The Regional Center for Renewable Energy and Energy Efficiency (RCREEE) is an independent not-for-profit regional organization that aims to enable and increase the adoption of renewable energy and energy efficiency practices in the Arab region. RCREEE teams with regional governments and global organizations to initiate and lead clean energy policy dialogues, strategies, technologies and capacity development in order to increase Arab states' share of tomorrow's energy.

Through its solid alliance with the League of Arab States, RCREEE is committed to tackle each country's specific needs and objectives through collaborating with Arab policy makers, businesses, international organizations and academic communities in key work areas: capacity development and learning, policies and regulations, research and statistics, and technical assistance. The center is also involved in various local and regional projects and initiatives that are tailored to specific objectives.

Having today 16 Arab countries among its members, RCREEE strives to lead renewable energy and energy efficiency initiatives and expertise in all Arab states based on five core strategic impact areas: facts and figures, policies, people, institutions, and finance. RCREEE is financed through its member state contributions, government grants provided by Germany through the German Development Cooperation (GIZ) GmbH, Denmark through the Danish International Development Agency (DANIDA), and Egypt through the New and Renewable Energy Authority (NREA). RCREEE is also financed through selected fee-for-service contracts.
Energy Efficiency Indicators in RCREEE Member States - 2014

Regional Center for Renewable Energy and Energy Efficiency (RCREEE)
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### Units of measurement

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>GWh</td>
<td>gigawatt-hour</td>
</tr>
<tr>
<td>Kg</td>
<td>kilogram</td>
</tr>
<tr>
<td>Kgoe</td>
<td>kilogram of oil equivalent</td>
</tr>
<tr>
<td>Km</td>
<td>kilometre</td>
</tr>
<tr>
<td>KWh</td>
<td>kilowatt-hour</td>
</tr>
<tr>
<td>Mtoe</td>
<td>million ton of oil equivalent</td>
</tr>
<tr>
<td>MW</td>
<td>megawatt</td>
</tr>
<tr>
<td>m2</td>
<td>square metre</td>
</tr>
<tr>
<td>p.km</td>
<td>passenger-kilometre</td>
</tr>
<tr>
<td>toe</td>
<td>ton of oil equivalent</td>
</tr>
<tr>
<td>tCO₂ₑ</td>
<td>ton of CO₂ equivalent</td>
</tr>
<tr>
<td>TWh</td>
<td>terawatt-hour</td>
</tr>
</tbody>
</table>

### Currency and related symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>US dollar</td>
</tr>
<tr>
<td>$2000</td>
<td>US dollar at constant value for the year 2000</td>
</tr>
<tr>
<td>LC</td>
<td>Local currency</td>
</tr>
</tbody>
</table>

### Other abbreviations

- ADEME: French Environment and Energy Management Agency
- AETS: Apparent Efficiency of the Transformation Sector
- CFL: Compact fluorescent lighting
- CIF: Cost, insurance and freight
- CO₂: Carbon Dioxide
- BP: British Petroleum
- DW: Dwelling
- EE: Energy efficiency
- EIB: European Investment Bank
- ESEF: Electricity sector emissions factor
- EU: European Union
- FAO: Food and Agriculture Organization
- GDP: Gross domestic product
- GHG: Greenhouse gas
- GN: Guest - night
- IEA: International Energy Agency
- IMF: International Monetary Fund
- IPP: Independent power producer
- IPCC: Intergovernmental Panel on Climate Change
- LNG: Liquefied natural gas
- LPG: Liquefied petroleum gas
- MED-ENEC: Mediterranean Energy Efficiency in the Construction Sector
- MEDENER: Association of Mediterranean Energy Conservation Agencies
- MRV: Measurement, reporting and verification
- NAMA: National Appropriate Mitigation Action
- NEEAP: National Energy Efficiency Action Plan
- NG: Natural gas
- PPP: Power purchasing parity
- RCREEE: Regional Center for Renewable Energy and Energy Efficiency
- SCPG: Specific consumption of power
- RE: Renewable energy
- SWH: Solar water heater
- UN: United Nations
- UNFCCC: United Nations Framework Convention on Climate Change
- WB: World Bank
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Preface

Reliability of energy data and indicators through regionally consistent methodologies is one of the strategic objectives of the Regional Center for Renewable Energy and Energy Efficiency (RCREEE). Through its different projects, RCREEE strives to provide insights about the energy transition taking place in the Arab region.

The present work is a part of a wider scope project launched in 2011 in cooperation with Plan Bleu. The project allows to continue the process of capacity building on energy statistics and indicators. This project is in synergy with the flagship of RCREEE which is the regional information system on renewable energy and energy efficiency data and indicators developed according to the recommendation raised in the first edition issued in 2011. This information system including a component related to the EE data and indicators will facilitate the exchange of energy information between the Arab countries.

This report is the second edition after the one issued in 2011. The first edition covered only ten RCREEE member states and focuses on the period between 2000 and 2009. This edition extends the duration covered to be from 2000 to 2012. The new edition also extends geographically to include three additional countries that joined RCREEE in late 2011; Bahrain, Iraq and Sudan. For the economic data, like GDP and the value-added of sectors, the base year taken into consideration is different in the two editions. For the 1st edition, the reference year was 2000, and for the 2nd edition it is 2005, which is currently the base year commonly used by the international statistical community.

In general, the same methodology and process are adopted to produce both editions, based on a collaborative effort among member states while building capacity during the process.
Energy Efficiency Indicators in RCREEE Member States

I. Introduction

1. Why energy indicators

Energy indicators can be used to perform a preliminary and fast diagnosis of the energy situation in a given country without investing too much time and financial resources. Implementing a benchmarking process that uses specific indicators can also be used as an approach to position the country’s energy situation among other countries or regions. An approach that uses indicators can be treated as a continuous process where further analytical diagnosis can be performed when needed.

Energy indicators are particularly considered as an important instrument for energy sector governance. Indeed, energy indicators are necessary for policy makers in a country to develop policies and energy efficiency (EE) programs by setting final and intermediate objectives expressed as indicators. In addition, indicators also serve as a good instrument for the monitoring and evaluation of policies and programs of energy efficiency, so they can be adjusted if necessary. The evaluation of energy efficiency policies by indicators also allows institutions responsible for EE promotion (e.g. energy efficiency agencies) to provide relevant arguments to policy makers to get public support for EE programs. This can be done by showing indicators that express positive impacts for the State and/or for the community.

2. What should be measured?

Theoretically, it is possible to build a very large number of indicators ranging from the macro to the most detailed. However, the choice of indicators to be developed must be governed by a number of bases:

- The availability and quality of data necessary for indicators’ construction. This is often a bottleneck in developing countries. It was also a strong constraint throughout this project and in almost all countries represented in this study
- The real needs of indicators for different levels of decision making related to energy policy. In fact, it is indeed better to have a reduced number of indicators than many, but specify relevancy for the target policymakers

In light of the above, two types of indicators were distinguished according to the level of decision conferred:

- Macro policy indicators which are designed to be used by high level policy makers in order to monitor the broad national goals associated to the energy sector. At this level we can measure the impact of energy policy in terms of strategic, macroeconomic, social and environmental issues
- Operational indicators can be utilized by decision makers at sectors and branches levels within an organization or public agency. At this level, the objective is to measure the energy performance of the target activities, such as industry, transport, building, etc.

3. The Energy Efficiency Indicators in RCREEE Member States Project

This report is part of the project Energy Efficiency Indicators in RCREEE Member States. The overall objective of the project is to strengthen the capacities of RCREEE member countries in data collection, development and interpretation of indicators. Specifically, the project aims at developing a set of common energy indicators for 12 years (2000-2012) for the 13 member countries, which include: Algeria, Bahrain, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Palestine, Sudan, Syria, Tunisia and Yemen.

The project is part of the continuity of RCREEE activity that started with the project implemented in collaboration with the Plan Bleu during the years 2011-2012, and has allowed the publication of the first report on energy indicators in the region.

It is important to point out that within the project, three training sessions were organized in order to enhance the capacities of the countries’ staff to be able to independently continue the process of producing and analyzing relevant indicators:

- A training session in September 2013 in Amman for the project focal points
- A training session in October 2013 in Manama for Iraqi and Bahraini teams
- A training session in April 2014 in Tunis for participants from all RCREEE member countries.

This report presents the main results of this project. It contains four major parts:

- The socio-economic context in the countries of the Region
- The energy context
- The macro policy indicators
- The operational level indicators

The EE Indicators Project

- Is aiming at enhancing the capacity of RCREEE Member States in developing and interpreting energy indicators
- Is the continuity of a strategic activity of RCREEE started since 2011
- Is developed with the full collaboration of member State representatives
II. Socio-Economic Context

The target region covers 13 counties with various economic, social and political situations, which makes difficult to treating it as homogenous bloc. For that reason the socio-economic indicators presented below for the overall region should be taken with great precaution, since they may not be very relevant to a country-specific scenario. Hence, the analysis will focus mainly on the individual situation of each country alone. Moreover, the socio-economic analysis will concentrate on issues that are decisive for the energy features, such as demography, economic growth and activity structures.

1. Demography

In 2012, the overall region was inhabited by roughly 300 million people, while in 2000, the population was estimated 239 million. The average annual population growth within that period rose to around 1.9%. However, the pace was very different from country to country as shown by the following chart:

![Figure 2: Annual population growth between 2000 and 2012 (source: UN)](image)

In some gulf countries, and particularly Bahrain, the population growth over the last decade was reinforced by the massive arrival of foreign labor linked the immigration policy of the country. For Sudan, the low population growth is linked to the separation of South Sudan in 2010. As a result, the population of North Sudan decreased from approximately 40 million inhabitants to 33 million in 2011.

Urbanization is also a factor that highly affects the form and amplitude of energy consumption. The region has shown within the last decade a clear trend towards urbanization with an increase of the share of the urban population moving from 50% in 2000 to 55% in 2012.

1 Share of GDP between the activity categories
2. Economy

2.1. Economic growth

In 2012, the GDP current price of the region was approximately $1182 billion and shared by the different countries as following:

Three countries in particular; Egypt, Iraq and Algeria, represent around 60% of the total GDP of the region, while they account for less than 50% of the population. However, in terms of economic growth, the average annual rate of the region within the period 2000-2012 was around 2.6%. The best performance was observed in Palestine, Jordan and Bahrain.

It is important to raise the fact that economic growth in many countries of the region was largely affected by the economic slowdown as a result of the Arab spring in 2011 and 2012, as shown by the following table:

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual GDP Growth 2010-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>2.7%</td>
</tr>
<tr>
<td>Egypt</td>
<td>2.0%</td>
</tr>
<tr>
<td>Jordan</td>
<td>2.7%</td>
</tr>
<tr>
<td>Lebanon</td>
<td>2.2%</td>
</tr>
<tr>
<td>Libya</td>
<td>-11.8%</td>
</tr>
<tr>
<td>Sudan</td>
<td>-6.8%</td>
</tr>
<tr>
<td>Syria</td>
<td>-2.2%</td>
</tr>
<tr>
<td>Tunisia</td>
<td>0.8%</td>
</tr>
<tr>
<td>Yemen</td>
<td>-5.3%</td>
</tr>
</tbody>
</table>

Table 1: Economic growth in Arab Spring Countries between 2010 and 2012 (source: WB)

The average income per capita in the region is estimated to around $3940/capita in 2012.
Based on this indicator, the countries could be classified into three groups (Figure 6):

- High income countries: Bahrain, Libya and Lebanon
- Upper Middle income countries: Tunisia, Algeria, Iraq, Morocco, Jordan, Syria and Egypt
- Lower middle income countries: Sudan, Yemen and Palestine

The economic growth of the region:

- Was hardly affected since 2011 after the events of the Arab Spring
- In some country like Libya, Syria and Yemen, there was an economic recession

2.2. Economic structure

The economic structure of the region shows a large diversity of economy types, ranging from monoculture economies based on large hydrocarbon exports such as Iraq, Libya, and Algeria and to a less extent Bahrain and Sudan, to diversified economies like Tunisia, Jordan, Lebanon, Egypt and Morocco. In the region, the GDP is mainly composed by industry activity\(^2\) (45%) and services (41%). However, there are large disparities between countries, as shown by the following chart:

While services are the main sector of the economy in Lebanon, Jordan, Tunisia, Morocco and Palestine, hydrocarbon industries are the main contributors to GDP in Algeria, Bahrain, Iraq and Libya. The agricultural sector still has a significant role in GDP contribution in the region, particularly in Sudan, Morocco and Syria.

These differences in economy structures, combined with other technical effects\(^3\), have a significant impact on primary and final energy demand levels.

The GDP structure

- It is dominated globally by industry (45%), mainly coming from hydrocarbon industry
- Services have an important share (41%)
- Services are dominating in non-oil countries, such as Jordan, Tunisia, Lebanon, Morocco, Yemen and Palestine

\(^2\) Including energy industry

\(^3\) Such as the impact of technology choice, process performance, etc.
III. Energy Context

1. Production

Energy production in the region has increased from 512 Mtoe in 2000 to around 538 Mtoe in 2012, representing an annual average growth rate of 0.4%. This is much below the growth rate of the world conventional energy production estimated to around 2.4% during the same period.

Around 85% of the regional energy production is covered by 4 countries: Algeria (27%), Iraq (26%), Egypt (16%) and Libya (15%). RCREEE member states produce mainly oil (65%) and natural gas (32%). The renewable energy, mainly hydropower, represents around 3% of the total energy produced in 2012.

However, more than 62% of this production is exported by the region, which is about 320 Mtoe in 2012. Iraq is the major exporter (35% of the region’s exports) followed by Algeria (32%).

One has to underline that the energy exports of the region have decreased by 1.4% per year since 2000 under the double effect of decreasing energy resources and increasing domestic demand.

Energy production

- It is growing up slowly, 0.4% annually between 2000 (512 Mtoe) and 2012 (538 Mtoe)
- Around 85% is covered by 4 countries: Algeria, Iraq, Egypt and Libya.
- More than 60% is exported, yet decreasing by 1.4% per year since 2000
- Services are the leading sources of GDP income in non-oil countries, such as Jordan, Tunisia, Lebanon, Morocco, Yemen and Palestine
2. Primary Energy Demand

Between 2000 and 2012, primary energy demand in the region grew from 193 to 285 Mtoe, increasing by around 3.2% per year. Growth in primary energy demand was diverse among the countries of the region, as shown by the following chart.

The greatest demand for primary energy was observed in Palestine, Morocco, Algeria and Iraq as a result of economic and population growth.

It is worth to underline that growth in primary energy consumption was propelled by fuel consumption for electricity generation, which represents more than 35% of the primary energy consumption in the region. In fact, electricity generation has grown from 228 TWh in 2000 to around 468 TWh in 2012, with an annual rate of about 6.6% during the period 2000-2012, ranging from 11.4% in Sudan to 4.7% in Tunisia.

Finally, as shown by the following chart, there has been no decoupling 4 between economic growth and primary energy and power demand in the region during the last decade. The average annual growth of GDP is around 2.5% per year, which is lower than the growth rate of primary energy consumption and much lower than the increase in demand for power.

4 Growing with different rate
One can also note the speculative effect of the Iraq war early in the beginning of the century and the Arab Spring in 2011.

**Primary energy demand**
- Demand is growing fast (3.2%) in parallel with economic and population growth, and the low efficiency of energy use
- Demand is driven by the electricity sector, which has experienced an increase of more than 6% per year
- No decoupling between economic growth, primary energy and power demand
- A clear risk for exporting countries to lose gradually their energy hydrocarbon falls

### 3. The Energy Mix

The mix of the primary energy demand is still dominated by oil which represents around 55% of the demand. However, the share of natural gas is increasing in the region, mainly used for electricity generation. Its share has increased from 36% in 2000 to more than 42% in 2012.

More than three quarters of the gas consumption in the region is driven by three countries: Egypt (40%), Algeria (25%) and Bahrain (11%).
Coal is used mainly in Morocco for electricity generation.

Finally, the contribution of renewable energy sources\(^1\) is still non-significant in the region, about 1% of the mix. Hydropower is the leading source of renewable energy in the region, which is produced mainly 3 countries: Egypt (42% of the total hyrdo energy consumption in the region), Sudan (21%) and Iraq (13%).

There should be a substantial contribution of biomass, mainly in rural areas; unfortunately, this form of energy is difficult to estimate as it is not recorded in official statistics. In Tunisia and Morocco, the share of firewood in primary energy consumption is estimated to be over 10% and 20%, respectively.

**Energy mix**
- Very low contribution of renewable energy in the primary energy demand, although the ambitious announced plans by the countries
- Dominance of oil products but an increasing share of natural gas

### 4. Final Energy Demand

Regarding final energy, the consumption of the region has raised from 117 Mtoe in 2000 to around 172 Mtoe in 2012, showing an annual growth rate of 3.4%. It represents more than 62% of the total primary energy demand of the region.

Around 40% of this final energy is consumed by the transport sector, 27% by households and 23% by the industry sector (including energy sector). Services and agriculture are consuming together around 11%.

---

\(^{1}\) Excluding firewood
For all countries, transport and residential sectors seem to have the largest share of final energy demand, except in Bahrain where industry consumes the largest share of the total energy produced at approximately 60% of total final energy.

This is because of the large energy intensive industries, consuming mainly natural gas, such as the petrochemical industry (Gulf Petrochemical industries Company, producing ammonia, methanol and urea for export), aluminum industry (Aluminum Bahrain, the large world exporter of aluminum) as well as other plants including Iron and Steel.

Electricity consumption represents a share of 18% of the final energy demand in the region and ranges from 6% in Sudan to 26% in Egypt.

The factors determining this share in the countries are various:

- **Electrification rate.** The share in countries such as Sudan and Yemen is minimal where the electrification rate is still very low.
- **Electricity tariffs.** For that reason the share is very important in Egypt and Syria.
- **The importance of the service sector in the economy.** The share is rather high in Lebanon and Tunisia where the economy is mainly based on services.

As shown by the following chart, electricity is consumed mainly by the building sector including households and services activities (57%).

---

**Figure 14:** Share of fuel for electricity generation in the primary energy mix in 2012 (source: countries + IEA)

**Figure 15:** Share final electricity in the final energy consumption energy mix in 2012 (source: countries + IEA)
Final energy demand

- Dominance of transport sector (40%) due to the increase of the demand for mobility of persons and goods, the low efficient urban planning and the lack of public transport
- Important place to building sector with 34% of the final demand. For electricity consumption the share of building is about 60%
- Important and growing share of electricity consumption
- Transport, building and electricity sectors have to be focused in priority
Energy Efficiency Indicators in RCREEE Member States

IV. Macro Policy Indicators

Energy indicators can be separated into main categories:

- **Macro policy indicators** which are designed to be used by high level policy makers in order to monitor the broad national goals associated to energy sector
- **Operational level indicators** targeting decision makers at sectors and branches level

This chapter will focus on the first type and attempt to provide a few set of indicators reflecting the main energy policy issues in the countries of region. In fact, the energy policy discussed below should contribute to raise the main following challenges:

- Energy security supply
- The impacts of energy on economy competitiveness
- The impacts of energy on macroeconomic equilibrium
- The impacts of energy on social and environmental sustainability

1. Energy Security Supply

The energy security can be monitored through the indicator of **Energy Dependency** which can be defined as following:

\[ EDI = \frac{-(\text{Energy production} - \text{Primary energy consumption})}{\text{Primary energy consumption}} \]

The higher the indicator is, the more dependent a country is on supply from other countries to meet its energy needs. This ratio is negative for net exporters and positive for net importers countries.

For the whole region, the dependency indicators has increased from -166% in 2000 to -90% in 2012. Thus, globally, the region is still independent for its energy supply, but its level of independence has almost halved in the last decade. The following chart also shows that this trend is the same for all the countries, except Libya where oil production significantly increased in 2012.

![Figure 16: Energy Dependency ratio evolution between 2000 and 2012 (source: Countries)](image)

Indeed, even in oil-based economies, such as Algeria, Iraq, Bahrain and Yemen, the primary energy demand is increasing much faster than energy production, thus reinforcing the tendency towards energy dependence. For Libya, the dependency indicator seems to be improved. However, the data related to 2012 should be considered with caution because the energy sector has seen severe disruptions. This was due to the massive destruction of the electrical infrastructure and to the immigration of large population to Tunisia, following the civil war of 2011.

Other countries like Syria, Egypt, Sudan and Tunisia are experiencing a transition situation from being an exporter to becoming an importer of energy that puts their economies in a stressful situation (national energy bill, energy subsidies, etc.). The largest decline in "energy supply autonomy" is registered in Syria, which exported the equivalent of its domestic consumption in 2000 and barely covered its needs in 2012.

Countries that are totally dependent on their external energy supply, such as Morocco, Jordan and Lebanon have adapted their energy systems to cope with this situation, particularly through a cost recovery energy pricing.

On the short and mid-term outlook the net importer countries have to manage their social and economic vulnerability to shocks in international energy prices. For net energy exporter countries, the challenge is to preserve, on the long term, their hydrocarbon wealth and diversify their economies in order to prepare them for an eventual depletion of oil reserves.
2. Impact on Economic Competitiveness

In addition to the strategic issue of the security and continuity of national energy supply, the energy sector in most countries of the region is socially and economically vulnerable to increases in international energy prices. This vulnerability can be analyzed through three main aspects:

- The energy intensity at macro level, which can give an idea about energy efficiency of the overall economy
- Expensive energy bills for these countries in comparison with the performance of their economies, which can reduce their economic competitiveness and need large amounts of foreign currency to pay these energy bills
- The pressure on public finances caused by the large amount of subsidies on domestic energy prices, justified by the protection of the poor

In the short term, after the Arab Spring movements, any cost-effective energy tariff policy including high increase in domestic energy prices would not be socio-politically acceptable. Thus, governments often face a dilemma between the need to protect the poorest social classes and the need to preserve the balance of their public finances against a continual increase in international energy prices.

For net energy exporting countries, the situation is for the moment less critical. However, even for the large energy producers the energy dependency ratio is getting higher because of the quick increase in the internal demand and the stagnation (or low rate of increase) in gas and oil production.

For these reasons we have thought it is useful to integrate in this work some indicators on energy bill and energy subsidies, although we are aware of the difficulty of such exercise. We have introduced three indicators:

- Primary energy intensity
- Ratio of energy bill to GDP at current price
- Ratio of energy subsidies to GDP at current price

2.1. Primary Energy intensity

Primary energy intensity is defined as the primary energy consumption divided by the GDP at constant price. It aims to measure the overall energy efficiency of the economy.

The following chart presents the development of primary energy intensities during the period 2000 to 2012.

As shown by the following chart, the average intensity in the region is about 0.45 toe/1000 $2005 in 2012, more than 4 times the OECD average of 0.11 toe/1000 $2005. Hence, among target countries, there is a huge potential for energy efficiency improvement in the region.
Primary energy intensity of GDP varies considerably among the target countries. It is very high for Iraq, Bahrain, Egypt, Syria and Sudan and rather low in the case of Tunisia, Morocco, Palestine and Lebanon, where the economic activity is dominated by services which provide high value added, but consumes little energy.

Finally, it is very important to highlight that the values of energy intensities have to be treated with caution, for the following reasons:

- The informal energy market is not reflected in statistics and can have an impact on reducing the energy intensity. For example biomass, which represents a substantial portion of rural household energy consumption, particularly in Egypt, Iraq, Yemen and Morocco, is not included in the energy intensity calculation;
- Cross-border smuggling of petroleum products in the region can cause energy intensities to be over or under-estimated. In fact, significant illegal trade of oil products exists between Syria and Lebanon, Syria and Jordan, Iraq and Jordan, Yemen and Saudi Arabia, Morocco and Algeria, Tunisia and Algeria, Libya and Tunisia, and Egypt and Palestine. That activity is not reflected in official energy statistics.
- The suppressed demand is due to the lack of energy supply (e.g. in Yemen and Palestine) and also the lack of electrical appliances in households in some countries such as Yemen, Palestine and to a lesser extent Egypt and Morocco, and makes it meaningless to compare energy intensity between the target countries.

### Primary energy intensity

- It gives an idea about the energy performance of the overall economy, but should be treated with caution because of the specificity of the socio-economic context of each country
- The energy intensities in the region are rather high compared to developed countries which makes its economy less competitive
- The benchmark of energy intensities shows a huge potential for energy efficiency improvement in the region

#### 2.2. Energy bill

The precise calculation of the energy bill and public subsidies to energy in a country often raises serious methodology issues. First, the concepts of energy bill and subsidies must be defined.

Energy bill, or the cost of energy supply for the community, is made up of two components:

- The cost of the quantity of consumed primary energy produced locally
- The cost of the quantity of primary energy imported from abroad

So, the cost of imported energy, the national energy bill, can be expressed as:

\[
\text{National energy bill} = \sum Q_i \times PCI + \sum Q_j \times IP_j
\]

- \(Q_i\): Consumed quantity of the primary energy product (i) produced locally
- \(PCI\): Local production cost of the primary energy product (i)
- \(Q_j\): Consumed quantity of the primary energy product (j) imported from abroad
- \(IP_j\): CIF\(^5\) import price of the primary energy product (j)

\(^5\) Cost, insurance and freight.
For the energy bill, the simplified method proposes the following definition: sum of the quantities of consumed primary energy products multiplied by their international prices.

This definition raises two important issues:

- International prices used for bill calculation are the annual average price on the Mediterranean market provided by PLATTS database. These prices do not accurately reflect the real import costs paid by countries, which depend on several factors (quantities purchased, purchase dates, bilateral trade agreements, geographical position, etc.)
- For importing countries, the bill calculated under this method is quite close to the real bill paid by the country. However, for exporting countries (even partially), the method reflects the value of local energy consumption on the international market.

**Energy bill**

- Is calculated on the basis of opportunity cost by considering the international energy prices as the supply cost
- The energy bill of the countries is developing quickly in the same rhythm of international energy prices. It moved from 10% of the GDP in 2000 to 16% in 2012.
- The energy bill constitutes a big challenge for economy competitiveness and for commercial balances, particularly for net energy importers.

The following figure illustrates the evolution of the ratio energy bill to GDP for the countries of the region.

![Figure 18: Energy bill to GDP in 2000, 2008 and 2012 (source: Countries)](image)

The average energy bill represented around 16% of GDP of the region in 2012, while it was only 10% in 2000. The lowest ratio is observed in Sudan and Palestine, because of their low energy consumption, while the highest is in Jordan, around 25% of the GDP in 2012. Almost for all Arab spring countries, except Tunisia, there was a drop of the energy bill to GDP in 2012 because of the primary energy supply shortage linked to the revolution events.

Of course, the share of energy bill to the GDP has increased at the same pace as the international prices of oil, as shown by the following chart, for Sudan, Jordan and the overall region.
2.3. Energy subsidy

The calculation of the public energy subsidy is more complex. For a given product, the subsidy is equal to the price at which a state sells to energy distributors (in case of administered prices) minus the supply cost of the product (CIF import price or production cost or local processing) plus taxes collected by the state on the product.

However, in most countries of the region the parameters for calculating the real costs of energy supply, and especially the amount of public energy subsidy, are very often not available. For example, this is the case for the real energy production costs and the average import prices that heavily depend upon energy supply sources and trade agreements, etc. Even in countries where such data exists, they are often considered as highly confidential and inaccessible.

For these reasons we, in agreement with the experts’ working group, adopted a simplified method that does not provide accurate values of the bill and energy subsidies. However the method should give a good approximation, sufficient for policy decisions.

The values calculated by the proposed method should not be considered as the real costs, such as those established by public accounting of the financial flows of energy (when they exist).

In the region, both energy importers and producers have relied heavily on generalized energy price subsidies as their main tool to provide social protection and share hydrocarbon wealth.

Subsidies to energy products are measured as the difference between the value of consumption at world and domestic prices. According the IMF, the total energy subsidies in the overall region cost about 90 billion USD in 2011 and equivalent to 8.5% of regional GDP.
Energy Efficiency Indicators in RCREEE Member States

About 60% of total energy subsidies in the region are accounted for petroleum products, while the remainder represents subsidies on electricity and natural gas. As shown by the following chart, subsidies for oil products are predominant in Iraq, Egypt, Libya and Bahrain.

In Algeria, natural gas subsidies are predominant, while in Lebanon, Jordan and Tunisia the electricity sector receives the most amount of subsidies.

As a conclusion, to insure financial sustainability of the energy sector deep reform of the energy tariff system has to be undertaken in order to allocate subsidy to the poorest of the population and to public sectors such as education and health.

3. The Impacts on Social Sustainability

Energy subsidy
- Subsidies to energy products are measured as the difference between the value of consumption at world and domestic prices.
- According the IMF, the total energy subsidies in the overall region cost about 90 billion USD in 2011 and equivalent to 8.5% of the regional GDP to be compared to the budget for education which represents only 4.1%.
- About 60% of total energy subsidies in the region are accounted for petroleum products.
- This subsidy make a particular challenge for the public finance of net energy importer countries.
- It is expected to increase in the future because of increases in international energy prices putting the public finances in the region under more pressure.
The indicator used to measure social sustainability is the share of energy in household expenditures. We have limited the calculation to the expenditures for electricity, which represents the largest share of energy consumption of the residential sector. The calculation method is to value the electricity consumption using the average electricity tariff in the residential sector and then divide it by the household expenditures at current price. The following chart shows the results for the different countries in 2012.

The highest proportion is observed in Palestine, where the electricity is very expensive because it is purchased in bulk from Israel at a very high price. It is followed by Jordan with a share of about 6% of the household’s budget. The lowest shares are recorded in Libya, Iraq and Syria, given the low electricity prices. In Yemen, a country under electrified, the share of electricity in household expenses remains relatively low. Finally, in Lebanon, the share of electricity in household budget may be underestimated if one takes into account the self-production of electricity consumed by households.

4. The Impacts on Environmental Sustainability

**Social sustainability**

- The social sustainability impact of energy can be measured through the share of energy in the households budget.
- This share ranges from 0.3% to 9% depending on the context of the countries (energy tariffs, level of consumption, wealth of the households, etc.)
- If the energy subsidy is removed, this share can increase significantly, putting large household categories in difficulties.
The impact of energy on the global environment is one of the major sustainability issues. This impact can be measured through the CO2 intensity which is defined as the ratio between the total CO2 emission of the energy sector and the GDP current price. The average CO2 intensity in 2010 is around (1.25 tCO2e /1000 $2005) is about three times more than the OECD average (0.4 tCO2e /1000 $2005), as shown in the following chart:

![Figure 24: CO2 intensities from fuel combustion in 2011](image)

The CO2 intensities are strongly correlated with primary energy intensities and its mix. Syria, Iraq, Egypt, Lebanon and Bahrain therefore show the highest CO2 intensities in the region.

**Environmental sustainability**

- The region is emitting less CO2 per capita than developed countries
- But it emits 3 times more than the OECD region by unit of GDP
V. Operational Level Indicators

1. Energy Transformation Sector

1.1. Structural indicators

The energy transformation sector in the region is mainly composed of crude oil refineries, power generation capacities and some LPG and LNG facilities, mainly in Algeria, Egypt and Bahrain.

The total refinery capacity in the region in 2012 is estimated at 3.226 million barrels per day, located mainly in Egypt, Iraq, Algeria and Libya. In most cases, the refining capacity is not sufficient to meet national demand. Indeed, apart from Algeria and Bahrain, all other countries are forced to import additional quantities of oil products to meet local demand. In 2011, for example, the net import of oil products is around 10 Mtoe.

![Refinery capacities in the project countries in 2012](source: Countries)

**Refining sector**
- Total refinery capacity of 3.226 million barrel per day, located mainly in Egypt, Iraq, Algeria and Libya
- The region is net importer of oil products (10 Mtoe in 2011)

For electricity, the total installed generating capacity in the region has doubled between 2000 and 2012 rising from 51 TW to 104 TW, making the electricity sector under crucial challenge. Five countries have experienced the largest increase of capacity; they are Iraq, Egypt, Algeria Libya and Bahrain. Electricity generation is mainly based on oil and gas. The share of renewable energy (RE) in the power generation capacity is estimated at around 11.4% in 2012 including hydro (10.3%), and wind and solar (1.1%).

![Installed power generation capacity in the project countries in 2000 and 2012](source: Countries)

![Installed renewable power generation capacity in the project countries in 2012](source: Countries)
In overall the region, the electricity sector has consumed in 2012 around 35% of the total primary energy demand in the region against only 26% in 2000. However, the situation is very different from country to country depending on the contribution level of the renewable energy sector and imports in the electricity supply, as shown by the following chart:

*Figure 28: Share of fuel for electricity generation in the primary energy mix in 2012 (source: countries + IEA)*

For example the lowest share is in Sudan because it relies mainly on hydroelectricity for its electricity supply. The same scenario is observed in Palestine, where electricity is mainly imported from Israel.

**Electricity sector**
- Total capacity doubled between 2000 and 2012 (51 TW to 104 TW)
- Big challenge of meeting peak load demand
- Electricity generation based mainly on oil and gas
- Renewable energy shares around 11% from which 10% is hydro
- A sharp increase of the electricity demand, growing annually at 6% per year
- Electricity sector is making large pressures on primary energy demand. The share of fuel for generation in primary energy demand has grown from 26% in 2000 to 35% in 2012
- The electricity sector has to particularly focus on the energy efficiency policies of the country

### 1.2. Performance indicators

The main objective is to assess the energy transformation sector according to its energy and environmental performances. To assess the energy performance of the transformation sector, two indicators are proposed.

#### 1.2.1. Ratio of final to primary energy consumption

The efficiency of the overall energy transformation sector including all types of processing of energy transformation is measured by using the ratio of final energy consumption to primary energy consumption. As presented in the following chart, this indicator has almost remained stable between 2000 and 2012, around 60%.
This ratio varies widely among countries due to many factors, particularly the efficiency level of electricity generation, the share of renewables in the primary energy demand, the share of final product imports, etc. Libya shows the lowest ratio, with an average of 53% in 2012 against 39% in 2000. Except Syria and Yemen, the final to primary energy ratio does not vary greatly between countries and ranges between 60% and 70%.

The efficiency of the energy transformation sector tends to decline in some countries like Egypt, Iraq, Lebanon, Tunisia and Palestine. The other countries have experienced slight improvement of this ratio since 2000.

1.2.2. The specific consumption of power generation

The specific consumption indicator measures the efficiency of installed power generation capacity. Its level depends on many factors, among them the power generation technology mix, the obsolescence of the plants, the renewable energy share, the efficiency of plant operation and maintenance, the shape of the load demand curve, etc.

The average specific consumption for the region has decreased slightly from 222 toe/GWh in 2000 to 212 toe/GWh in 2012. The variations per country are shown in the flowing chart:

Because of renewable electricity generation, mainly hydropower; Sudan, Lebanon, Egypt and Morocco have the lowest specific consumption in 2012, at 66 toe/GWh, 170 toe/GWh, 184 toe/GWh and 180 toe/GWh, respectively.
Excluding renewable electricity generation, the SCPG in Egypt and Morocco would increase to 240 toe/GWh and 243 toe/GWh, respectively. It clearly shows the role of renewable energy in increasing the efficiency of electricity generation in a given country. On the other hand, Iraq and Bahrain present the highest specific consumptions with 303 toe/GWh and 257 toe/GWh, respectively in 2012.

1.2.3. GHG emission performances

The environmental performance of the power generation sector can be measured through the emission factor defined as the emitted quantity of CO$_2$ per kWh of generated electricity. The following chart presents this indicator for all the countries in the region.

The average emission factor in the region is around 589 TCO$_2$/GWh which is not far from the world average, but still very high compared to the OECD average (434 TCO$_2$/GWh). In Sudan, where electricity is primarily generated from hydropower, has the lowest emission factor, at approximately 204 TCO$_2$/GWh. The highest emission factor is in Iraq, where electricity generation, mainly from oil-fired power, is very low in efficiency.

Performance indicators

- A low efficiency of the transformation sector, 60% against a normal efficiency of 70% to 75%
- High specific consumption of electricity generation, around 212 toe/GWh in 2012
- High grid losses that can reach 30% in some countries
- High emission factor compared to developed countries (589 TCO$_2$/GWh compared to OECD average of 434 TCO$_2$/GWh)
2. Building Sector

The building sector includes both residential and tertiary sectors. It represents almost one-third of the final energy consumption in the region, about approximately 56 Mtoe in 2012. Final energy consumption of buildings in the region has increased 175% between 2000 and 2012, with an average annual growth rate of 5.3%.

The sector is by far the first electricity consumer in the region with a share exceeding 57% in 2012. Indeed, the electricity consumption of the sector has more than doubled during the same period (222%), as shown by the following chart.

![Energy Consumption Growth](chart)

**Figure 32: Final energy and electricity consumption index growth in building sector (source: Countries)**

Energy consumption in the building sector is dominated by residential demand with a share of 27% of the total final energy demand in the region and 40% of its electricity demand. The tertiary buildings sector represents only 7% of this total consumption and 17% of the total electricity demand in the region.

Many prospective studies have shown that the building sector’s energy demand over time will have a large increase in the future, at the expense of the other sectors. This is because of many drivers, such as:

- Increase of the building stocks, particularly in the residential sector
- Improvement in the living standards of the population as a result of economic growth
- The rapid urban growth in the region, etc.

For instance, the number of dwellings in the region has quickly increased from around 40 million dwellings in 2000 to around 60 million dwellings in 2012, with an annual average growth rate of 2 % representing an additional yearly stock of more than 1 million dwellings.

### Building sector

- 34% of the final energy demand
- 57% of the electricity demand
- A high increase of demand, with 175% between 2000 and 2012 for energy demand and 200% for electricity
- The building sector should be particularly focused by the energy efficiency policies in the countries of the region (building insulation, appliances performances improvement, etc.)

2.1. Indicators in residential sector

2.1.1. Energy intensity

Final energy intensity for the residential sector is defined as the ratio between the final energy consumption of the sector and the consumption of households at constant price. to evaluate the effect of income levels of the different countries in the region, the parity of power purchase (PPP) was used to make this comparison and presented in the following chart:

Except Algeria, Bahrain and Sudan, final energy intensities of the residential sector have ranged between 20 and 40 kgoe/1000 ppp$2005, over the period 2000 to 2012.

In Algeria and Bahrain, the high levels of energy intensity can be explained by the high level by individual energy consumption compared to the other countries. For Sudan, the high intensity is explained by the general level of poverty and so the low expenditures of the households.
It is worth highlighting that the comparison of countries’ performances in terms of residential final intensity has to be considered carefully, because of the diversity of a country’s contexts (level of wealth, equipment rate of households by appliances, etc.). In fact, this indicator is very sensitive to some key factors such as:

- Climate,
- Construction mode
- Level of appliance ownership
- Fuel mix
- Penetration rate of renewables (solar water heater), etc.

**Residential sector**

- 27% of the final energy consumption
- 40% of the electricity consumption
- A high energy intensity in some countries showing low efficiency of the energy use
- High energy and electricity consumption per dwelling in some countries confirming the energy waste in this sector
- Low penetration of solar water heaters irrespective of the high potential in the region
2.1.2. Unit consumption of energy per dwelling

The indicator of unit consumption is calculated as the ratio between the energy consumption of the residential sector and the number of dwellings.

The average unit of consumption per dwelling in the region was around 729 kgoe in 2012, compared to 522 kgoe/dw in 2000, representing an average increase of 3% per year, as shown by the following chart.

![Figure 34: Final energy consumption per dwelling (source: countries)](chart)

The households in Bahrain seem to be the most final energy consumers in the region, with an average of 3.1 toe/dwelling, followed by Libya with an average of 1.7 toe/Dw. Because of the lack of access to energy, Yemen shows the lowest rate.

Regarding electricity, the average consumption per dwelling in the region has increased from 1737 kWh in 2000 to 2644 kWh in 2012, an increase of almost 3.5% per year, as shown by the following chart.

![Figure 35: Electricity consumption per dwelling (source: Countries)](chart)

Bahrain households, are by far, the largest consumers of electricity with more than 30000 kWh per dwelling, followed by Syria (4800 kWh/Dw), Iraq (4688 kWh) and Lebanon 4278 kWh/Dw.

The lowest consumption of electricity is observed in Yemen and Sudan, at 719 kWh/Dw and 681 kWh, respectively. This can be explained by the low access to electricity in these 2 countries; 29% in Sudan and 40% in Yemen.

Finally for almost all countries in the region the electricity per dwelling has increased between 2000 and 2012, but at different rates. The highest increases were observed in Sudan (14.1% per year), Egypt (6.4%) and Morocco (5.7%).
2.1.3. Renewable energy use in the sector

The objective of this indicator is to evaluate the level of use of renewable energies by households. The solar water heater (SWH) is the main renewable technology used by the households in the region. The penetration of solar water heaters in a country is measured in terms of collector area per 1000 inhabitants.

The following chart presents the indicator for countries where there is significant development of the solar water heater market.

Palestine and Jordan are the leading countries for SWH penetration in the region, followed by Lebanon. The development of SWH in these countries is mainly explained by the high tariffs for energy used for water heating (electricity and LPG).

Some SWH markets are emerging in the region, such as Tunisia, Morocco and to a lesser extent Syria. Particularly, the SWH market in Tunisia has shown rapid growth in the last 10 years due to a public incentive program PROSOL that promotes the development of the solar thermal market. PROSOL is based on a win-win financial mechanism, which includes a loan for domestic consumers to purchase SWHs and capital cost subsidy provided by the Tunisian government of 20% of system costs. This mechanism has transformed the market (7,000 m² in 2004 to 80,000 m² per year currently) and allowed the creation of an important local industry.

2.2. Indicators in tertiary sector

The tertiary sector covers a very diverse range of activities including hotels, commerce, banks, administration, etc. This is one of the main reasons explaining why energy and activities data are not readily available. In the best case, the energy balance provides only energy consumption of the entire sector, but not disaggregated consumption by sub-sector. Because of the great heterogeneity, activity data are either non-existent or scattered among many institutions, which make it hard to collect them, within the time frame of the project. Also in the target countries, there is a significant lack of specific studies and surveys dedicated to the main tertiary sub-sectors, which could at least provide timely and relevant data.

The main indicator developed for the tertiary sector is the final energy intensity defined as the final energy consumption of the sector divided by its value added at constant price. The following chart presents this indicator for some the target countries.
The energy intensity of the tertiary sector can be influenced by many factors, including the climate of the country and the structure of the sector. For that reason, a simple comparison between countries may not lead to accurate conclusions.

Lebanon and Morocco, where bank activity is well developed among the tertiary sector, present the lowest intensities (10 and 13 kgoe/1000 $2005 in 2011). In fact, banks have very high value added with low energy consumption compared with other activities like hotels or office buildings.

The highest intensities are observed in Sudan, Yemen and Syria. This can be explained by many factors: the dominance of the informal service sector, the dominance of government building in energy consumption, etc.

**Tertiary sector**
- A lack of data on energy consumption and on economic activities in most of the countries
- 7% of the final energy consumption in the region
- 17% of the electricity consumption
- A high energy intensity in some countries showing low efficiency of the energy use
- Surveys have to be carried out to address the gap of data

### 3. Industry Sector
#### 3.1. Energy intensity

Energy intensity of the industry sector is defined as the ratio between the energy consumption of the sector and its value added.

As shown by the following chart, Egypt presents the highest energy intensity for industry in the region, mainly because of the outdated industry systems and the predominance of state-owned factories.

Jordan, Tunisia and Morocco have similar intensities because of the similar industry structure found in these countries, moving more and more towards less energy intensive industries, and with higher value added.

![Figure 38: Final energy intensities of industry sector (source: countries + WB)](image)

Algeria has the lowest intensity, at around 0.08 toe/1000 $2005, in 2011. This low intensity is mainly due to the predominance of the hydrocarbon industry characterized by low energy consumption and high value added, at a time when international oil and gas prices were high.

Yemen and Lebanon’s energy intensities are also low and can be explained by the predominance of small industrial units, usually low energy intensive.

It should be highlighted that a decreasing trend in energy intensity can be observed in most countries of the region over the last years. This can be explained in part by the tendency of the development of light industry in the region and the improvement of the efficiency in industrial processes.
3.2. Specific consumption of energy intensive branches

In order to measure the technical effects on the energy consumption of a given industry, the indicator of specific energy consumption is used, which provides the energy content of a given industrial product. It is defined as the final quantity of energy required to produce one physical unit of the product. It is a relevant indicator, usually used to measure the energy performance of energy intensive processes like cement, sugar, steel, paper, phosphate, etc.

However, because of lack of data this indicator was used only for the cement branch, as presented by the following chart:

![Figure 39: Specific consumption of cement sector in 2011 (source: Countries)](chart)

The cement sectors in Jordan, Morocco and Tunisia are the most energy efficient in the region and remain comparable to those in Europe. In fact, most cement factories in these countries belong to international groups – mainly European – which have made significant efforts in energy optimization to meet international standards for energy consumption and local air pollutants.

On the other hand, Iraq, Sudan, Syria and Bahrain present the highest specific consumptions within the cement branches, ranging from 114 to 120 kgoe/ton. In these countries, there is significant energy saving potential in this sector.

**Industry sector**

- A huge lack of data on the energy consumption and activities at desegregated level in most of the countries
- 23% of the final energy consumption
- 30% of the electricity consumption
- A high energy intensity in some countries showing low efficiency of the energy use
- A general decrease of the intensity in most countries because of the changing structure towards light industry
- A high specific consumption of cement branch in many countries of the region showing the high potential of energy saving in this sector
- Cement has to be particularly focused in the EE policies in these countries
4. Transport Sector

As mentioned earlier, the transport sector, including road, rail, air and maritime, is the most important energy consumer in the region with a share of about 40% of the final energy demand. Depending on the country, its part is ranging from 20% in Bahrain to 59% in Libya, as shown by the following chart. Its share of total final energy has significantly increased from 34% in 2000 to 39% in 2012.

![Figure 40: Share of transport in final energy demand in 2012 (source: countries + IEA)](image)

As shown by the graph below, transport energy consumption has grown by about 3% per year over the period 2000-2012, but was uneven across countries. Sudan, Libya, Morocco, Algeria and Bahrain have experienced very high growth exceeding 6% per year.

![Figure 41: Annual growth of transport energy consumption between 2000 and 2012 (source: countries + IEA)](image)

This increase is mainly explained by the rapid development of the transportation sector in the region as a result of various factors, including: economic growth, fast urbanization, congestion and a large proportion of the population shifting to private cars in the absence of good quality public transport.
4.1. Energy intensity

Energy intensity is defined as the ratio between total final energy consumption of the sector and GDP at constant price, as transport is integrated to all the other economic activities.

The average energy intensity of the transport sector in the region was estimated in 2011 at 0.104 toe/1000 $2005, as shown by the following chart.

![Energy intensity chart](source: countries)

However, this intensity differs from country to another depending on the local conditions of the transport sector and ranges from 0.048 toe/1000 $2005 in Tunisia to 0.235 toe/1000 $2005 in Iraq. Except Iraq, Libya, Syria and Egypt, all the other countries have shown intensities lower than the average of the region.
4.2. Rate of motorization

One important determining factor for the energy intensity of the transport sector is the rate of motorization defined as the ratio of number of cars to the population. The following chart presents this indicator of all the countries of the region.

The average rate of motorization in the region was around 74 vehicles per 1000 hab. in 2011, but ranging from 537 Veh./1000 hab. in Bahrain to 27 Veh./1000 hab. in Sudan.
VI. Conclusion and Recommendations

Conclusion
It is insufficient to illustrate a general overview of the region without taking into consideration the entire regional context and events over the past few years.

In general, the economic structure in the region is dominated by the industry, mainly the hydrocarbon. The services sector has an important share of GDP in non-oil countries, such as Jordan, Tunisia, Lebanon, Morocco, Yemen and Palestine.

The energy production is growing slowly, mainly due to four countries; Algeria, Iraq, Egypt and Libya. The primary energy demand is growing fast due to the economic and population growth within an inefficiency use of energy. The growth is mainly driven by demand on electricity.

The region is still independent for its energy supply, but its level of independence has almost halved in the last decade. Even for oil-based economies, the demand on energy is increasing much faster than energy production, thus reinforcing the tendency towards energy dependency.

The primary energy intensities in the region are rather high, compared to developed countries, which makes their economies less competitive. This shows a huge potential for energy efficiency improvement in the region.

Regarding the electricity sector, the demand is growing fast, putting a large pressure on primary energy demand, mainly oil and gas. To meet this demand increase, the installed power capacity has doubled between 2000 and 2012.

The increase of the energy demand, coupled with the volatility in international primary energy prices, implies large economic challenges, particularly for non-oil countries in the region. The impacts are mainly reflected through energy bills and public subsidies to energy tariffs. The energy bill constitutes a real challenge for economy competitiveness and commercial balances. The total energy subsidies have been estimated to around 8.5% of the GDP of the overall region, from which almost 60% are accounted for petroleum products.

Recommendations
It is imperative that Arab countries implement ambitious but realistic National Energy Efficiency Action Plans (NEEAPs) targeting different sectors. Some sectors and practices should be targeted as a priority based on a deep analysis of the indicators. This will help to identify potentials of energy efficiency exist and to set the priority for measures. Moreover, the NEEAPs need to be monitored and evaluated regularly through the definition and calculation of relevant energy efficiency indicators to measure energy, socio-economic and environmental impacts of these programs. Depending on the context, bottom-up indicators to measure expected impacts more accurately can also complement this evaluation.

Based on the present energy indicators analysis, energy efficiency policy in the region has to focus on:

- The electricity sector, which has a low efficiency in the transformation process, high grid losses and high emission factors compared to developed countries.
- The transport sector, as the first energy consumer in the region. Having a high-energy intensity, this sector needs a strong improvement of public transport and optimization of urban planning.
- The building sector (including residential and tertiary), which has a highly increasing final energy demand. As a first consumer of electricity, this sector needs specific energy efficiency measures such as building insulation, appliances performances improvement (particularly for air conditioning), Solar Water Heater marks and certification development, etc.
- The industrial sector consumption has a high-energy intensity in some countries, while it decreases in most countries, due to the changing structure towards light industries. The cement sector in many countries in the region that has a high specific consumption needs to receive a priority for adopting energy efficiency measures.

Highlighting these key results shows the importance of energy statistics for the region, and hence the importance of collecting reliable data efficiently. A major prerequisite to data collection is the availability of qualified human resources. RCREEE, as a regional player in this field, is strategically placed to promote and develop capacity building activities and recommendations. The below non-exhaustive list of topics is presented as an example of areas of intervention:

- Basic concepts on energy
- Basic concept on aggregated macroeconomic values
- Energy accounting including energy balances and desegregated energy consumption
- Macro level and sector level energy indicators: calculation and interpretation
- Principals of organizing and managing energy information systems, etc.

A fundamental issue was raised during the course of the study: Do we have the required energy data sets in the region? If the answer to this question is yes, the data must be comparable and of an acceptable quality. Morocco and Jordan are two countries in the region which stand out in terms of data availability. On the other hand, if data is unavailable, then a data gap is clearly identified and necessary action must be taken for data collection, bearing in mind the following challenges:

- The absence of data, particularly at disaggregated level, due to the weakness of the national statistical systems (absence of regular surveys, etc.).
- The lack of cooperation of some data source institutions and cumbersome procedures for access to information
- The lack of specialized capacities to collect and analyze the required information.