November, 2013

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1. Abbreviations

ASFR	Age Specific Fertility Rate
DOS	Department of Statistics
FP	Family Planning
GOJ	Government of Jordan
GWh	Gigawatt Hours
HPC	Higher Population Council
HPI	Health Policy Initiative
HPP	Health Policy Project
JD	Jordanian Dinars
KWH	kilowatt hour
MEMR	Ministry of Energy and Mineral Resources
RAPID	Resources for the Awareness of Population Impacts on Development
RH	Reproductive Health
TFR	Total Fertility Rate
TOE	Tons of Oil Equivalent
UNFPA	United Nations Fund for Population
USAID	United States Agency for International Development

2. Definitions, Units of Measurement and Conversion Coefficients in the Energy Sector

- **Un-renewable energy:** Depleted energy which will expire by time because of over use. It is found in nature in limited quantities.
- **Renewable energy:** Permanent, non-depleted natural energy, available in nature and continuously renewed as long as life continues
- **Primary energy**: Energy not subjected to any change or transformation, such as crude oil, natural gas, coal, etc.
- **Final energy**: Energy that is available for final consumption, but has not yet been delivered to the consumer. Examples include petroleum derivatives that have been produced and stored in petrol stations, or electricity before distribution and transmission.
- **Final energy consumption**: Energy that is consumed by the end user for all purposes of energy utilization (e.g. consumption by the different sectors)
- **Energy density**: The ratio of energy consumption to economic or material yield. At the national level, it is the ratio of total local consumption of primary energy, or the consumption of final energy, to the GDP (value added) or material yield. The energy needed to produce one unit of the GDP at fixed prices.
- Units used in electric power is Kilowatt hour(KwH):

  Kilowatt hour(KwH) = 1,000 watts

  = 3.6 mega joule

  1 Watt-second = 1 joule

- The unit used to measure thermal energy is the calorie. (Calorie: The amount of thermal energy needed to raise the temperature of one gram of water by one degree Celsius. This unit equals 4.1868 joule).
- Quantities of petroleum and petroleum derivatives are measured by mass (tons) or size (cubic meter or barrel):

  1 metric ton = 1,000 kilograms = 7 barrels of petroleum

  1 cubic meter = 1,000 liters = 6.29 barrels of petroleum

  Ton Oil Equivalent (TOE): The amount of thermal energy produced by burning one

  ton of petroleum

  1 TOE = 10 gigacalories
  = 41.9 gigajoules
  = 1.43 ton coal equivalent
  = 11.63 megawatt-hour
  = 7 barrel oil equivalent

3. Executive Summary

Jordan's resources are limited, especially energy and water resources. The Jordanian population has increased in the last sixty years to more than twelve-fold, from 0.59 million in 1952 to about 6.4 million in 2012, and this has increased the pressure on services and natural resources such as energy.

In response to this, the Higher Population Council has increased its efforts to raise awareness about the impacts of population growth and age distribution on development, in order to gain the support of decision makers for population related issues. Included in these efforts is the development of advocacy studies and presentations focusing on vital sectors in Jordan; health, education, water, energy and land use. This document was developed specifically to support the presentation for the energy sector.

Energy is one of the main components of the civilized societies and needed for all of its sectors and activities for operating factories, means of transport and for heating and cooling and domestic purposes.

Population growth has led to an increase in demand for energy for domestic, cooling, and heating purposes and due to the growth in economy and its uses for industrial purposes. This trend is expected to continue over the coming years and is considered a major challenge that should be addressed if Jordan is to meet its future needs for energy.

The issues to be addressed if Jordan is to meet its future needs for energy are many. Some of these issues are:

- Scarcity of local oil
- Rising prices of oil in the international market
- Critical and serious supply-demand imbalance
- Costly new sources of energy (infrastructure and operating), and
- Increasing pressure on resources from changes in population, development, and lifestyles.

Resolving these issues will take a concerted effort and commitment from the government and the people of Jordan; and each of these issues needs to be addressed in multiple and different ways. One of the least expensive approaches that can be taken immediately, and will be the underlying theme of this presentation, is to reduce population growth.

The Resources for the Awareness of Population Impacts on Development (RAPID) study, including the resulting presentation, is one of the most useful advocacy tools for engaging the support of policy and decision makers, and it was adopted by the Higher Population Council (HPC) to enhance multi-sectorial engagement in addressing the urgent population issue. This document provides an overview of the RAPID study that was developed for the energy sector in Jordan, demonstrating its importance as an advocacy tool, the methodology that was used in its preparation, and the recommendations and conclusions that were provided through the engagement of the national entities, such as the Higher Population Council, the Department of Statistics, and the Ministry of Energy and Mineral Resources. It

utilizes two main Total Fertility Rate (TFR) scenarios, the constant TFR scenario and the reduced TFR scenario, and demonstrates how these two scenarios impact the energy sector differently. It will also illustrate findings from developed projections and assumptions, which were built on the goals and objectives of the Ministry of Energy and Mineral Resources, as well as the main benefits the Government of Jordan (GOJ) can gain from the achievement of the reduced TFR. Finally, this document emphasizes that the most important tool for achieving the target TFR and gaining the associated benefits is family planning.

In 2013, the Health Policy Project (HPP), in collaboration with the HPC and the Ministry of Energy and Mineral Resources (MEMR) and Department of Statistics (DOS), worked on developing the energy RAPID study. The Health Policy Project (HPP) technical team had collected the necessary data from their reliable sources, then used SPECTRUM model to develop population projections, and calculated the indicators through cooperation of MEMR and National Electric Power Company (NEPCO) and using the ministry software (MAED), developed by Jordan Atomic Energy Commission. MAED uses social, economic, and technological factors to predict future energy needs, including future population as the main input. It was agreed to define two TFR scenarios and any related population assumptions, including life expectancy and international migration. Afterward, the HPP discussed requested changes on population projections with HPC, such as TFR, ASFR, sex ratio at birth, life expectancy, model life table and international migration. Specific indicators were chosen based on importance and impact, and the study and presentation were developed based on these indicators, emphasizing the benefits gained by adopting the reduced TFR scenario between the years 2012 and 2035.

In light of the agreed upon scenarios for the TFR, the main results were:

1. Jordan will need about 80,000 GWh in 2035 compared to 67,000 GWh with reduced fertility rate scenario.

2. Electricity production cost will increase 2.2 billion JD in 2012 to 11.5 billion dinars in 2035 if the current total fertility rate remained compared to 9.6 billion JD if the fertility rate was reduced.

3. If the current fertility rate continued, Jordan would spend about 131 billion JD to provide electricity between now and 2035. With reduced fertility, Jordan would spend 12 billion JD less over this time period – spending only 119 billion JD between now and 2035. Over the entire period, about 12 billion JD would be saved as a result of reduced fertility.

4. Cumulative savings in electricity of 12 billion JD, are equivalent to about 55% of the total GDP in 2012; and assuming a 2.7% annual growth in GDP between now and 2035, these savings would represent 29% of GDP in 2035.

5. The estimated total cumulative subsidies paid from public money between 2012 and 2035 would be about 28 million JD if the current fertility continued, compared with 25.4 billion JD if the fertility rate was reduced.

To address the current challenges of the energy sector, the Jordanian government has developed a long -term strategy to secure affordable sources of energy in order to meet the energy needs of the population and development in the future.

The main actions that need to be taken include:

First: diversifying the sources and types of energy, for example, extracting oil from shale reserves, solar and wind power, nuclear power

Second: Jordan needs to utilize local conventional and renewable sources

Third: the energy market must be liberalized and opened for private competition

Fourth: the regional energy grid projects must be reinforced

Finally: consumption in all sectors needs to be rationalized and efficiency must be improved

Reduction in population growth is important to save energy; there are many ways to achieve this and essentially, four major actions that can be taken to help reduce population growth:

> First**,** there needs to be public support of population policies and programs by high-level officials. Not only do these high-level officials decide on policies that affect population growth, but they also send an important message to everyone that reducing population growth is beneficial to everybody and all sectors – it is an essential part of the health and well-being of families and the country.
>
> Second**,** it is critical that all ministries consider population in their plans. This does not mean that the ministries need to merely 'account' for population growth, but they also need to recognize that population growth is variable and can be influenced through their advocacy efforts.
>
> Third, it is essential that adequate funds are provided to implement plans and actions required to reduce population growth.
>
> Finally, governmental and non-governmental organizations and affiliations must be able to work together to bring about the necessary actions required to reduce population growth.

4. Introduction

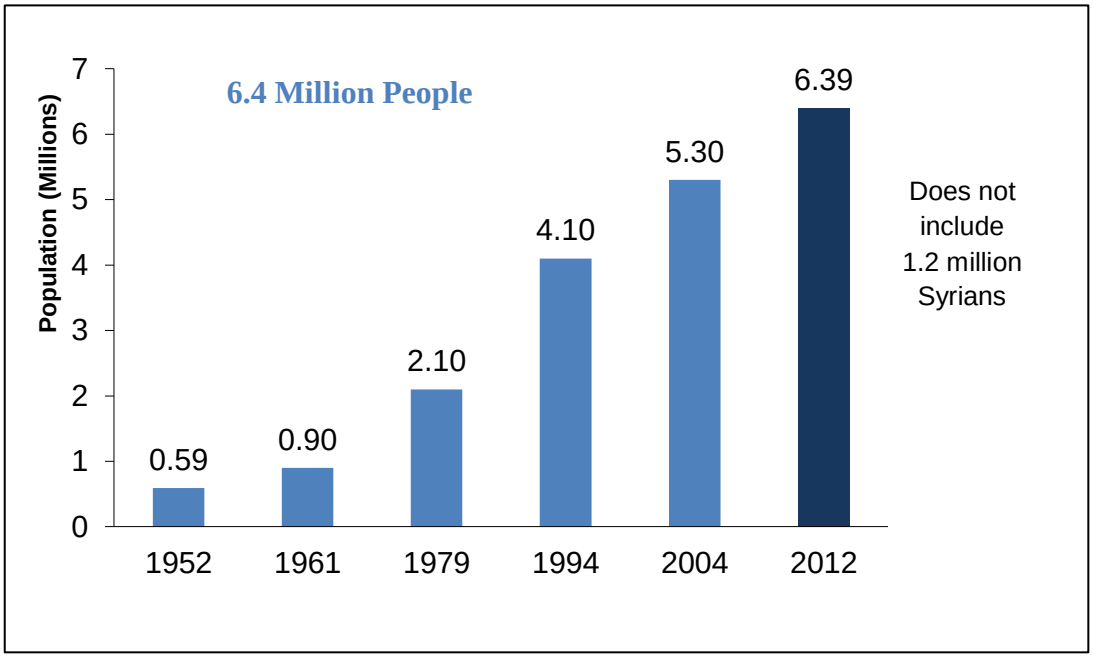
4.1 Summary of Jordan's population characteristics

Jordan is a country with limited resources especially in water and energy. Due to the effect of the rapid growth of the population, there has been an increase in the demand for energy. In response to his Majesty King Abdullah II instructions, the Higher Population Council (HPC) in 2004 exerted great efforts and coordinated with other government and non-government entities to increase policy and decision makers' awareness of the importance of population issues, and the need to develop the necessary strategies and programs to address this issue.

During the last sixty years, Jordan's population has increased dramatically. Upon reviewing the current characteristics of the population in 2012, we found that the population was estimated at 6.4 million, other than the 1.2 million Syrian refugees living in Jordan as per the latest statement of the Prime Minister of Jordan. On the national level, the Jordanian woman gave birth to 3.5 children. The crude birth rate was 27 and crude birth rate was 7 per thousand, and thus the natural increase was 2%, which is attributed to the difference between the crude birth rate and the crude death rate.

According to Jordan's five censuses and the 2012 estimates, the population of Jordan has increased substantially over the last 60 years – increasing more than 10 times between 1952 and 2012 from 0.6 million in 1952 to around 6.4 million in 2012. If the Syrian refugees were added, the 2012 figure increases to 7.6 million (Figure 1).

Figure 1 – Population Growth Trends (1952, 2004 and 2012)

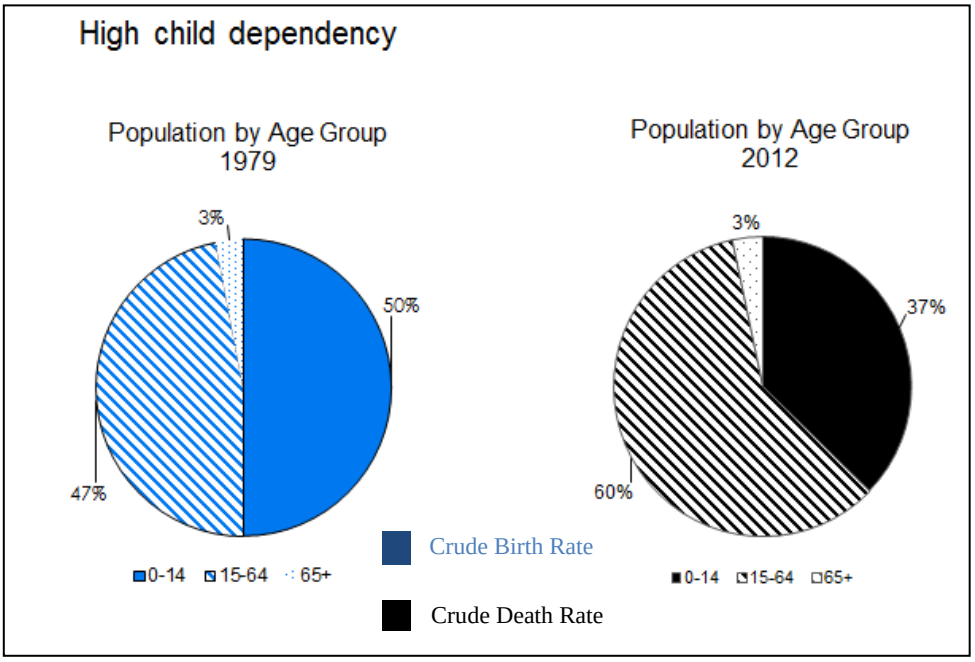


Sources: Jordan Censuses, 2012 DOS Estimates

The population age structure also witnessed changes in the past three decades. The most important feature of this change has been the decline in the proportion of children (individuals under the age of 15 years) as well as the increasing proportion of the working age population group (15-64 years). However, in spite of the change in the population age structure, the Jordanian society is still characterized by its youthful status, where more than one-third (about 37%) are children under the age of fifteen. In fact, even though the proportion of children in Jordan has declined by 13 percentage points over the last thirty years, the total number of children doubled during that time from about 1.1 to 2.4 million.

With the currently high proportion of children, and further rapid population and labor force growth expected – the result would be continued high dependency ratios in the future (Figure 2).

Figure 2- Population Age Structure (1979, 2012)



Source: 1979 Census and 2012 DHS

The Total Fertility Rate (TFR), defined as the average number of births a woman would have during her lifetime if she followed the current age specific fertility rates throughout the course of her reproductive years (15-49), has also historically been high. In 1976, the TFR in Jordan was extremely high at 7.4 births per woman. During the last thirty years, the TFR decreased substantially to 3.7 in 2002, and remained nearly constant afterwards, hovering at 3.8 in 2009. More recently, the TFR has declined to 3.5 as of 2012.

These indicators and others, such as life expectancy, which increased from 68 for males and 71 for females in 2002 to 72 and 74 years in 2012 respectively, indicates a marked enhancement in the health sector in Jordan. However, these improvements also exerted higher pressure on the socio-economic

sectors, due to the subsequent increase in population. This pressure, as well as the plateauing of TFR and the continuous increase in population, has encouraged related entities to enhance efforts and improve programs to decrease TFR and population growth.

4.2 Historical background and Literature review

The Health Policy Initiative (HPI) and the Policy projects, implemented by Futures Group and funded by the United States Agency for International Development (USAID), developed the SPECTRUM module which consists of the DemProj and RAPID applications. These two applications are used in the development of population and socio-economic sector projections.

DemProj is the base module in SPECTRUM. It consists of the main demographic and population data that all projections are built on. It is characterized by ease of use and adaptability to other WINDOWS programs. In DemProj, the user should provide the population by sex for the base year, TFR, ASFR, sex ratio at birth, life expectancy, a model life table, and international migration data. This information, in addition to the base year and projected years, builds the base for the developed population projections, which in turn are used in Energy Sector RAPID.

The indicators in the Energy sector, their costs and the impact of population growth on the demand for energy were calculated and a RAPID presentation was developed. The RAPID study and the developed presentation are important advocacy tools for engaging the support of policy and decision makers in reducing the population growth and its impact on reducing the subsidies provided by the government for energy and the demand for energy. This is achieved through estimating the needs and cost needed to save energy according to the current and the reduced population growth (Current Total Fertility Rate and Reduced Total Fertility Rate)

4.3 Importance of the RAPID study to Jordan

The RAPID study is important for many reasons, including:

1. Jordan has limited natural resources and faces a high population growth rate. This puts more pressure on national entities to provide high quality services and products to the growing population. The study shows the effect of population growth on the development sectors in a clear manner that enables policy makers to understand their role in this issue and meeting the water and energy demands.
2. The study is intended to be presented to decision and policy makers in the country. Accordingly, it addresses the issues that these officials are interested in and demonstrates the impact population growth will have on those issues, encouraging them to consider the necessary actions.
3. The study has been used in many other countries that faced the same issues as Jordan, and played a major role in shifting and changing their policies.
4. The study advocates for a multi-sectorial approach to address population issues, reducing the pressure of addressing this issue by one ministry. Engaging all development sectors in Jordan helps create the commitment required to bring about policy change.

5. Finally, this study provides decision makers direct and clear recommendations and required actions to mitigate the challenges associated with population growth, providing decision-makers the option to adopt one or more suitable actions for application.

4.4 Why the energy sector was chosen to develop the RAPID Study

The RAPID Study is a vital tool for gaining the support of decision and policy makers of various vital sectors. As mentioned earlier, natural resources are rare in Jordan which has made the demand for energy one of the important issues that need to be studied side by side with the economic and social needs of the population. Because of this, HPC and HPP decided that it is important to intensify efforts toward gaining the support of MEMR for population issues, such that the MEMR will incorporate population factors in its plans. Galvanizing this support can be achieved with the help of the RAPID study, which acts as a strong advocacy tool for FP/RH by addressing the energy sector specifically. The growth in population increases the demand for energy including electricity, the high costs of producing it and the subsidies provided by the government to cover their needs for energy and electricity for household use, heating and cooling will affect the amount of financial resources needed to support other services such as education, health and others, and hence, the GOJ must find a sustainable way to provide the energy to meet this growing demand.

5. Methodology

5.1 Identify the most important variables in energy

Energy is one of the foundations of civilized societies and is needed by all sectors as it is used in factories, transportation, heating, cooling and domestic purposes.

Energy is available in several different forms confined to four main levels:

1 - **Kinetic Energy:** the energy produced by the fast random movement of particles

2 - **Potential Energy**: the energy possessed by a body by virtue of its position relative to others, stresses within itself, electric charge, and other factors

3 - **Electric Energy**: it a natural energy that could be obtained in several ways, including lightning or friction, but can be generated by a chemical reaction in the batteries or converting thermal energy into electricity.

4 - **Nuclear Energy** the energy released during nuclear fission or fusion, esp. when used to generate electricity.

A discussion was conducted with representatives from the MEMR and the National Electric Power Company to identify the most important variables that must be included and addressed in the study that is directly related to population growth, which is the focus of RAPID study. It was agreed to address energy consumption, cost and government subsidies. The two main criteria to select the appropriate variables were the availability of needed information to calculate the indicator and extent it is influenced by population growth.

5.2 Data collection

Energy plays an important role in all economic and social development plans. Despite the efforts of statistical departments and energy enterprises around the world, some of the data available do not meet the standard requirements, which do not help in developing national plans, especially in light of global trends to achieve social development and environmental preservation.

The HPP in cooperation with HPC had made sure that the base for the energy sector RAPID is accurate and up-to-date data, collected from reliable sources, with the year 2012 as the baseline. The technical team worked on collecting the population and energy data from relevant sources such as MEMR.

This study is divided into five parts:

First: Population characteristics and recent demographic trends.

Second: Population projections under two different growth scenarios.

Third: The current energy status in Jordan.

Fourth: The impact of population growth on future demand for energy.

Finally: Actions that can be taken to address the consequences of population growth on energy.

In addition to direct contact with the ministries and entities, the team continuously reviewed the studies, surveys, reports and official websites that provided the required data. The team kept an accurate record of the gathered data, and ensured the main sources were identified.

5.3 Defining TFR scenarios and population assumptions

The first step in developing a RAPID study is to define the alternative fertility scenarios. Best practices in countries show that it is most effective to identify two or three scenarios. Using many scenarios may distract the decision maker from the main objective of decreasing the Total Fertility Rate (TFR). The team decided to use two scenarios; one showing what would happen if fertility continued at its current levels and the second showing the impact of reduced fertility consistent with the goals of the National Agenda. For example, the National Agenda and the Demographic Opportunity Document projected the objective of decreasing the TFR to 3.0 children per woman in 2017 and 2.1 children per woman by the year 2030.

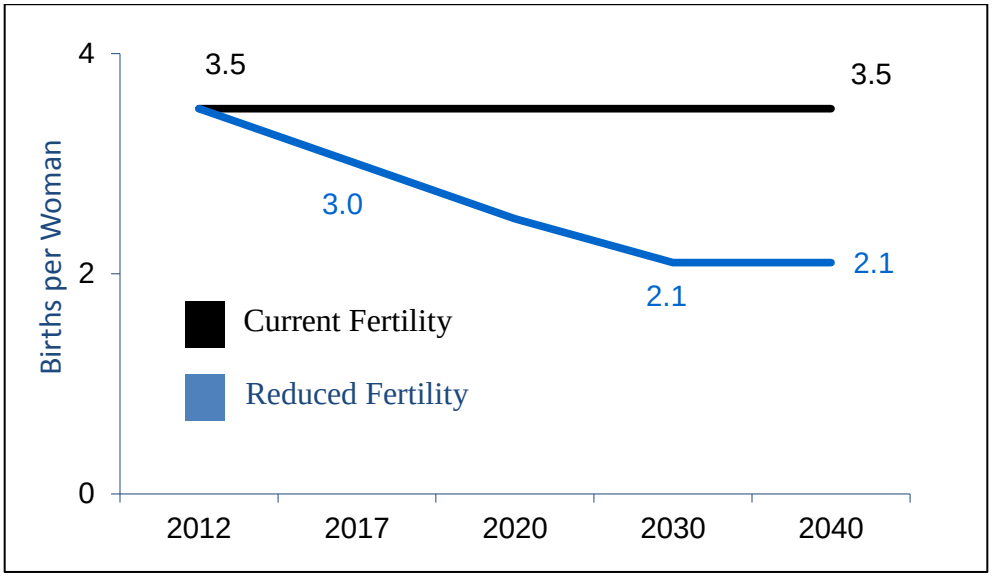
The second step is to define the TFR milestones. These are usually found at the national level and in accepted policies (as mentioned earlier). The user of the RAPID module enters the baseline and milestone information for these scenarios into the SPECTRUM model and interpolates between them in order to define the projected TFR for all the years of the projection.

The RAPID presentation prepared two future scenarios based on alternative TFR assumptions:

Scenario 1 - The TFR remains constant at its current level in 2012
Scenario 2 – The TFR declines to reflect the goals of the National Agenda

According to the first scenario, the TFR remains constant at its current rate at 3.5 children per woman. Under the second scenario, the TFR is reduced from 3.5 children per woman in the base year (2012) to reach 3.0 in 2017 and 2.1 in 2030 according to the above mentioned documents. Afterwards, the TFR remains constant (Figure 3).

Figure 3 – Total Fertility Rate (TFR) Scenarios



Source: The National Agenda, the Demographic Opportunity Document, and the Energy RAPID Technical Team

In addition to defining the scenarios and TFR assumptions, the team decided, in collaboration with the DOS, on the other population assumptions:

1- Life expectancy for males and females
Total life expectancy was projected to increase to 75 years in 2017 and remain constant afterwards. These assumptions were based on the data and studies received from DOS

2- Net migration
The team decided to estimate the net migration to be zero. The lack of accurate and up-to-date data was the main reason for this definition.

5.4 Population projections :

On initiating the population projections, the RAPID module requires the identification of the base year, and the last year of projection. For best results, the span of these two years should not exceed 50 years. Longer projection periods of time tend to dilute the relevant effectiveness of the findings, as policy makers are oftentimes more concerned with short-term, rather than long-term impacts.

Once the base year is identified, the user of the module enters population information based on:

1- Sex (male and female)
2- Five years age groups (0-4, 5-9, 10-14,…, 65+)

These data are taken from the latest DOS studies and surveys. In addition, the user enters the following information:

1- The TFR (based on the defined scenarios)
2- The ASFR (Age Specific Fertility Rate) – in this section the user can choose between manual entry of data or one of the model tables most suitable to the situation in Jordan. Based on the data received from HPC and DOS, the energy RAPID was built on the UN Average model table.
3- Sex ratio at birth – this identifies the number of male births per 100 female births. Based on the data received from DOS, sex ratio at birth was identified as 105.
4- Life expectancy – this is identified as the average number of years a newborn can expect to live based on mortality conditions at the base year. This is identified for both males and females, and has been increasing in Jordan due to the enhancement of the health sector. Based on the data from DOS, males in Jordan are expected to live for 72 years, and females for 74 years. As mentioned earlier, the technical team and DOS projected total life expectancy to increase to 75 in 2017, and to remain constant afterwards.
5- Model life table – these tables relate to the survivorship of the population in a country over a period of time. The RAPID module identifies 10 model life tables to choose from. The technical team identified Coale-Demeny East life table as the most appropriate for Jordan.
6- International migration – as mentioned earlier, international migration was identified at zero due to the lack of accurate and up-to-date data.

These data, in addition to the population information for the base year, are the main data to enter in the DemProj module, which calculates the population projections for the defined period of time (2012 – 2040) for the Jordan Energy RAPID.

Based on the above, the population projections for Jordan were calculated for the years 2012 – 2040 according to the constant and declining TFR scenarios on a 1 year and 5 year basis.

5.5 Defining energy sector assumptions

The next step in developing the RAPID study was to identify the assumptions used in the energy sector.

With MEMR representatives, the assumptions which the estimates were based on were defined as the following:

- The needs were estimated using the program applied by the ministry after entering the population factor using HPP data and in cooperation with HPC.
- Total cost of one KwH is 189 fils, and for end consumer 73 fils KwH; assuming that the percentage of household consumption from the national electricity consumption is (35%).
- Production of a thousand GwH costs Jordan 143678 JD.

5.6 Identifying important variables and calculating projections

The team identified the necessary indicators for the energy sector based on their relation to population growth and the influence they have on decision makers. The data were collected for each of these indicators and the formulas that were needed to calculate the projections were entered into the excel sheets (attached CD).

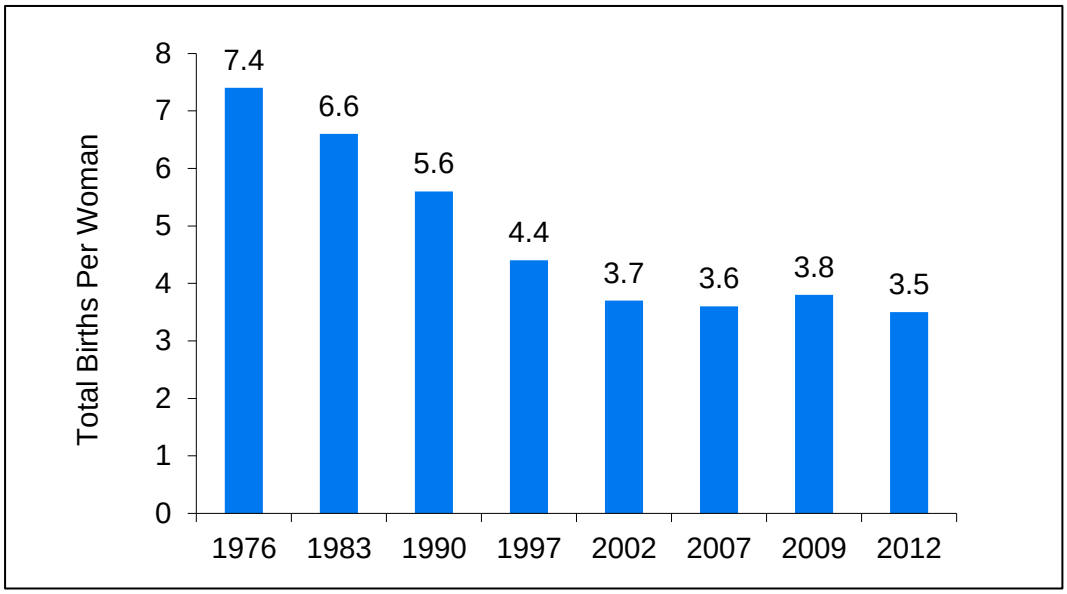
Once these indicators were calculated, only indicators with the most importance and impact were chosen for inclusion in the final RAPID study.

6. Results

6.1 Population Characteristics

In this section, the main population characteristics of Jordan are provided, including the base year population (2012), crude birth rate, crude death rate, the rate of natural increase, and the life expectancy for males and females. In addition, the figures show the trend in population growth, and crude birth and death rates, as well as the rate of natural increase during the last fifty years. Also illustrated are the national level changes in TFR since 1976, a decrease from 7.4 children per woman to 3.5 in 2012 (Figure 4),

Figure 4 – Total Fertility Rate (TFR) Trends



Source: DOS, Jordan Demographic and Health Surveys

The data for this section have been gathered from Jordan censuses; the Jordan Population and Family Health Surveys; DOS estimates, studies and reports; the Demographic Opportunity document; and the projections developed by HPP.

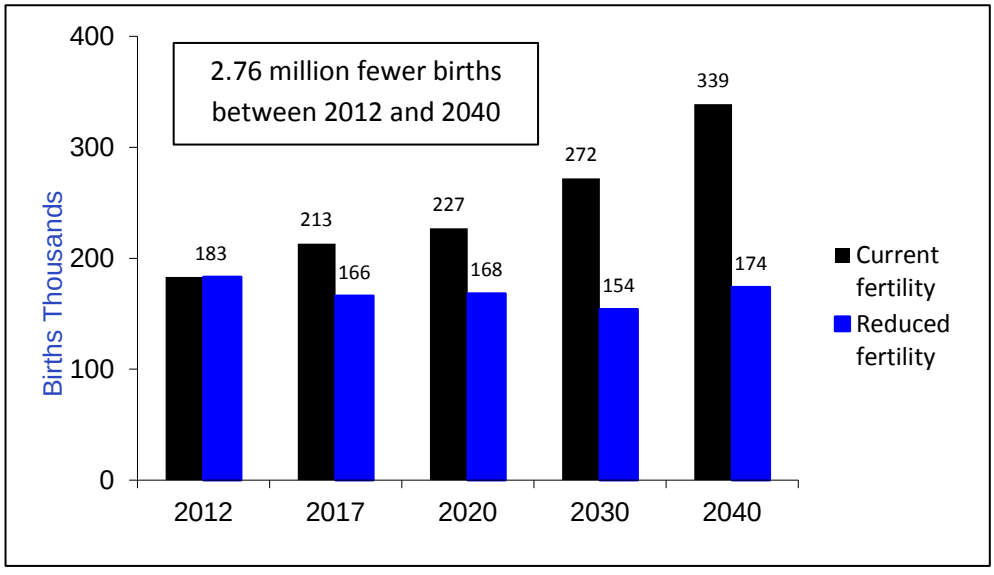
6.2 Population Projections

This section identified the main scenarios that were to be used throughout the study to illustrate the effect of population on the energy sector in Jordan. The team decided to use two scenarios as mentioned earlier:

- Constant TFR scenario
- Declining TFR scenario

The section defined the details for each scenario and how they were differentiated in the study. The team decided to use the color black for the first scenario, while blue was used for the second. In addition, the section defined all other population assumptions that were used. The next step was to show the change in the projected annual births and population under the two scenarios. The calculated projections demonstrated that constant TFR does not necessarily mean a constant number of annual births, due to the youthful Jordanian age structure and the large number of women in their reproductive years (15-64). As such, even if fertility remained constant, the annual number of births would still increase, as progressively larger cohorts of females reach reproductive age. In 2012, there were approximately 183 thousand births in Jordan. The projections showed that under the constant TFR scenario, the annual number of births would increase during the next thirty years to 339 thousand by 2040. However, under the reduced TFR the annual number of births would decrease to 174 thousand by 2040 (Figure 5). Overtime, this is equivalent to a difference of 2.76 million fewer births between 2012 and 2040.

Figure 5 – Annual Births (2009-2040)

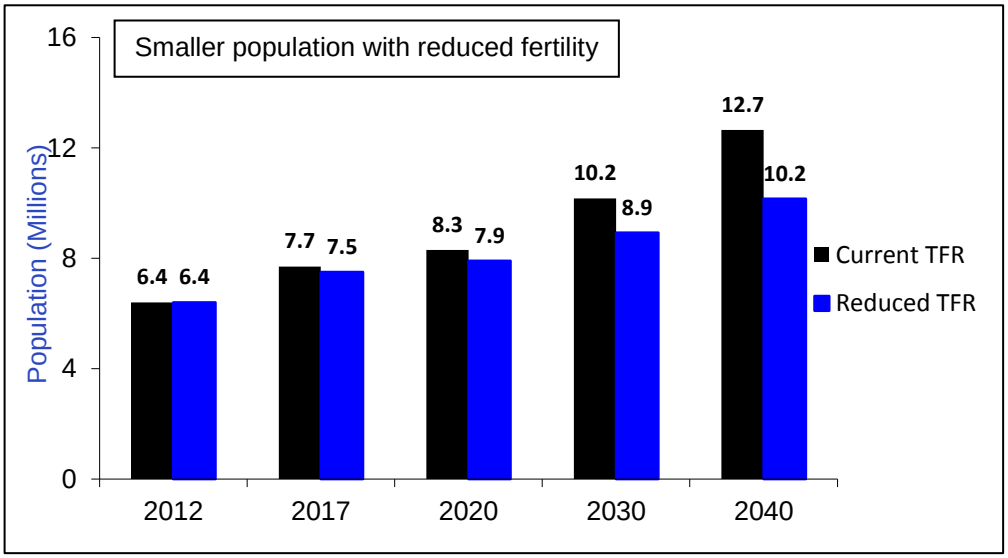


Source: DOS Data and Projections, 2011

Population growth is directly affected by the annual number of births. In 2012, Jordan's population stood at about 6.4 million. If the constant fertility continued and TFR did not decrease, the population

projections predicted a substantial increase in the total population, reaching 10.5 million in 2030, and more than doubling to 13.2 million by 2040. Even under the reduced TFR scenario, the population would continue to grow, although at a slower rate, increasing to 9.3 million in 2030 and 10.15 million by 2040 (Figure 6).

Figure 6 – Total Population Growth (2012-2040)



Source: DOS Data and Projections, 2011

The team ensured that for the presentation, each slide contained the source of the data and the assumptions used in calculating the projections as a footnote.

6.3 Energy Status

In Jordan, energy is considered very challenging as it lacks domestic resources and relies heavily on imports. Jordan relatively needs large amounts of energy to meet its economic and social growth. Data indicate an increase in the annual demand for energy at a rate that reaches 3%, and 6% for electricity .

Natural gas is used in electrical power generation, and that reduces the value of the crude oil bill and thus contributes in reducing the budget deficit resulting from subsidies for petroleum products. Methane gas, which is used in electrical power generation, accounts for 91% of natural gas, while Aldoxan carbonate and nitrogen account for 8.3% and 0.5%, respectively, and the rest is composed of propane and ethane.

Primary energy is the energy that has not been subjected to any change or transformation, such as crude oil, natural gas, coal, etc. Total primary energy consumption has increased in the past few years as a result of population increase and economic growth. Jordan does not produce crude oil and natural

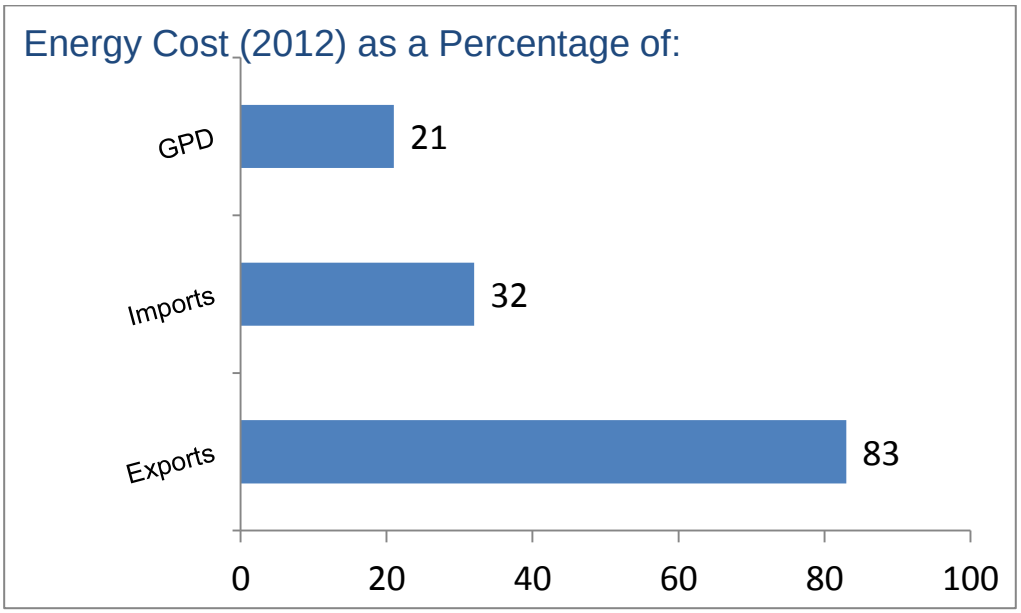
gas in commercial quantities as it is relatively low compared to neighboring countries. Jordan has worked over the past years on oil exploration in different areas.

Around two fifths of the petroleum currently consumed in Jordan is diesel, mainly for transportation and heating. Fuel oil and gasoline rank second (28%) and third (18%) respectively among the petroleum products consumed in Jordan. Around two fifths of the energy currently consumed in Jordan is used by the transport sector. Household consumption of energy ranks second (23%). Industry and services accounts for 20% and 16% respectively.

Jordan is heavily dependent on imported energy sources, which consist of crude oil and its products, where these sources constitute 95% of commercial energy consumed in Jordan. The cost of imported fuel is considered to be a great burden on the Jordanian economy, as the steady rise in global oil prices has led to the increased amount of the oil bill, leading to an increased burden on the budget through the subsidies offered on the petroleum products.

Energy is extremely expensive in Jordan, and 97% of all energy used in Jordan is imported. Energy costs are equivalent to nearly 21% of the total annual GDP; energy costs are equivalent to 32% of the value of all annual imports; and are equivalent to the value of 83% of all exports (Figure 7). As the population grows, so will the consumption of energy, and consequently, the expenses to provide the amount of energy required in the future.

Figure 7: Energy cost as percentage of GPD, imports and exports

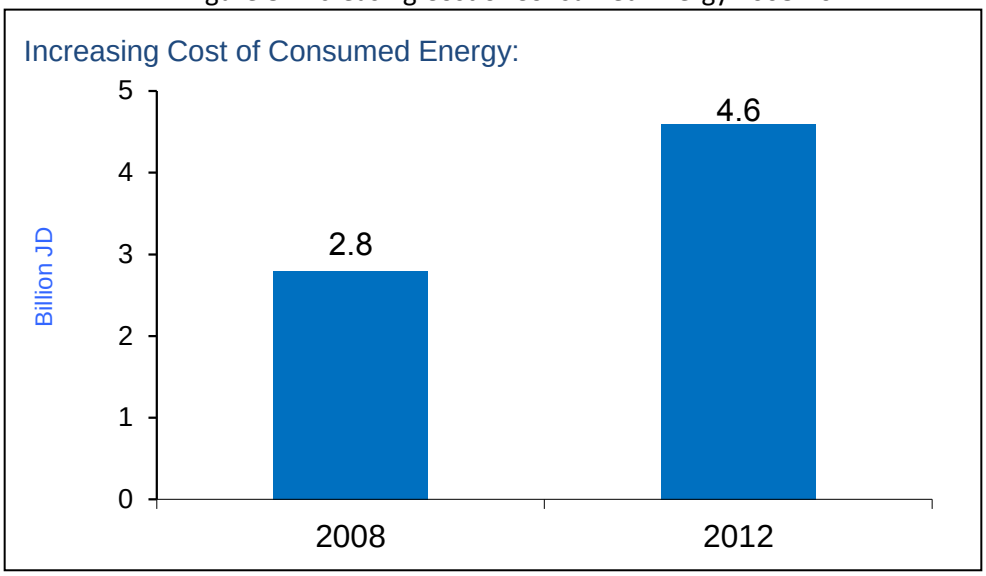


Source: MEMR, Energy 2012 – Facts and Figures

Most of energy consumed in Jordan comes from petroleum products and, with the escalation of petroleum prices and the Egyptian oil crisis in recent years, the cost of energy has increased

significantly. Between 2008 and 2012, the cost of energy rose by 45% - increasing from 2.8 billion JD to 4.6 billion (Figure 8).

Figure 8: Increasing Cost of Consumed Energy 2008-2012

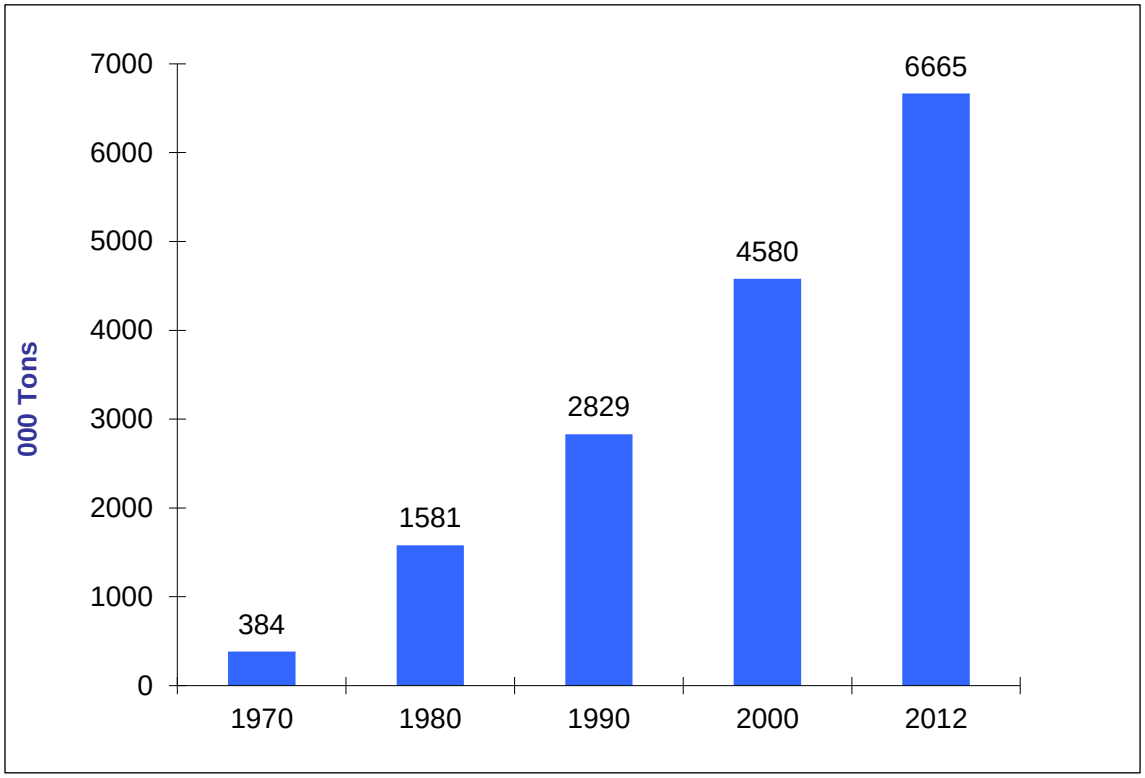


Source: MEMR, Energy 2013 – Facts and Figures

Petroleum - today's major source of energy - is one of Jordan's most scarce natural resources. Petroleum is necessary for transport, electricity, food production, household consumption, tourism and industrial uses. In 2011 crude oil and products and natural gas accounted for 94% of energy consumed in Jordan.

As a result of increased demand, caused in large part by the population growth, the need for petroleum has increased over the past four decades. According to Jordan's MEMR data "Energy 2012 – Facts and Figures", petroleum consumption has increased drastically over the past 40 years – increasing from 384 thousand tons in 1970 to 4.6 million tons in 2000 and to nearly 6.7 million tons in 2012 (Figure 9). This problem will worsen in the future because of population growth and the high price of oil.

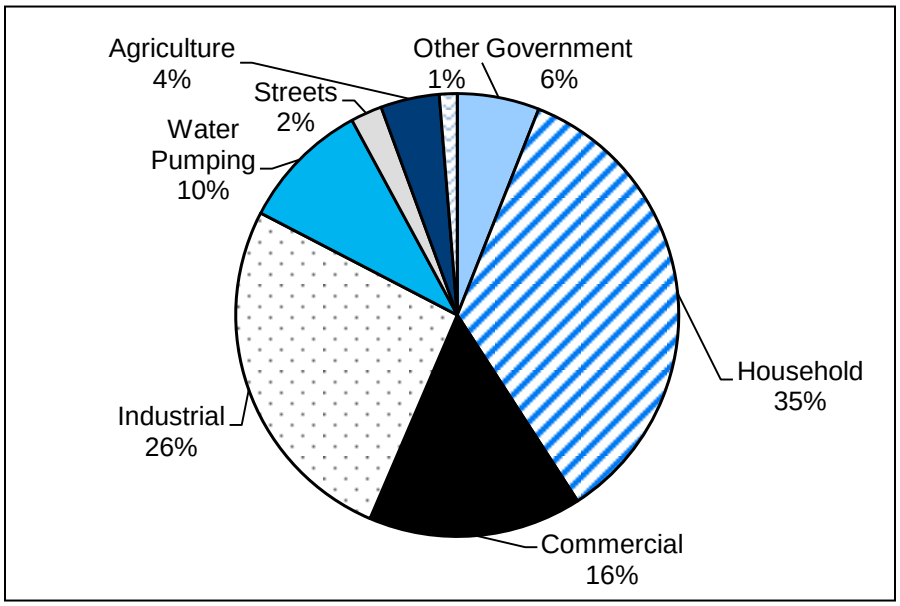
Figure 9: Petroleum Products Consumption 1970-2012



Source: MEMR 2013, Facts and Numbers

Electricity is the energy generated as a result of transfer of electrons from the one end of the connector to the other., This generates an electric current that moves in the opposite direction of the movement of electrons which creates a difference in voltage between the ends of the connector. Other than locally produced electricity, Jordan imports electricity from Egypt and Syria to meet its needs. In the past three decades, the Arab world have witnessed great advancements in the electricity sector in order to keep pace with rising electricity consumption by about twenty-fold . Electricity is a major end use of energy that is highly linked to population growth and size. As a result of the population increase in Jordan, as well as economic growth, consumption increases year after year.

Figure 10: Electricity Consumption by Sector 2011



Source: MEMR, Energy 2012 – Facts and Figures

Currently, 35% of electricity is consumed by households. Industrial and commercial uses account for 26% and 16% respectively of electricity consumed. Together, these three sectors account for 77% of the total electricity consumed (Figure 10).

5.4 Population Growth Impacts on Energy

Estimates of consumed quantities of energy are one of the major concerns of the decision-makers due to its impact on economic growth and many other aspects. Energy is one of the poles of the social and economic development. According to the economic reform program, which was approved by the government and achieved its objectives during the first years of its application, targeted values were defined for all economic and service sectors. While taking into account the economic growth rates projected for the coming period, estimates were generated for the future demand for energy.

As mentioned previously, population growth has a direct impact on the energy sector in Jordan by increasing the demand. For the following projections, we are using the Ministry of Energy and Mineral Resources' MAED software. This software, created by the IAEC, uses multiple social, economic and technological driving factors to create its forecasts. It is used by the ministry for forecasting future country energy needs, and includes population size as one of the inputs to the model.

In 2011, the Ministry estimated that about 7,500 TOE (Ton of Energy) of primary energy were consumed in Jordan. Holding all other variables used in the model constant between scenarios in the future, the amount of primary energy consumed with if the current fertility rate continued would increase from 7,700 TOE in 2012 to about 18,300 TOE by 2035. With reduced fertility rate, the amount of primary energy required in 2035 would be about 17,300 TOE, or 6% less. Assuming that the cost of one TOE was

equivalent to today's cost of about 540 thousand JD, the amount saved in 2035 alone would be approximately 540 million JD.

Including the Syrian population into the projections increases the amount of primary energy required in the future as well. With the Syrian population included, the total amount of primary energy consumed in 2035 is projected to be 19,100 TOE under the current fertility rate scenario and 18,000 TOE under the reduced fertility rate scenario.

The most important indicators for the study:

Indicator 1 - Total Electricity Consumption:

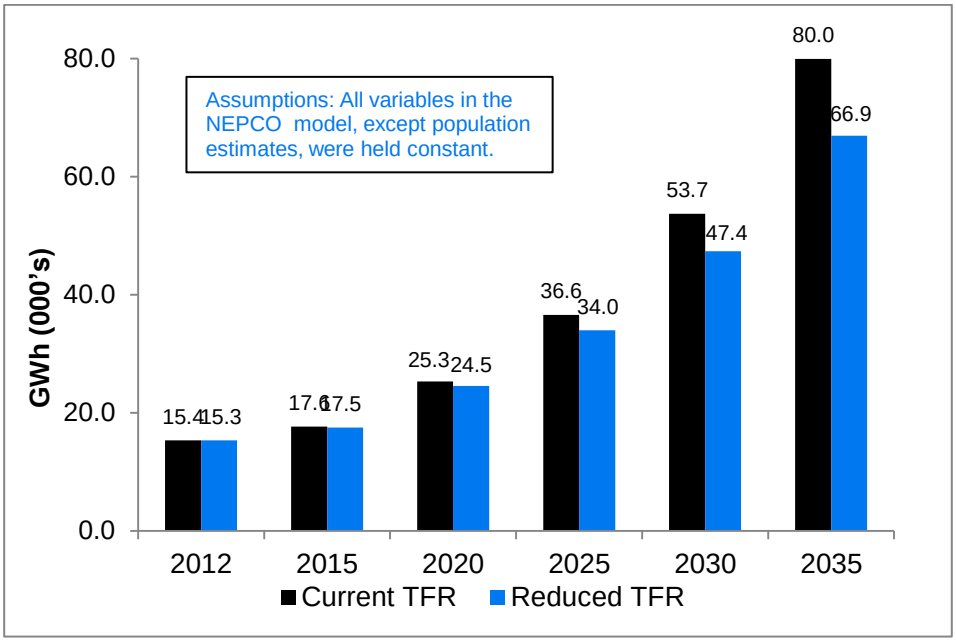
In Jordan, the electricity generation industry started in 1937, and in 1996 the electricity sector was restructured and represented by three separate companies, which are:

1) National Electric Power Company (NEPCO): responsible for transmission and power control activities.
2) Central Electricity Generation Company (CEGCO): responsible for electricity generation stations.
3) Electricity Distribution Company (EDCO): responsible for distributing electricity.

In addition to two other companies, which are Jordan Electric Power Company (JEPCO) and Irbid District Distribution Company (IDECO). Electricity generation is one of the major uses of primary energy, and is more closely related to the size of the population than primary energy. To estimate future electricity consumption, we used the National Electric Power Company's (NEPCO) model, which takes into account all factors that affect demand on electricity, including population.

In 2012, NEPCO estimated that about 15,400 GWH of electricity were consumed in Jordan. As mentioned before, we held all other variables used in the model constant to isolate the impact of population growth on future electricity consumption. Under the scenario of constant fertility rate, the amount of electricity consumed would increase to 80,000 GWH by 2035. In contrast, under reduced fertility rate, the amount of primary energy required in 2035 would be about 67,000 GWH, or 16% less (Figure 11).

Figure 11 – Total Electricity Consumption

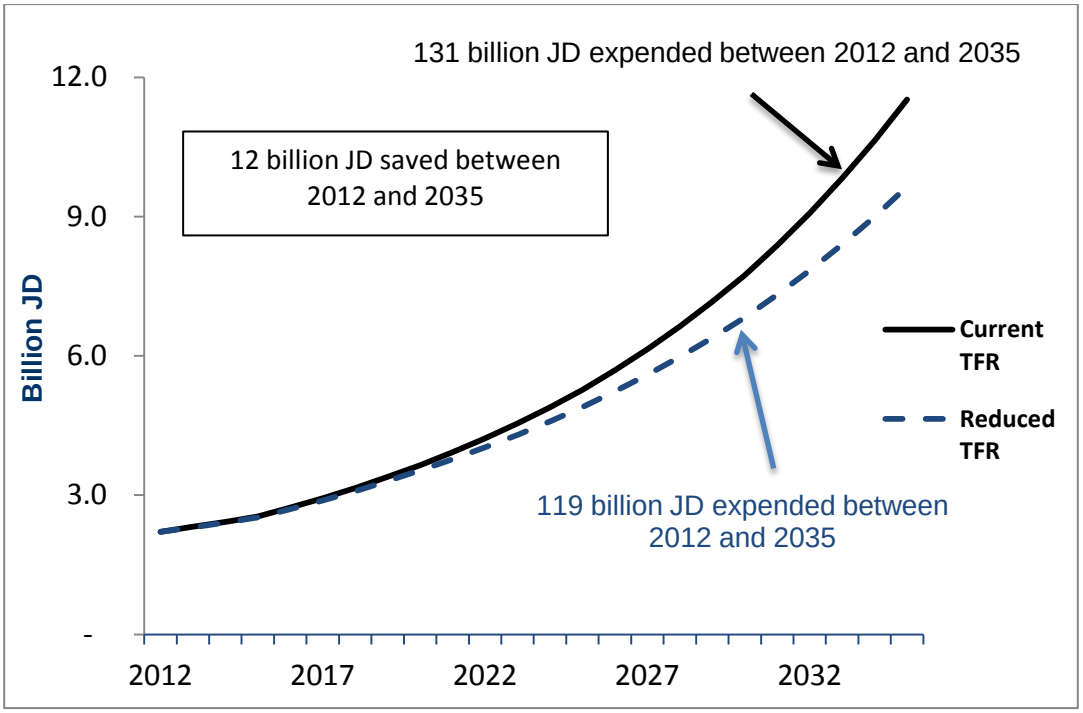


Source: MEMR, Energy 2012 – Facts and Figures and NEPCO 2013-2035 Forecasts

Indicator 2- Costs of Electricity:

The costs to provide electricity to meet future requirements would increase commensurately with demand. With each GWH costing about 144,000 JD to produce, the total cost to provide electricity would rise from about 2.2 billion JD in 2012 to 11.5 billion JD in 2035 if the current fertility rate continued; to 9.6 billion JD in 2035 under reduced fertility rate (Figure 12).

Figure 12 – Cost of Electricity 2012-2035

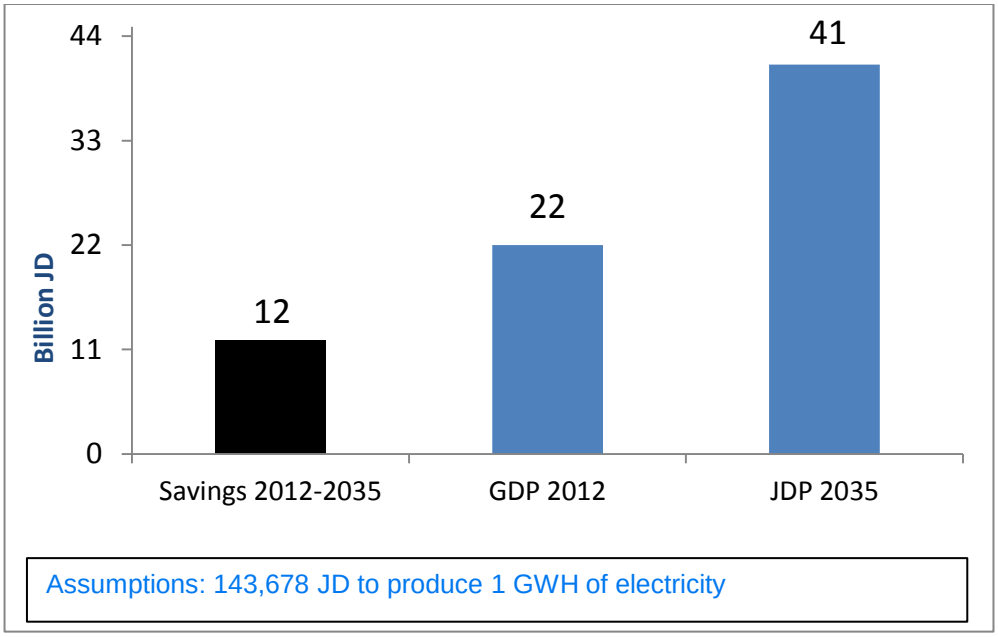


Source: MEMR, Energy 2012 – Facts and Figures and NEPCO 2013-2035 Forecasts; Agency for regulating the electricity sector, Annual Report 2011, p. 32

Indicator 3- Cumulative Costs of Electricity:

The third indicator is the cumulative costs of electricity in comparison with the GDP. This indicator is measured up by calculating the amount of savings between the two TFR scenarios to determine savings through reducing the fertility rate and reaching targeted value. As presented in Figure 13, the cumulative savings in electricity, of 12 billion JD, is equivalent to about 55% of the total GDP in 2012; and assuming a 2.7% annual growth in GDP between now and 2035, these savings would represent 29% of GDP in 2035.

Figure 13: Cumulative Electricity Savings vs. Annual GDP

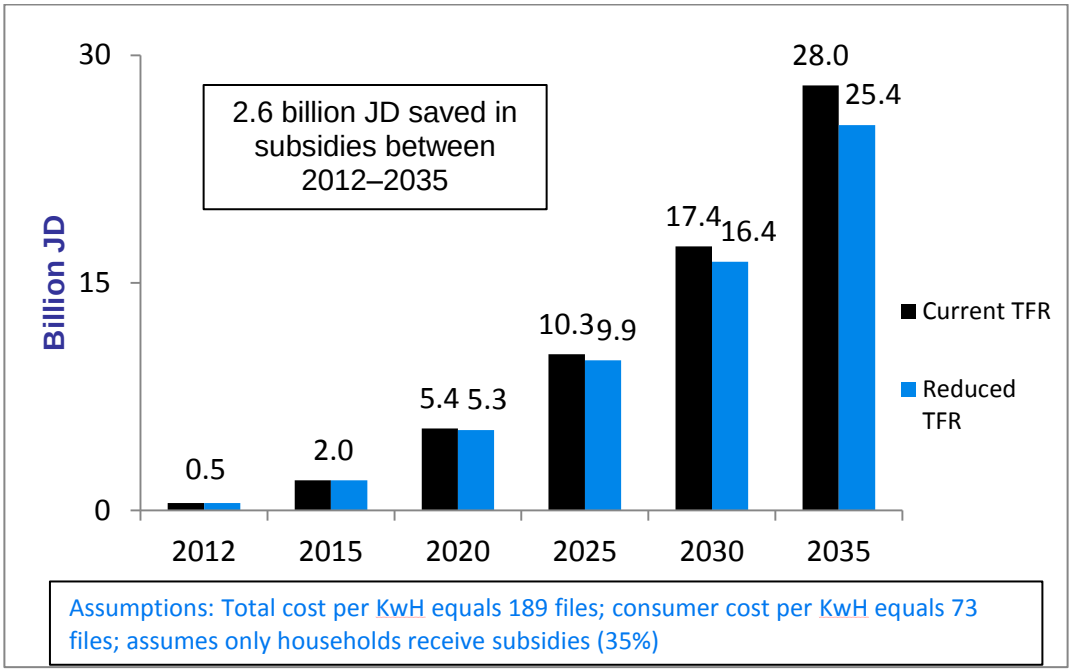


Source: MEMR, Energy 2012 – Facts and Figures and NEPCO 2013-2035 Forecasts; Agency for regulating the electricity sector, Annual Report 2011, p. 32

Indicator 4- Cumulative Subsidies for Electricity

The cost of imported fuel is considered to be a great burden on the Jordanian economy, as the steady rise in global oil prices has led to an increase of the oil bill, leading to an increased burden on the budget through the subsidies offered on the petroleum products. Based on the current cost of 189 files per KwH, and the average price paid by the consumer of 73 files per KwH, the estimated total cumulative subsidies paid from public money between 2012 and 2035 would be about 28 million JD if the current fertility rate continued, as compared to 25.4 billion JD with reduced fertility rate. The overall savings in electricity subsidies over the entire period would be about 2.6 billion JD.

Figure 14: Estimated electricity subsidies 2012–2035



Source: MEMR, Energy 2012 – Facts and Figures and NEPCO 2013–2035 Forecasts; Agency for Regulating the Electricity Sector, Annual Report 2011

7. Conclusions and Recommendations

Main results:

In light of the agreed upon scenarios for the TFR, the main results were:

1. Jordan will need to 80,000 GWh in 2035 compared to 67,000 GWh with reduced fertility rate scenario.

2. Electricity production cost will increase from 2.2 billion JD in 2012 to 11.5 billion dinars in 2035 if the current total fertility rate remained compared to 9.6 billion JD in the reduced total fertility rate.

3. If current fertility rate continued, Jordan would spend about 131 billion JD to provide electricity between 2012 and 2035. With a reduced fertility rate, Jordan would spend 12 billion JD less over this time period – spending only 119 billion JD between 2012 and 2035. Over the entire period, about 12 billion JD would be saved as a result of a reduced fertility rate.

4. In the reduced fertility rate scenario cumulative savings in electricity of 12 billion JD, would be equivalent to about 55% of the total GDP in 2012; and assuming a 2.7% annual growth in GDP between 2012 and 2035, this savings would represent 29% of GDP in 2035 .

5. The estimated total cumulative subsidies paid from public money between 2012 and 2035 would be about 28 million JD if the current fertility rate continued, as compared to 25.4 billion JD with reduced fertility rate.

Recommendations:

To address the energy challenges that are currently facing Jordan, the Government of Jordan has developed a long-term strategy to secure affordable sources of energy that can meet future population and development needs. The main actions that need to be taken include:

First: the sources and kinds of energy need to be diversified, for example, extracting oil from shale reserves, solar and wind power, nuclear power

Second: Jordan needs to utilize local conventional and renewable sources

Third: the energy market must be liberalized and opened for private competition

Fourth: the regional energy grid projects must be reinforced

Finally: consumption in all sectors needs to be rationalized and efficiency must be improved

Reduction in population is important in energy savings, there are many ways to achieve this and essentially, we have identified four major actions that can be taken to help reduce Fertility Rate and decrease population growth.

- **First,** there needs to be public support for population policies and programs by high-level officials. Not only do these high-level officials decide on policies that affect population growth, but they also send an important message to everyone that reducing population growth is beneficial to everybody and all sectors – it is an essential part of the health and well-being of families and the country.
- **Second,** it is critical that all ministries consider population in their plans. This does not mean that the ministries need to merely 'account' for population growth, but they also need to recognize that population growth is variable and can be influenced through their advocacy efforts.
- **Third**, it is essential that adequate funds are provided to implement plans and actions required to reduce population growth.
- **Finally**, governmental and non-governmental organizations and affiliations must be able to work together to bring about the necessary actions required to reduce population growth.

Family planning is one of the ways that can directly affect population growth, which in turn will affect the future demand for energy and the ability of Jordan to provide sufficient energy resources for its citizens. Providing high quality family planning services, counseling and contraceptives and can all affect the use of family planning methods but all this requires financial resources. It is critical that sufficient funds are provided to support these efforts.

Promoting sustainable population growth will not eliminate all energy issues facing the country, but it is a necessary step that needs to be taken in combination with many others if Jordan is to successfully resolve its pressing energy situation.

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