%	1%	1%	1%	1%	1%	1%	2%
URIC	Usage rate of the installed power generation capacity	%	45%	40%	41%	42%	43%	42%	45%	45%	47%	46%
AETS	Apparent Efficiency of Energy Transformation Sector	%	67%	64%	65%	65%	64%	65%	64%	61%	62%	62%
PGEFF	Power generation efficiency of thermal plants	%	38%	37%	39%	39%	40%	40%	40%	39%	39%	39%
SCFFP	Specific Consumption of thermal power plants	toe/GWh	227,89	233,66	222,14	220,50	214,88	214,43	214,93	217,76	218,43	218,53
PGF	Power generation efficiency	%	38%	37%	39%	39%	40%	40%	40%	40%	39%	40%
SCPG	Specific Consumption of Power Generation	toe/GWh	225,73	231,83	222,05	219,26	213,56	213,57	212,70	216,23	218,83	217,56
TDEE	Transmission and Distribution Electricity system Efficiency	%	0,88	0,87	0,88	0,87	0,87	0,86	0,86	0,86	0,86	0,86
PGEF	Power Generation Emission Factor	teCO2/GWh	545,21	557,70	536,01	542,20	530,35	518,47	522,40	535,94	545,80	538,85
ESEF	Electricity Sector Emission Factor	teCO2/GWh	616,66	634,51	609,89	611,16	601,99	595,34	603,32	621,31	626,69	623,12

The table leads to the following comments:

- A minor improvement of the renewable energy electricity penetration in term of installed capacity, mainly due to the installation of new wind farms (extension of Sidi Daoud site from 10 MW to 54 MW);
- A decrease of apparent efficiency of energy transformation sector with 6% of efficiency loss. This can be explained by the oldness of the Tunisian refinery but also the losses in electricity transmission and distribution system;
- A rather stagnation of the power generation efficiency and the specific consumption of the thermal power generation (39% and 219 to/GWh);
- A slight improvement of overall power generation efficiency from 38% in 2000 to around 40% in 2009 due to the introduction of the wind energy farm od Sidi Daoud.
- A small increase of the losses of distribution and transmission network for which the efficiency has moved from 88% in 2000 to 86% in 2009.
- Finally, the emission factor power generation has registered and slight improvement due to naturel gas use and the introduction of renewable energy (Wind).

3. Industry sector indicators

Manufacturing industries, producing largely for export, are a major source of foreign currency revenue. In 2009, industrial sector contributes to about 31% to the total GDP.

The industry sector, exclusive of the energy industries (production of hydrocarbons, refining, and power plants) appears as the top consuming sector, with 2.2 million of toe in 2009, that is about 36% of the total final commercial energy consumption of Tunisia, and offers the largest energy saving potential.

The structure of energy consumption in the industrial sector remains dominated by oil products which account for about 42% of consumption. However, this share has declined sharply over the past 20 years due to the natural gas penetration, whose share has almost doubled since 1990 (34% in 2009). This trend is the result of a proactive public policy of energy diversification based on the substitution of petroleum products by natural gas in the industrial sector.

Within the sector, the distribution of consumption is by far dominated by the branch of construction material which alone accounts for about 60% of the consumption sector, followed by chemical products (12%).

Among the 6000 industry unit in Tunisia, about 320 companies (with energy consumption greater than 800 toe per year) represent about 75% of total consumption in the sector. Finally, 55 companies whose consumption is greater than 5000 toe per year (say energy-intensive industries) represent alone over 40% of the sector consumption. These companies are targeted in a special way by the energy efficiency policy in Tunisia.

The following table presents the main indicators calculated with in the current project for industry sector.

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
BSEC	*Specific energy consumption for the Cement*	toe/t	0,084	0,086	0,081	0,085	0,091	0,086	0,087	0,089	0,085	0,087
	Specific energy consumption for the Phosphate		0,007	0,007	0,008	0,007	0,006	0,006	0,006	0,007	0,007	0,006
	Specific energy consumption for the Phosphoric acid		0,027	0,020	0,020	0,025	0,022	0,024	0,026	0,027	0,031	0,029
	Specific energy consumption for the T. Super Phosphate		0,078	0,083	0,082	0,074	0,075	0,075	0,069	0,071	0,065	0,073
	Specific energy consumption for the Steel		0,565	0,538	0,555	0,556	0,335	0,327	0,367	0,318	0,235	0,239
	Specific energy consumption for the Paper		1,130	1,040	1,087	1,144	1,224	1,234	1,160	1,238	1,253	1,398
	Specific energy consumption for the Sugar		0,167	0,165	0,174	0,169	0,155	0,138	0,133	0,142	0,130	0,141
FEIIS	Final Energy Intensity of Industry Sector	toe/1000 TD	0,564	0,559	0,544	0,543	0,547	0,513	0,529	0,510	0,494	0,536
IEBR	Ratio of Industry sector Energy Bill to Added Value	%	12%	9%	9%	9%	11%	14%	17%	17%	22%	14%
IESR	Ratio of public subsidies to added value	%	0%	0%	0%	0%	0%	2%	3%	2%	5%	0%
IESRGB	Ratio of public subsidies for energy to Government Budget	%	0%	0%	0%	0%	0%	1%	1%	1%	3%	0%
IELSR	Ratio of public subsidies for electricity to added value	%	1%	0%	0%	0%	1%	1%	1%	2%	4%	1%
IICO2	Intensity of CO2	teCO2/ 1000 TD	2,031	2,049	1,967	1,993	1,979	1,898	1,943	1,888	1,854	2,003
IAEF	Average emission factor of industry sector	teCO2/toe	3,602	3,669	3,612	3,672	3,617	3,700	3,672	3,704	3,753	3,738

The final energy intensity for industry sector has been significantly improved from 0.564 toe/1000 TND1990 in 2000 to around 0.494 in 2008 than 0.536 in 2009[3]. The increase of the energy intensity in 2009 can be explained by the massive introduction in 2009 of the use of petroleum coke in many cement factories, with lower efficiency. However, in general the industry sector is coming more and more efficient, translating the results of the energy efficiency public programs in this sector.

At branch level, a significant decrease of the specific consumption is observed for the steel industry, because of changing of process for the sole manufactory in the sector (in Menzel Bourguiba). For the other, the specific consumption is remaining unchanged or slightly improved.

Finally, we can notice a slight improvement in environmental indicators, with 13 % for intensity of CO2 and 13 % for average emission factor, due to, among others, the massive introduction of natural gas.

Energy indicators (specific energy consumption and intensity) improvement can be explained largely by the key role played by energy efficiency policy in the country, particularly with the mandatory energy audits and incentive measures for industry sector, since the industrial activity structure has not changed

[3] Including mines and non

a lot within the next 10 years. According to ANME assessment, the cumulated primary energy saving in the industry sector, between 2005 and 2011, is estimated to around 1200 ktoe.

4. tertiary sector indicators

Services sector output is central for the Tunisian economy with an average annual growth of 5.9%, contributing to around 60% of Tunisian GDP. Moreover, this sector (hotels, restaurants, transport, communication, finances) absorbs around 40% of total employment in the country.

From energy point of view, the tertiary sector is a heterogeneous and complex branch and very often the energy consumption is integrated with residential sector under the term "building sector". In Tunisia, the tertiary sector energy consumption is figured out alone and is estimated to about 9 % of the total final energy consumption of the country.

The following table presents the main indicators calculated with in the current project for the tertiary sector.

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
FEITS	Final Energy Intensity of Tertiary Sector	toe/1000 LC	0,062	0,060	0,059	0,060	0,060	0,056	0,051	0,050	0,048	0,047
TDRSHR	Diffusion Rate of Solar Water Heaters in tertiary sector	m²/1000 hab	0,558	0,749	1,066	1,209	1,198	1,186	1,182	1,187	1,277	1,579
TEBR	Ratio of energy bill to added value in tertiary sector	%	1,49%	1,11%	1,01%	1,09%	1,40%	1,74%	1,83%	1,89%	2,43%	1,50%
TELSR	Ratio of public subsidies for energy to added value	%	0,02%	0,00%	0,00%	0,00%	0,00%	0,21%	0,18%	0,14%	0,56%	0,00%
TESRGB	Ratio of public subsidies for energy to Government Budget	%	0,02%	0,00%	0,00%	0,00%	0,00%	0,31%	0,29%	0,22%	0,90%	0,00%
HECNG	Energy Consumption per night guest	kgoe/Nigh Guest	4,806	4,946	6,106	6,552	3,882	3,596	3,601	3,754	3,733	4,154
TICO2	Intensity of CO2	teCO2/ 1000 LC	0,263	0,261	0,250	0,261	0,259	0,241	0,227	0,224	0,218	0,210
TAEF	Average emission factor	teCO2/toe	4,213	4,335	4,261	4,363	4,276	4,308	4,412	4,433	4,510	4,519

The table shows:

- A significant improvement of the final energy intensity, with an average of 3.2 % per year, i.e. 25% of the whole variation between 2000 and 2009. This trend confirms a key role played by energy efficiency policy including mandatory and incentive measures;
- A Significant improvement in environmental indicators, with 32% for intensity of CO2 and 9% for average emission factor because of the important introduction of the use of the natural gas in the sector;

- An overall decreasing trend for energy consumption by night guest in tourism sector since 2003;
- A strong increase in diffusion rate of solar water heaters by an average of 12 % per year, i.e. 180 % on the whole period of 2000-2009.

5. Residential sector indicators

The housing stock in Tunisia has shown strong growth over the past three decades resulting from the deliberate policy of Tunisia in access to housing. If one is based on the extrapolation of the trends observed during the period 1994-2004, the housing stock would be in 2009 around 2.886 million dwelling, with more than 65% in urban area and 35% in rural side.

The stock of dwelling is mainly constituted by individual buildings and the collective flats represent less than 8% of the dwellings.

With 17% of total final energy consumption the residential sector is in the 3rd place after industry and transport sectors. However, with an average increase of about 3% per year during the last 10 years, this sector could be one the most important consumer within the next years.

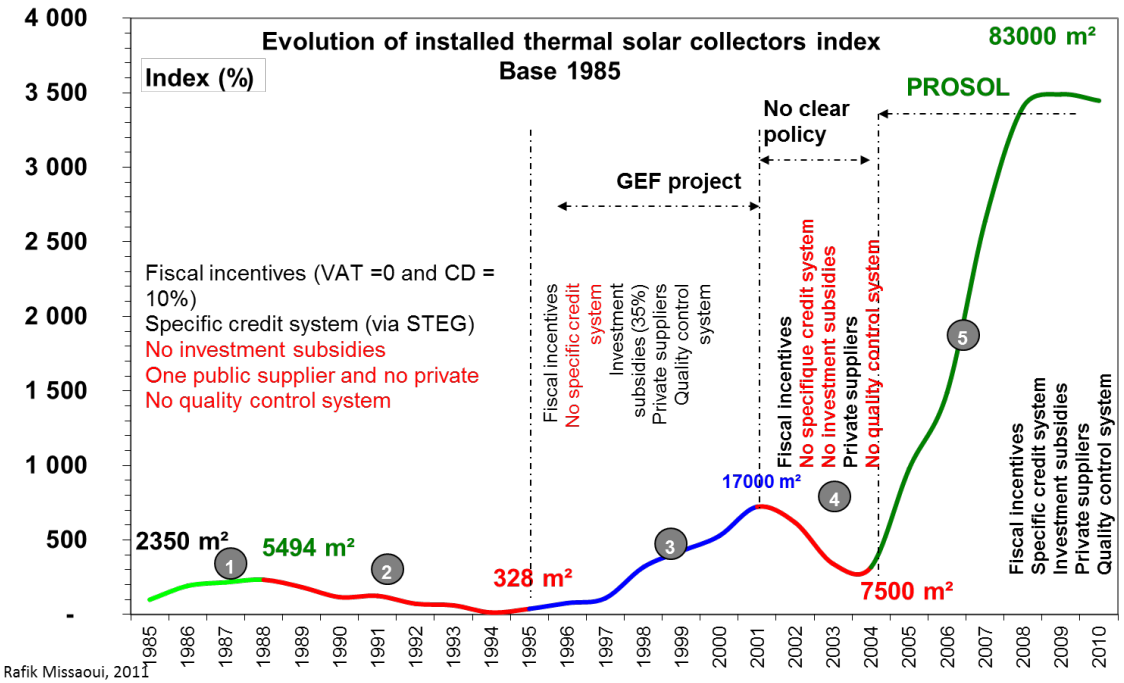
Aware about this issue, the Tunisian government has set up many programs and measures aiming at improving energy efficiency in this sector:

- Labeling and minimum standards of the appliances, mainly refrigerators and air conditioning;
- Efficient lighting promotion and interdiction of sailing of incandescent bulbs with more than 100 W;
- Thermal building code with minimum technical requirements of specific consumption;
- Financial incentive for solar water heaters within the Prosol Program, since 2005.

The following table presents the main indicators calculated with in the current project for the households sector.

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
UCED	Unit Consumption of Energy per Dwelling	kgoe/Dw	343,70	348,93	351,58	360,86	375,05	374,54	351,49	341,55	338,72	340,06
SCEM²	Specific Consumption of Energy per area unit	kgoe/m²	3	3	4	4	4	4	4	3	3	3
UEICD	Unit Consumption of Electricity per Dwelling	kWh/Dw	915,55	952,90	968,26	1077,62	1097,24	1111,38	1119,46	1121,92	1142,54	1141,04
SCEIM²	Specific Consumption of Electricity per m²	kWh/m²	9,156	9,529	9,683	10,776	10,972	11,114	11,195	11,219	11,425	11,410
RIPE	Intensity of Residential Sector	toe/ 1000 TD	0,074	0,073	0,072	0,072	0,073	0,072	0,066	0,063	0,061	0,060
RELSR	Ratio of public subsidies for energy to private consumption	%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
RESRGB	Ratio of public subsidies for energy to Government Budget	%	0%	0%	0%	0%	0%	0%	1%	0%	1%	0%
RAEF	Average emission factor	teCO2/toe	3,808	3,877	3,821	3,900	3,846	3,840	3,929	4,024	4,061	4,029
RICO2	Intensity of CO2	teCO2/1000TD	0,282	0,283	0,276	0,282	0,282	0,276	0,260	0,253	0,248	0,242
RDRSHR	Diffusion Rate of Solar Water Heaters in Residential sector	m2/1000 hab	6,9	8,6	10,0	10,7	11,4	13,6	16,9	22,8	30,3	37,9
ERACR	Equipment Rate of Air conditioning in Residential sector	Unit/Dw	3,3%	4,2%	5,2%	6,5%	8,1%	9,2%	10,4%	11,8%	13,4%	15,1%
ERFR	Equipment Rate of refrigerator in Residential sector	Unit/Dw	71,7%	73,5%	75,4%	77,3%	79,3%	79,8%	80,3%	80,8%	81,4%	81,9%
SEPC	Share of energy expenses in household private consumption	%	2,6%	2,6%	2,6%	2,7%	2,7%	2,7%	2,7%	2,7%	2,7%	2,7%

Thanks to the effort on energy efficiency, the final energy intensity has been improved significantly with the period with an average of 2.2 % per year.



The overall energy consumption per dwelling and the specific consumption per area unit remain almost stable, with a very slight decrease tendency. This is not the case for electricity consumption per dwelling which increase on average by 2.5 % per year during the period.

Concerning appliances diffusion rates, one can notice the impressive increase of air condition rate with an average of 18.3% per year which is now causing a real problem of the increase of the electricity peak load during the summer. For the refrigerators, the increase rate is rather low (1.5% per year) because of the saturation of the stock.

The penetration rate of the solar water heater in Tunisian is growing up very quickly due to the PROSOL program based on an innovative financial mechanism involving public subsidy of solar water heater prices and a loan system via the electricity company. The following curve shows the solar water heater market evolution during the last 30 years in Tunisia and the impact of the PROSOL program which starts in 2005.

Finally, within the observation period, there was a significant efficiency gain for environmental indicators, with on average 1.6% per year for the average emission factor and 3.8 % per year for the CO_2 intensity. This can be explained, partly, by the ambitious program of the Tunisian government in term of natural gas use penetration in the sector.

6. Transport sector indicators

The transport sector energy consumption accounts for 30% of the total final consumption and about 40% of petroleum products in the country. Final energy consumption of transport sector has increased from 1620 ktoe in 2000 to around 1782 ktoe in 2009, which is in average 10% of increase on the whole period.

Setting up an energy efficiency policy in the transport sector is rather difficult because of the complexity of this sector in term of institutional, organizational and technical issues. The Tunisian situation is in fact characterized by the high development of the private car stock and the lack of the collective transport supply in term of quantity and quantity which decrease the energy performance of the sector.

Moreover, because of its scattered nature and its institutional complexity, there is a huge lack of data in this sector for both socio-economic and energy consumption aspects. Availability of data requires to gather data from a large set of institutional stakeholders but also to carry out field surveys at large scale which is usually very expensive. ANME has started to develop a national information system with the help of the UNDP in order to set up a common data platform for the transport stakeholders.

Up to now, the Tunisian energy efficiency has focused mainly on technical aspect and not on organizational and institutional ones. The main measures are:

- Mandatory energy audits for transport companies consuming more than 500 toe per year
- 20% subsidy of the cost of any energy efficiency measures
- Mandatory engine diagnosis with the yearly technical control of vehicles

The ANME estimates the energy saving in the transport sector, due to these measures, to around 146 ktoe on the period 2005-2010.

The following table presents the main indicators calculated with in the current project for the transport sector.

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
TrFEI	Final Energy Intensity	toe/1000 TD	0,094	0,091	0,089	0,086	0,083	0,082	0,077	0,076	0,073	0,069
STEHE	Share of household expenditure for transport	%	5%	6%	7%	7%	8%	9%	9%	10%	11%	12%
EUCC	Average Energy Unit Consumption of Cars	kgeo/car/year	1664	1617	1564	1550	1483	1485	1415	1387	1319	1248
EUCC G	Average Energy Unit Consumption of gasoline Cars	kgeo/car/year	1085	1071	1037	975	917	878	814	819	782	759
EUCC D	Average Energy Unit Consumption of diesel Cars	kgeo/car/year	2249	2176	2112	2148	2080	2139	2075	2048	1963	1855
AEFTS	Average emission factor of transport sector	teCO2/toe	2,934	2,938	2,936	2,941	2,939	2,940	2,941	2,943	2,946	2,947
MR	Motorization rate	persons / Vehicle	12,74	12,08	11,51	11,19	10,71	10,39	10,09	9,70	9,33	8,99
ICO2	Intensity of CO2	teCO2/1000 TD	0,277	0,268	0,261	0,252	0,244	0,241	0,227	0,224	0,214	0,203
SCRW	Specific consumption for Rail ways	kgoe/ p.km	0,008	0,008	0,008	0,009	0,010	0,010	0,010	0,010	0,010	0,010

This table shows:

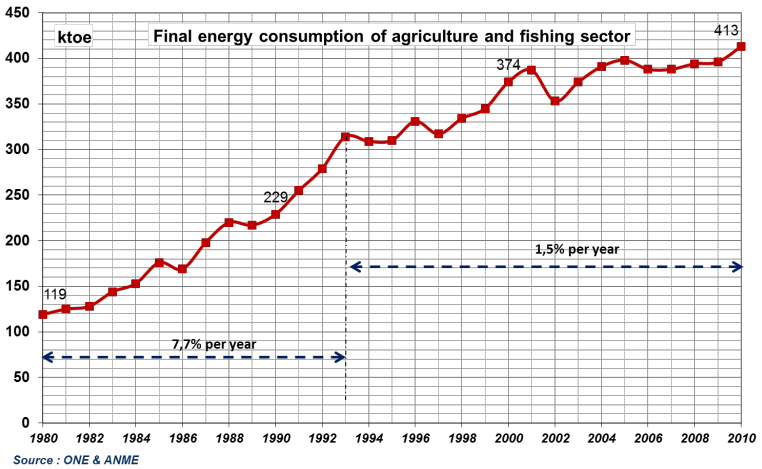
- Significant improvement of the final energy intensity of the sector with an average 3.4 % per year, i.e. 27 % of the whole period;
- Strong increase of household's expenditures for transport. The share of expenses for transport has more than doubled between 2000 and 2009. This shows clearly the increasing pressure of transport on the household's budget.
- Significant decrease of the average energy unit consumption of cars, by 2.7 % per year, i.e. 15% of the whole variation between 2000 and 2009.
- Stagnation of the average emission factor of transport sector, with 3 % of the on the whole period.
- Strong improvement of the intensity of CO2 of transport sector, with 25 % on the whole period.

Finally, one has to underline that the unavailability of data did not allow calculation of other important indicators required for the monitoring of energy efficiency policies in the transport sector, such as the specific consumption of the private transport, goods road transport, shipping, etc.

Moreover, the reliability of the data has to be improved. For example, the data on private car stock includes circulating cars and downgraded vehicles, which make the data overestimated.

7. Agriculture and fishing sector indicator

Agricultural activity, accounts for 9% to 11% of the GDP, depending on the climate conditions. The energy consumption of the sector has increased with an annual rate of around 7.7% during the 80's due the intensification and modernization of the agriculture activity. However, this rate has fall to around 1.5% since the 90's because of the modernization accomplishment and the limitation of the utile agriculture area in the country.



Although it represents less than 9% of the final energy balance, the energy consumption of this sector covers important socio-economic issues. In fact, energy expenses share in the crops and fish production costs is getting more and more high involving additional economic difficulties for the small farms and fishing units. Energy efficiency policy in this sector should aim not only improving energy balance but also economic protecting of large layers of population.

The flowing table presents the main indicators calculated for this sector:

Abbreviation	Indicators	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
FEIA	Final Energy Intensity of agriculture	toe/1000LC	0,164	0,173	0,177	0,155	0,147	0,161	0,151	0,146	0,147	0,138
FEIF	Final Energy Intensity of fishing	toe/1000LC	0,647	0,783	0,760	0,862	0,759	0,785	0,730	0,720	0,565	0,580
SCF	Specific consumption for fishing	toe/ tone	0,862	1,020	1,043	1,133	0,948	0,971	0,849	0,862	0,859	0,845
SDCA	Share of Dry cultivated area	%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
SICA	Share of Irrigated cultivated area	%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
SEWMP	Share of equipped wells with Moto pumps	%	36%	32%	29%	25%	22%	20%	18%	17%	15%	14%
SEWElP	Share of equipped wells with electro pumps	%	64%	68%	71%	75%	78%	80%	82%	83%	85%	86%

The energy intensity of the agriculture sector is varying according to the years because highly depending on the climate conditions, since the major part of the cultures are rainfall. However, there is a slight tendency to improvement since 2000, due to most probably to the effort done in water saving and pumping electrification since the 90's.

For the fishing sector, the intensity has increased since the 90's and reach its maximum in 2003, which can be partly explained by the depletion of the fish resources in the Mediterranean Sea. Then since 2007, the sector has showed an improvement tendency of energy intensity due to most probably to the proliferation of the breeding fish units.

As it is not an intensive energy sector the agricultural and fishing sector are usually poor in term of energy data availability. However, in Tunisia, availability of detailed information on energy consumption has considerably increased thanks to the recent study curried out by the ANME in 2009 on the "strategy of energy efficiency and renewable energy development in the agriculture and the fishing sector". This study has allowed providing energy consumption by use, by form of energy, by type of crops, by region, etc. It gives also some relevant indicators such as energy intensity of branches and specific consumption of main products.

V. Conclusion

Tunisia is rather advanced in term of energy and GHG emission indicators thank to the implementation of an information system initiated by the ANME in cooperation with ADEME since more than five years. This cooperation program has allowed also enhancing the capacity of the ANME staff to improve the data collection and develop a set of indicators used by the decision makers.

We should mention also the importance of the five years STEG survey on energy consumption and appliances in household sector. It constitutes one of the major sources of data for this sector.

However, some sectors are still poor on reliable data, mainly the transport and tertiary sectors. For the present exercise, the unavailability of data has constituted real barriers to develop particular indicators such as specific consumption per mode of transports.

For that reason, it is highly recommended to improve data collection system by strengthen coordination and information exchange between main stakeholders in the country. This can lead also to the need to carry out specific surveys to gather some categories of information such as mobility data and energy consumption per mode for transport sector. Finally, some data have to be estimated; it is than essential to harmonize the estimation methodologies in the country.

VI. References and relevant websites

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