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EGYPT

EXECUTIVE SUMMARY

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Observatoire Méditerranéen de l'Energie

OBSERVATOIRE MEDITERRANEEN DE L'ENERGIE

105, rue des Trois Fontanot
92000 Nanterre, France
Tel : +33 (0)1 70 16 91 20
Fax: +33 (0)1 70 16 91 19
ome@ome.org
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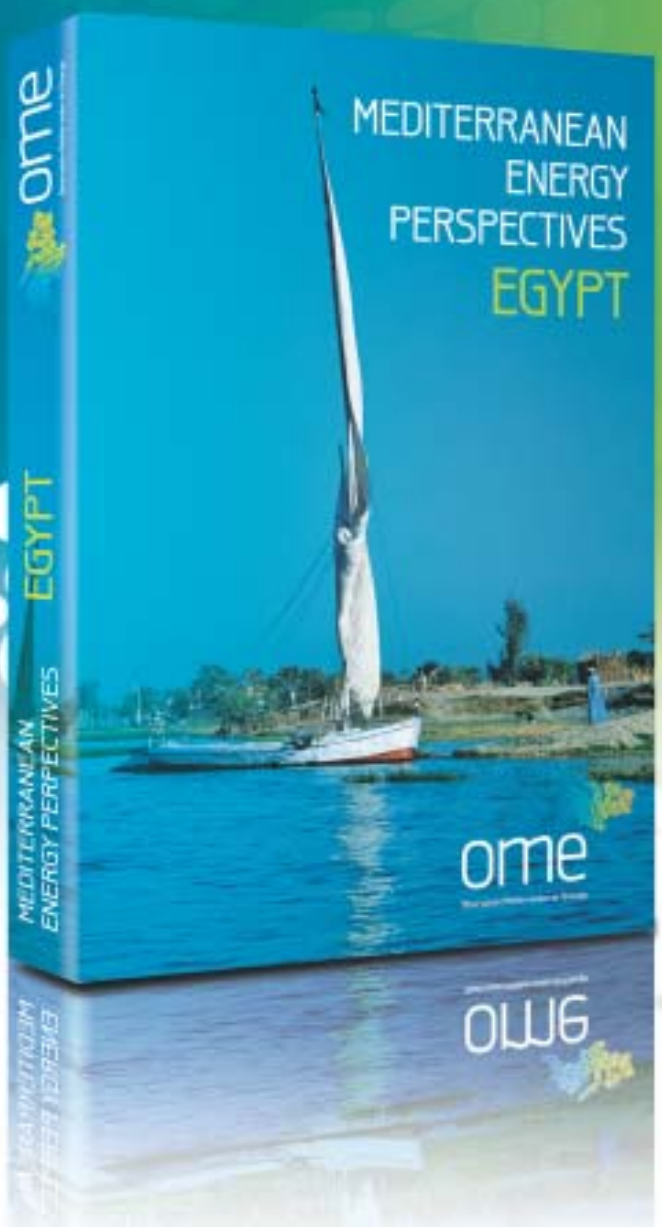

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EXECUTIVE SUMMARY

At the start of the second decade of the 21st century, Egypt faces a number of challenges and constraints to be able to supply affordable energy to its people and to sustain rapid economic growth. Its economy is diversified with a significant energy sector, growing industry and service sectors and projected robust growth of 4% to 5.6% per year for the next two decades. Egypt has the largest population in the Mediterranean region for which living standards and human development indicators have improved and are expected to continue to do so. Today there is an extensive system of social subsidies. Egypt needs large investments in the energy sector to meet the expected growth in energy demand. Private financing will be necessary, which calls for continuing reforms to its energy markets.

This study was conducted prior and finalized during the geopolitical unrest which shook Egypt and the Arab countries and which incurred important political changes in Egypt in early 2011. Energy forecasts presented in this study were made prior to these developments. However, while short-term dynamics in the energy sector may be uncertain, we believe that they will not have a radical impact on the long-term energy trends presented in this study.

EGYPT IS THE FIRST IN-DEPTH COUNTRY REVIEW IN OME'S MEDITERRANEAN ENERGY PERSPECTIVE SERIES

This in-depth study provides insights into Egypt's energy profile from the early 20th century to the current situation and the outlook for the next two decades. *Mediterranean Energy Perspectives: Egypt* presents detailed analysis and data on the supply and demand balance for the major components of the energy sector with particular focus on oil and natural gas from reserves to markets and the emerging developments in non-hydro renewable energy sources. It draws upon the extensive expertise of the Observatoire Méditerranéen de l'Energie (OME) and its members. It has been prepared by a joint-team of Egyptian energy industry, institutions, experts and OME's technical staff to provide an important reference for industry analysts and investors who wish to get a complete picture and a full understanding of the energy industry and market in Egypt, the way they operate and their long-term perspectives.

The outlook to 2030 presents two OME scenarios and a high economic growth case with two variants, based on official economic forecasts from Egypt. The two OME outlooks are the *Conservative Scenario* and the *Proactive Scenario* based on OME's Mediterranean Energy Model:

– The *Conservative Scenario* considers past trends, policies in force and ongoing projects, but takes a cautious approach regarding the implementation of policy measures and planned projects.

– The *Proactive Scenario* assumes effective achievements to radically improve efficiency in energy production and end-use applications and a more diversified energy supply mix including increased nuclear and much more renewable energy.

The High Economic Growth scenarios based on the economic forecasts of the Egypt Ministry of Economic Development have two variants:

– The *High Economic Growth Scenario* (HEG) is based on high and sustained economic growth projections and assumes energy demand modelled in the same way as the OME scenarios but electricity generation to meet electricity demand forecasts is based on the projections made by Egyptian Electric Holding Company (EEHC) which include the increased utilization of gas and the development of wind, as well as introducing nuclear before the end of this decade;

– The *High Economic Growth Diversification Scenario* (HEG DIV) is also based on high economic growth projections and co-related increases in energy demand, as decoupling is not foreseen in the outlook, but with an ambitious diversification of the electricity generation mix with more renewable, more nuclear and the introduction of clean coal-fired power plants based on the shares of primary energy sources in the electricity generation mix for 2030 provided by Egyptian Natural Gas Holding Company (EGAS).

ENERGY PROFILE IN A NUTSHELL

A number of distinctive features characterise Egypt's energy sector. First, its hydrocarbon resources and hydropower development on the Nile River have allowed Egypt to be largely energy self-sufficient for decades and, in fact, to be a net energy exporter, though the trade balance for oil is shifting to become a net importer. Egypt's energy mix will continue to be dominated by oil and natural gas, which account for 86% of primary energy demand in 2030 even in the Proactive Scenario. Second, Egypt's geographic situation makes it a key transit route for oil and natural gas exports from the Middle East. It has the potential to play an important role in the further development of regional natural gas and electricity markets in North Africa and the Mediterranean region. Also related to its geography, Egypt is richly endowed with renewable energy opportunities with solar in vast areas of desert and world-class wind resources. Another noteworthy element is that the energy sector largely rests in the hands of the state: hydrocarbons are state-owned and controlled; electricity generation, transmission and distribution are owned and managed by state-owned entities, although in the early 2000s three generation projects on a build-own-operate-transfer basis were developed by the private sector, but investments have stagnated since then. As its energy mix is mostly oil and gas, carbon dioxide (CO_2) from fuel combustion is Egypt's main source of greenhouse-gas emissions and, in the Conservative Scenario, they are expected to double from today's levels by 2030.

In all four scenarios, demand for all energy sources increases, with fossil fuels accounting for the lion's share of total primary energy demand in 2030. Since 1970, energy demand has grown by about 6.5% per year. The annual average increase in demand in the Conservative

Scenario is about 3.7%, with a slightly higher rate in the years to 2020 and a bit lower in the following decade, while the Proactive Scenario foresees demand growth of about 3% per year. In the High Economic Growth Scenarios energy demand would increase at an average of 4.8% per year to 2030.

ROBUST POPULATION GROWTH AND ECONOMIC DEVELOPMENT WILL DRIVE DEMAND HIGHER

The key drivers of energy demand in the outlook are continuation of robust economic growth at about 4% per year in OME scenarios (5.6% in the High Economic Growth Scenarios) and an increase of around 1.5% per year in population. Total final energy consumption expands by 3.9% on average per year to 2030 in the Conservative Scenario and about 3.3% on average in the Proactive Scenario. In both perspectives, industry accounts for 40% of demand, transport for one-third and households for 20% of total energy consumption in 2030. In the High Economic Growth Scenarios, final energy consumption increases substantially by about 5% on average per year.

Since the 1980s, three industrial sectors stand out as major energy consumers: iron and steel, construction and petrochemicals. Iron and steel and the construction sub-sectors generally have a domestic focus whereas chemicals, in particular petrochemicals, have an export element. Today petrochemicals account for about 30% of total industry energy consumption and it is expected to see sustained growth with triple the demand level in 2030 in the Conservative and Proactive cases and a five-fold increase in the High Economic Growth Scenarios. All scenarios see continued growth in energy demand in construction in parallel with a large increase in residential buildings, as well as in iron and steel.

More people, more cars and a growing economy have greatly boosted demand for oil products to fuel transport. The number of vehicles multiplied from 167 000 in 1970 to more than 5 million in 2010. It is expected to more than double by 2030.

In the early 1990s, the use of natural gas as a transport fuel was endorsed and the government encouraged the private sector to commercialise natural gas vehicles. It set a target to increase the number of natural gas vehicles to 300 000 by 2015 and all scenarios adopt this assumption. In 2030, oil remains the primary fuel in the transport sector in all scenarios. While the use of natural gas for transport fuel will be a modest share of overall natural gas consumption, in absolute terms the increase is notable.

Egyptian households use energy for cooking, heating water, lighting, refrigeration and other appliances. Energy consumption for space heating, ventilation and air conditioning is much less prevalent. Per capita energy consumption in the residential sector is low by international comparison. This reflects relatively poor comfort levels for large portions of the population. Yet, the electrification rate is close to 100% due to government actions over more than three decades, directed particularly at rural areas. A strong upward trend in energy consumption in the residential sector is expected as the number and size of dwellings get bigger, rising incomes bring lifestyle and comfort level changes and more people make use of modern energy services. This will have particular impact on the

electricity sector both in terms of base supply and capacity to manage peak loads, which are currently stressing the system.

Electricity demand is projected to increase more strongly than any other final form of energy. In the Conservative Scenario, it is expected to grow by 4.6% annually to 2030 and by nearly 6% in the High Economic Growth Scenarios. Efficiency improvements in both the supply and end use of electricity in the Proactive Scenario dampen demand growth to 3.8% per year. Natural gas, which now accounts for 70% of electricity generation, maintains a high share of the generation mix in all scenarios. However, renewables expand to 30% of the installed capacity in the Proactive Scenario and 35% in the High Economic Growth Diversification Scenario. Additional capacity needed to meet demand in 2030 is 47 gigawatts in the Conservative case, 41 gigawatts in the Proactive outlook and 70 and 76 gigawatts in the High Economic Growth Scenarios.

ENERGY SUBSIDIES RESULT IN ECONOMICALLY INEFFICIENT ALLOCATION OF RESOURCES AND MARKET DISTORTIONS

In Egypt, energy products are generally priced below economic costs with the implicit subsidies accounting for about 25% of total government expenditures. In fiscal year 2009, energy subsidies in the government budget were more than 60 billion Egyptian pounds, mostly to subsidise petrol prices and for liquefied petroleum gas, which is widely used as household cooking fuel. Petroleum subsides amounted to EGP 83 billion in 2010 and are expected to increase to EGP 100 billion in 2011 due to rising oil prices. By comparison, the level of direct subsidies for electricity consumption is smaller since electricity prices reflect the low cost, due to subsidies, of the fuel used in power generation. Restructuring energy subsidies and adjustments to domestic fuel prices have been a key objective of the government's reforms since 2004. Of course, subsidy reform is a particularly sensitive issue since from a social point of view it is difficult to take abrupt actions.

HYDROCARBONS ARE A KEYSTONE OF EGYPT'S ECONOMY

Egypt is a significant oil producer, refiner and a rapidly growing natural gas producer. Notably, its strategic location is valuable for the Mediterranean region as well as global energy markets. Hydrocarbons are among the most important and strategic sectors in the country. Over time, their economic significance has increased, accounting for 15% of Egypt's gross domestic production in fiscal year 2009/2010. When the Suez Canal revenues are included, the total share of petroleum-related activities in national GDP is more than 17%.

After tourism revenues, petroleum exports and Suez Canal revenues are Egypt's main sources of foreign currency. In addition to its oil and gas export role, Egypt has international strategic importance with two transit routes that it operates. The Suez Canal is one of the world's most important marine routes, through which close to 10% of the international daily trade of crude oil, oil products and liquefied natural gas is transported. The Canal and the Suez Mediterranean pipeline transport most of the Arab/Persian Gulf petroleum that

is exported to the European Union and United States. With the expansion of the Arab Gas Pipeline and liquefied natural gas facilities, Egypt will continue to be an important supplier to Europe and the Mediterranean region, and beyond.

INDIGENOUS OIL AND NATURAL GAS SUPPLY DOMESTIC AND EXPORT MARKETS

Egypt has potential for additional hydrocarbon discoveries, as the country is still relatively under-explored. Although the discovery rate is high, the probability of finding giant new oil fields seems low. Nevertheless, some major discoveries are possible recognising the deeper knowledge of the geology, use of advanced technology such as improved mapping of sub-salt plays and increased interest of foreign contractors. For natural gas, infrastructure is crucial. Coal in Egypt is used exclusively in industry and is less than 1% of primary energy demand.

The main challenges facing Egypt's petroleum industry are adopting an effective upstream policy and encouraging efficient use of resources in an environment that currently is characterised by a high degree of bureaucracy and highly subsidised domestic prices.

Fossil fuels are the driving force of Egypt's energy sector today and are expected to remain the dominant energy sources for the next two decades. Oil and gas each both provide over 46% of primary energy to meet today's demands for economic activities and human needs. These shares remain high in the outlook scenarios with natural gas accounting for 58% of primary demand and oil for 35% by 2030 in the Conservative Scenario; these fuels account for lesser contributions in the Proactive case with oil down to 30% and natural gas at 55%. In the High Economic Growth Scenarios, the fossil fuel share in the energy mix in 2030 would be 93% in the High Economic Growth Scenario and 87% in the High Economic Growth Diversification Scenario.

Egypt's proven crude oil and condensate reserves are 4.5 billion barrels. Since the start of commercial production in 1910, a little more than 10 billion barrels of oil have been produced. More than 75% of all crude oil and condensate produced were from fields in the Gulf of Suez and Sinai Peninsula, which currently hold over 40% of remaining oil reserves. Estimates for undiscovered oil reserves range from less than 1 billion to more than 5 billion barrels.

Egypt has a long and successful record of attracting international interest from major investors to participate in oil exploration and production activities. By making exploration and production agreements more attractive with increased cost-recovery allowances, larger blocks and longer license periods, Egypt's total petroleum reserves and production continued to climb. Oil production in Egypt exhibited impressive growth in the many decades since the start of the commercial petroleum industry early in the 20th century. A rising trend in production first made Egypt self-sufficient in oil and then an exporter.

The main production areas are the Gulf of Suez, Sinai Peninsula, Western Desert, Eastern Desert, Mediterranean Sea and Nile Delta. Most production is from mature fields in the Gulf of Suez that are declining rapidly. Crude oil production peaked in 1993 at about 924 000 barrels per day. However, despite discoveries and advanced production techniques at mature fields, crude oil production is declining.

Finding ways to slow the decline is a key focus in Egypt's oil sector; approaches include enhanced recovery and reservoir management techniques, and possible development of oil shale resources. OME's outlook indicates that the decline in crude oil production is unlikely to be reversed for a sustained period. It foresees oil production to decline to 600 000 barrels per day by 2030.

EGYPT IS MOVING TO BECOME A NET OIL IMPORTER

Currently, fast growing domestic oil demand, stimulated by subsidised prices, in combination with declining production are a principal concern. Indicators are that Egypt will not be able to retain its net oil exporter status. Falling domestic oil production, robust demand and policy directives and oil subsidies have been factors that challenge Egypt's status as a net oil exporter. While Egypt will undoubtedly become a net oil importer, management of the assets and policies pursued will determine when the balance tilts.

AFRICA'S LARGEST CRUDE OIL REFINING CENTRE

Today, Egypt has eight refineries that have a combined crude oil processing capacity of more than 765 000 barrels per day, making it Africa's largest refining centre. Some crude oil is imported for processing as refining capacity exceeds domestic production. The majority of refineries are owned by the government and operated by subsidiary companies.

Completed in 2001, the Sidi Krir refinery is the first in the Middle East to comply with European Union environmental standards. About one-third of its output is exported since it meets the EU standards. Other facilities will comply with those standards as the refinery sector is upgraded.

Additional refinery capacity to increase production of lighter products, petrochemicals and higher-octane petrol is needed. Most of Egypt's refineries are designed to produce large amounts of fuel oil for use in power generation. Now there is less demand for fuel oil as the more recent power stations burn natural gas and the demand for lighter products such as diesel is increasing significantly. Today the growing imbalance is an important challenge in Egypt's oil industry. The government has plans to address it. Major modernisation and extension projects are underway in several refineries to increase capacity and production of high quality petroleum products.

NATURAL GAS TAKES THE LEAD IN THE HYDROCARBON SECTOR

Oil was the targeted commodity for all exploration activities in Egypt until the first commercial natural gas discovery was made in the Nile Delta in 1967 and the field was put on stream in 1975. Since then, Egypt's natural gas reserves have increased from 63 billion cubic metres (bcm) to 2 210 bcm in 2009. More than 75% of gas reserves in Egypt are located in the Mediterranean region, followed by the Western Desert, Gulf of Suez and Nile Delta. Almost 90% of the natural gas reserves are non-associated gas, mostly in the Nile Delta and Mediterranean Sea areas.

Until the 1970s, natural gas associated with oil production was flared because there was neither a collection network nor a local market. A series of large gas discoveries between 1967 and 1971, changed the landscape. A modest local natural gas market emerged with the start of commercial gas production in 1975. Construction of a 40 kilometre pipeline brought gas produced from the Abu Madi field to the Talkha area to fuel a power station, fertiliser and textile factories. This was the start of the National Gas Grid. Today natural gas is transmitted and distributed through the National Gas Grid, which extends from Matrouh in the northwest and the Western Desert to the Sinai in the east with high density in the Nile Delta and Suez areas.

In the mid-1980s, the government actively promoted natural gas use as a substitute for oil and began to develop a network to use the gas for power generation, as well as in the industrial, residential, commercial and transport sectors. The gas-for-oil substitution policy was to make use of Egypt's abundant gas reserves and to free up oil for export. Towards those aims, policy shifted to allow private companies to apply for franchise areas throughout the country to build, own and operate gas distribution systems in joint ventures with government entities.

Subsequently, the natural gas sector developed in an integrated way including field development, gas processing and treatment, transportation, distribution and marketing both for local and export markets. This stimulated more exploration, discoveries and production. Natural gas production increased from just 0.08 bcm in 1975 to more than 66 bcm in 2009. During the same period, marketed volumes increased from 0.03 bcm to 62 bcm. From first production in 1975 to June 2010, almost 700 bcm of natural gas have been produced in Egypt.

Egypt's natural gas policy played a major role in this achievement especially after 1993 when modifications allowed companies (in joint ventures with the government) to own the gas, which made commercial development more attractive. With more favourable conditions, the gas sector started to grow. It blossomed after the large discoveries were put into production from 2000, adding almost 35 bcm of new capacity.

Companies operating in Egypt are stepping up natural gas exploration and development. A key driver was relaxation of the government's gas purchase scheme. This was done to encourage upstream activity in deep-water resource areas and due to increased development costs.

Two-thirds of the natural gas production serves the domestic market and as a reserve for future generations. Consumption of natural gas has increased from about 2 bcm in 1980 to almost 44 bcm in 2009, tracking the pattern of domestic natural gas production. The Egyptian government encourages the use of natural gas in the domestic market and, since the 1980s, has actively promoted gas use as a substitute for fuel oil and has converted all oil-fired power plants to run on natural gas. As well, energy-intensive industries have been making a transition from oil to natural gas. Cement and steel factories and fertiliser plants are now using gas as feedstock or fuel or both. Also, the government has encouraged the commercialisation of compressed natural gas as a transportation fuel.

Natural gas is likely to be the primary growth driver of Egypt's energy sector for the foreseeable future. Reserves are the third highest in Africa, after Nigeria and Algeria, and less than a quarter has been produced. OME anticipates marketed gas production to continue to increase to as much as 120 bcm per year until around 2028. After 2030, however, natural gas production may fall fast.

NATURAL GAS EXPORTS TO THE REGION AND THE WORLD

Egypt began exporting natural gas in 2003 at less than 1 bcm, which expanded to 19.5 bcm in 2008, but dropped to 18.3 bcm in 2009 due to shrinking market demand. Liquefied natural gas (LNG) exports accounted for 68% of total natural gas exports in 2009. LNG exports started in 2004 from two major complexes at 2.3 bcm in 2004 to more than 15 bcm in 2008, down to 12.6 bcm in 2009 due to lower market demand. Spain is the leading customer, followed by Japan and South Korea with smaller amounts to other Asian countries and the Americas. LNG expansion plans are underway.

Natural gas exports by pipeline commenced through the Arab Gas Pipeline (AGP) to Jordan in 2003. Egyptian gas via the AGP reached Syria in 2008 and Lebanon in 2009. Egypt's pipeline gas exports increased from less than 1 bcm in 2003 to nearly 6 bcm in 2009.

To date, however, gas transportation on the AGP has been far below its design capacity of 10 bcm/year. The only firm sales from Egypt have been to Jordan and recently to Syria and Lebanon. In 2009, those exports represented about 45% of the AGP design capacity. Within the next few years, capacity utilisation is expected to increase as Egypt's gas exports through the AGP augment. In January 2008, Turkey and Syria signed an agreement to construct a 63 kilometre pipeline as the first segment of a Syria-Turkey connection with the AGP. The connection is expected to be completed by 2011. From Turkey, gas could reach Europe through the Kilis-Türkoglu interconnection and the Turkish national transmission grid.

The East Mediterranean Pipeline (El Arish–Ashkelon) is a 90 kilometre, 7 bcm capacity submarine gas branch pipeline from the AGP in Egypt to Israel. The pipeline is owned and operated by the East Mediterranean Gas Company, a joint stock company between Egyptian and Israeli interests organised in 2000. Operational since May 2008, the East Mediterranean Gas Company buys Egyptian gas for resale in Israel.

ALIGNING DOMESTIC DEMAND AND NATURAL GAS EXPORTS

There is growing concern in Egypt about how to balance increasing domestic demand for natural gas with export commitments and how to make best use of its rich natural gas endowment. One option is to export much of the gas and leave more oil for domestic consumption, which is subsidised for consumers. Another option is to export more oil and leave gas for domestic consumption, which is also subsidised. In either case, there is an opportunity cost. In the first case, Egypt may risk depleting its strategic resource, whereas in the second case it may gain from future high oil prices. But declining oil reserves limit the effectiveness of the second option.

In the debate, some call for banning gas exports, while others suggest that gas should not be used for electricity. Another group believes that the petrochemical industry is the best place for gas use since it provides an added value. When domestic gas production could not keep up with robust gas demand in 2008, the government froze new gas export projects to the end of 2010 and it may be extended to 2012.

EGYPTIANS ARE PLUGGING IN MORE AND MORE

Egypt's electricity sector faces a number of challenges to meet growing demand. Population growth, rising household incomes and more services in the mix of economic activities are driving the rising demand for electricity. The most pressing issues include obtaining sufficient base and peak load capacity; ensuring the availability of natural gas for power production, at price levels that can be absorbed by the retail electricity tariff; implementing the government's ambitious renewable energy agenda; improving energy efficiency; and advancing reform of tariffs and subsidies.

Meeting peak load is an immediate challenge. Since 2008, consumption patterns have changed and households are connecting more and more electrical appliances, such as 2.3 million air conditioners in the last few years that spike load demand peaks. It is also a long-term challenge as electricity demand expands as GDP grows and the moderate per capita levels rise to international levels.

Egypt's electricity generation was 131 terawatt-hours (TWh) in 2008. Electricity demand growth has been robust with annual average increases of 8.8% from 1980 to 1990 and 6% from 1990 to 2000, and then 7.7% per year. Annual electricity consumption rose from about 39 TWh in 1990 to 65 TWh in 2000 and then to 112 TWh in 2008. On a per capita basis, electricity demand has risen significantly over the last three decades from 422 kWh in 1980 to 1 704 kWh in 2008, an average annual increase of 5.3%. This per capita consumption compares with an average in Africa of 571 kWh and globally of 2 782 kWh per person.

TODAY NATURAL GAS SPARKS MOST OF THE KILOWATTS

Nearly 70% of electricity in Egypt is based on natural gas, the remainder being met mostly by oil and hydroelectricity. The share of gas has increased substantially since the late 1990s following significant discoveries of indigenous natural gas, declining oil production and the gas for oil substitution policy. Power plants consume about 56% of the domestic natural gas supply.

Total installed capacity was 23 502 megawatts in 2008, of which 16 650 MW was natural gas, 3 627 MW oil, 2 800 MW hydroelectric and 425 MW wind and solar. The Nile River is the mainstay of Egypt's hydropower base. Given that most of the existing hydropower resources have already been developed and the increased use of natural gas, the share of hydropower is expected to shrink in coming years. Egypt has plans to further expand electricity capacity by using the country's vast wind and solar resources.

Both resource development and policy preferences have led to an enormous increase of gas use in electricity production. Some of the newer plants are based on combined-cycle gas turbine technology. About one-third of the thermal plants have been in operation for more than 30 years and another third for about 20 years. Since the 1980s, a programme to rehabilitate aging plants has helped to reduce fuel consumption and extend their service life.

STATE-OWNED ENTITIES OWN AND OPERATE THE ELECTRICITY SYSTEM

Today, wholesale electricity is based on a "single-buyer" model. The government-owned Egyptian Electricity Holding Company accounts for about 91% of electricity generation. The remaining 9% is generated by build-own-operate-transfer plants, which mostly serve tourist complexes on the Red Sea coast and Sinai Peninsula and in some areas not connected to the national grid. The Egyptian Electricity Transmission Company is the single buyer of bulk power from the generating companies through power purchase agreements, which it sells it to nine distribution companies and direct customers who are connected to the transmission network. This single buyer model uses production cost curves for plant dispatch and, as such and in the context of centralised governance and financial management, offers limited opportunity for market-based competition for dispatch among the incumbent generation companies.

Egypt has put in place a number of measures to gradually reform its electricity sector from a vertically-integrated state-owned monopoly into a more market-oriented structure, although the transition has been and remains very cautious and gradual. The government is preparing the ground for further advancing the sector reform. A new Electricity Law, awaiting parliamentary approval, introduces a number of changes toward strengthening the sector's market orientation and opening it to private investment and competition.

ELECTRICITY IS HEAVILY SUBSIDED

Subsidies have enabled most people in Egypt to be able to afford electricity. The country's electrification rate is 99%. Electricity tariffs in Egypt are subsidised both at the end-user level and for fuel input to power production. In fiscal year 2009/2010, subsidies for electricity were 7.5 billion Egyptian pounds (EGP) not including the underlying fuel subsidy, and EGP 16.5 billion with the fuel subsidy. Tariffs were unchanged from the early 1990s to 2003 and actually decreased since inflation in that period averaged 6.9% per year. Yet, over the period demand has grown and costs have increased. This is not consistent with international norms, where tariffs have become more reflective of the cost of providing electric service. In preparation for efforts to restructure energy markets, modifications have been made to tariff structures and plans made to reduce subsidies over time. The challenge is to invigorate private sector investment and direct it to the pressing needs in the electricity sector, which to date largely have been financed by government funding or by soft loans from multilateral or bilateral sources.

NOT MUCH TRADE WITH NEIGHBOURS

Egypt's electricity network is interconnected with Libya, Jordan, Syria, Lebanon and Gaza, but the exchanges are limited and the cross-border lines are used mainly for operational solidarity. There are opportunities to expand electricity trade and take advantage of Egypt's strategic location as an inter-regional electricity hub.

ELECTRICITY PRODUCTION AND USE LOOK LIKELY TO EXPAND, BOOST EFFICIENCY AND DIVERSIFY SOURCES

Electricity consumption is expected to nearly double in the Conservative Scenario by 2030, with an average annual increase of 4.8% in the residential sector and 6% per year on average in the High Economic Growth Scenario. In the Proactive Scenario, the same economic performance is assumed, but electricity consumption is expected to be about 15% less than the Conservative Scenario in 2030, benefiting from a strong push for energy efficiency improvements through tariffs that better reflect the cost of service and price signals for peak periods. As well from measures in all sectors from energy-intensive industries to street lighting; energy standards for the thousands of air conditioners, refrigerators and laundry appliances that will be purchased by Egyptian households in the next 20 years; better building codes and incentives for sensible approaches such as solar water heating. Demand-side management practices such as the use of smart grids, interactive meters and load shedding incentives can help to curb the peak demand, the most expensive part of the load profile for the provision of electricity service.

To meet growing electricity demand, Egypt will need to add new generation capacity of 47 040 megawatts (MW) over the projection period under the Conservative Scenario, 41 269 MW under the Proactive Scenario, 69 520 MW in the High Economic Growth Scenario and 75 708 MW in the High Economic Growth Diversification Scenario. This would average around 2 000 MW per year of new capacity in the Conservative Scenario, well over 3 000 MW per year in the High Economic Growth Scenarios and around 1 900 MW per year in the Proactive Scenario. In addition, the grid infrastructure requirements will increase substantially in all scenarios.

NUCLEAR MAY ENTER THE GENERATION POOL

In addition to more renewables, efficiency improvements and demand-reduction measures, one of the major differences in the scenarios is the inclusion of nuclear power (starting as early as the end of this decade in the High Economic Growth Scenarios and after 2025 in the Conservative Scenario). Installed nuclear capacity in 2030 would range from 2 MW in the Conservative Scenario to 7 MW in the High Economic Growth Diversification Scenario (corresponding to 16 TWh to 58 TWh electricity production). With this ambitious outlook, the nuclear share in electricity generation in 2030 would be 4% in the Conservative Scenario, 10% in the Proactive Scenario, 7% in the High Economic Growth Scenario and up to 12% in the High Economic Growth Diversification Scenario.

Financing the nuclear programme is a challenge. An inter-ministerial committee charged with evaluation of funds for the first project is expected to explore three main financing options: government funds; partnership with the private sector, though this could violate a law that mandates the nuclear project be exclusively owned and operated by the state; and a third option in which component suppliers for the plant would provide financing. The costs of the first plant are estimated to be USD 4 billion.

However, following the major upheavals in the Arab region and the turmoil in Egypt early 2011 and after the Fukushima accident, it is most likely that Egyptian authorities will have to wait for the assessment of its consequences presently underway globally before rescheduling the introduction of nuclear capacity.

KEY AREAS FOR ACTION

The challenges faced by the energy sector in general, and by electricity supply in particular with recent peaking problems, underscore the need for action. Three key areas have been identified: application of demand-side management techniques and effective implementation of an economy-wide efficiency improvement strategy; pumped storage project options to mitigate electricity system constraints; polices and measures to enhance market opportunities for private investment in renewables and energy efficiency.

RENEWABLES: HARNESS THE WIND AND COLLECT THE RAYS

Egypt is richly endowed with renewable energy resources from solar insolation in the vast western desert, hydropower from the Nile River to world-class wind resources along the Gulf of Suez. There is enormous potential for renewable energy development in Egypt. Yet, today the contribution of renewable energy sources to total primary energy supply is fairly limited.

Traditionally biomass and hydropower have provided the largest share of renewable energy sources in Egypt. Developments in recent years have brought wind power into the mix. In 2008, renewables, including large hydro, accounted for 4% of the total primary energy supply. Renewables in the Conservative Scenario are expected to supply 4% of total primary energy supply in 2030, with increasing shares of wind and biomass. In the Proactive Scenario, renewables satisfy 9% of total primary energy supply in 2030 with robust growth of wind and biomass, and an increasing share for solar. In the High Economic Growth Scenario the share of renewables would decrease to 3% and increase to 6% in the diversification variant case.

Today more than half of the renewables contribution to energy demand is mostly traditional combustible biomass used in residential and industrial applications. The other half is electricity generation from hydro facilities. Over the projection period, renewables in final consumption compared with 2008 levels double in the Conservative Scenario and High Economic Growth Scenarios, and are 3.5 times higher in the Proactive perspective in 2030. A larger penetration of renewables in the transport sector is foreseen with an emerging biofuels industry based on agricultural waste and non-edible plants.

Renewables accounted for 14% of installed electricity generation capacity in 2008; about 94% was hydropower, most of the rest was wind power. The installation of wind turbines has pushed the capacity from 425 megawatts in 2008 to 565 MW in mid 2010, with many more projects in the pipeline. In 2030, renewables share in total installed capacity is 15% in the Conservative Scenario, at 10 gigawatts (GW); 30% in the Proactive Scenario, with 20 GW, 11% in the High Economic Growth Scenario, with 10 GW and 35% in the High Economic Growth Diversification Scenario, with 35 GW.

RENEWABLES TARGET OF 20% BY 2020

Since 2008, the government has been considering an ambitious target to reach the goal of 20% of energy from renewables by 2020. Private sector investment is critical to achieve this vision and requires more than the traditional approach of government pursuing generation projects in concert with donors and international financial institutions. To this end, the policy and regulatory framework is evolving. Of the additional capacity of 9 GW needed to achieve 17% in 2020 in the Proactive Scenario (4 GW in the Conservative, 6 GW in the High Economic Growth, and 10 GW in the High Economic Growth Diversification Scenario), about one-third is expected to be developed by the government in co-operative arrangements and two-thirds by the private sector.

The amount of electricity produced from renewable sources was 12% of the total in 2008, primarily from hydro. In the Conservative Scenario, renewables provide 26 terawatt-hours (TWh) by 2020 (10% of total production) and 37 TWh in 2030. In the Proactive Scenario, renewables account for 17% of electricity production in 2020 and 21% in 2030. Hydro is expected to remain fairly constant whereas other renewable energy resources exhibit growth of more than 19% per year. Notably, the Proactive Scenario is more or less in line with Egypt's strategy to source 20% of electricity generation from renewables by 2020. In the High Economic Growth Diversification Scenario the target of 22.5% of renewables in 2030 is set, incurring a 15% share of renewables in 2020.

EGYPT HAS HUGE POTENTIAL FOR ENERGY EFFICIENCY GAINS

Energy consumption in Egypt is on the rise. Egypt's abundance of energy resources and historically low energy prices have led to greater energy use on a per-capita basis than other countries at a similar stage of economic development. While it is a very broad aggregate measure, the ratio of energy consumption per unit of gross domestic product (GDP) experienced a 24% increase in Egypt from 1970 to 2007 with the largest share in industry (46%). All scenarios see a decrease in energy intensity per unit of GDP with about 3% in the Conservative case and almost 15% in the Proactive Scenario, with the largest savings in the transport sector (14%) followed by industry (12%) and the residential sector (11%). On a per-capita basis, it has increased four-fold since 1970 and the outlook is for it to increase by 70% from today's level in the Conservative Scenario with a bit more moderate growth in the Proactive Scenario. Significant opportunities exist to moderate energy consumption and achieve reductions in greenhouse-gas emissions by reducing losses and improving efficiency.

Energy productivity in the industrial sector is below international averages. In the industry sector, significant efficiency improvement opportunities exist in motor systems, including electrical drives and conversion devices, and the networks through which water, compressed air, and process materials flow. Notably, energy consumption per unit of output in Egypt's most important industries is 10% to 50% higher than the international average.

There is very high potential for energy efficiency to be coupled with the use of renewable energy sources to provide more sustainable energy service to all sectors of Egypt's economy. Buildings use about 55% of Egypt's electricity production of which some 36% is in residences, 7% in commercial and 5% public establishments. A large part of the consumption is for lighting services and cooling loads. Intelligent construction of new buildings that employ proper orientation, efficient materials for the building envelope, ventilation control, use of natural light, and efficient lighting devices and appliances can reduce energy demand and improve comfort levels without major additional costs.

Energy efficiency must be at the heart of Egypt's energy policy. However, the absence of a dedicated agency, the lack of co-ordination between the main stakeholders and the absence of mandatory targets, performance standards and energy efficiency related building codes are hindering effective energy efficiency developments.

WEAK INVESTMENT CLIMATE FOR RENEWABLES AND EFFICIENCY MEASURES CURB PROGRESS

Today both renewables and energy efficiency face significant barriers to attract commercial financing. Subsidies for conventional energy are an important hurdle. Other barriers include a lack of risk capital and financing mechanisms, and uncertainty concerning the policy and regulatory regime. The need to mobilise private finance is essential to advance renewables and energy efficiency in Egypt.

STRIKING A BALANCE FOR SUSTAINABLE DEVELOPMENT

Egypt faces challenges on many fronts to advance economic growth and social development in a manner that ensures environmental integrity. The consequences of energy production and use in all sectors are chief among environmental concerns in Egypt. They range from rising CO_2 emissions to air pollution from low-efficiency engines using hydrocarbon fuels and to demands on scarce water resources.

Water scarcity is a critical environmental problem in Egypt. Egypt is already a water-poor country and the availability of fresh water on a per capita basis is projected to decline further until 2030. In addition to water deficit, the demand levels are producing severe pollution both in surface and groundwater resources. Desalination technologies, together with recycling of waste water and an integrated water resource management strategy are of paramount importance to cope with this situation. However, desalination would

incur a huge increase in electricity demand and thus substantially add to the electricity generation requirements to 2030. Furthermore, waste production is growing rapidly. The annual production of municipal solid waste amounts to about 20 million tonnes. Most of the waste currently goes to uncontrolled open dumps, thus generating significant amounts of greenhouse-gas emissions and local pollution. Projections to 2025 indicate that municipal solid waste should reach 33 Mtoe, over 65% higher than current levels. A National Strategy for Integrated Waste Management was adopted in the year 2000. The Strategy sat out some targets to be reached by 2010, as to share of waste to be recycled, composted or disposed of. Despite considerable efforts, progress is still uneven and much remains to be done to ensure that the Strategy's objectives are met.

FOSSIL-FUEL COMBUSTION PUMPS OUT MOST OF EGYPT'S CO_2 EMISSIONS

Energy-related emissions were responsible for more than 60% of Egypt's total greenhouse-gas emissions in 2000. The bulk of energy-related emissions (55%) are from fuel combustion. An important contributing factor in Egypt is related to the age of fossil fuel-fired combustion units and their combustion efficiency. Electricity generation is the largest greenhouse-gas emitter, being responsible for more than one-third of total CO_2 emissions. The industry and transport sectors each contribute about 25%. CO_2 emissions witnessed a ten-fold increase over the period 1970 to 2008. This is less than the growth in energy supply as large amounts of natural gas reserves have been tapped since the 1990s and substituted for oil.

The outlook for energy-related carbon dioxide (CO_2) emissions in all scenarios shows an upward trend: 278 million tonnes of CO_2 in the Proactive Scenario, 23% less than in the Conservative case. Although in absolute values CO_2 emissions in the Proactive Scenario are much lower, they would still be more than 1.5 times higher than CO_2 emission levels in 2008. Under a stronger economic growth assumption, in the High Economic Growth and the Diversification Scenarios, CO_2 emissions would surge to 456 and 406 million tonnes of CO_2 respectively in 2030, more than 2.4 times higher than the current levels.

EGYPT BENEFITS FROM INTERNATIONAL CARBON OFFSET MECHANISMS

As a non-annex I country, Egypt is not required to meet any specific emission reduction or limitation targets in terms of its commitments under the United Nations Framework Convention on Climate Change or the Kyoto Protocol. Egypt, however, is taking mitigation measures based on national plans that include fuel switching, renewables development and energy efficiency improvements.

Egypt is benefiting from the opportunities to limit emissions offered by the Kyoto Protocol's Clean Development Mechanism (CDM). It has 15 projects in the official CDM pipeline that include fuel switching, landfill gas and renewable energy developments. Among the top countries for issued Certified Emission Reductions under the CDM, Egypt ranks seventh.

ISSUES TO KEEP IN MIND...

Mediterranean Energy Perspectives: Egypt is a comprehensive review of the past, present and likely future of the energy sector in this ancient land that is a crossroads in the Mediterranean region. This report is filled with data, figures, tables and analysis that stretch some 400 pages and represents the input from numerous experts. Perhaps, you, the reader, are only interested in one or two elements of a particular energy sector or only want to get a sense of the state of wind power in Egypt, or rather want an in-depth review of the stratigraphy of the Nile Delta. Regardless, this study will be of value to you. A few policy issues are highlighted in this summary to provide a context for better understanding the energy profile of Egypt:

- This Study is published at a time when Egypt initiates a new stage in its history that invites to the reconsideration of the overall energy policy. Co-ordination and strategic planning in the energy sector is now, more than ever, crucial to ensure adequate and affordable supplies, energy security, efficient use of resources and environmental protection. An integrated national energy policy needs to emerge in order to optimise the use of the country's resources, send the appropriate signals to markets and industry, and give confidence to lenders and investors.

- Petroleum exports constitute an important part of the Egyptian economy; therefore, continuous and balanced development of the petroleum sector is strategically important. The main challenges facing Egypt's petroleum industry are adopting an effective upstream policy and encouraging efficient use of resources in an environment that currently is characterised by a high degree of bureaucracy and highly subsidised domestic prices.

- From 2005 to today, Egypt's oil sector has struggled to maintain net export status. Targets to significantly expand indigenous natural gas production and use aim to substitute gas for oil in domestic markets to make more oil available for export. The discovery of additional gas reserves combined with stagnant or declining oil production has led to large-scale integration of gas into national energy policy. The issue is how to go forward.

- There is growing concern in Egypt about how to balance increasing domestic demand for natural gas with export commitments and how to make best use of its rich natural endowment.

- Meeting domestic demand for gas is a priority for the government. The tight balance between production and demand in the short term is due to not being able to convert reserves to productive capacity faster. The issue is not reserves, as undiscovered resource potential remains very high in Egypt. However, upstream investments in exploration and development need more encouragement. In addition, domestic natural gas prices need to be reformed to limit the burden of subsidies.

- When fuel subsidies were instituted, the idea was that citizens should benefit from the oil resources of the country. This entails both financial subsidies to energy consumers, and significant opportunity costs in terms of foregone foreign and government revenues. If sales prices are below cost, then problems can arise. This has occurred as the population level doubled and demand soared while oil

production declined. Subsidies have become an ongoing controversy. They have raised concerns about the negative impacts of "inefficiency" in implementing the subsidy scheme, such as endangering the future of reserves and the economic burden on the public finances.

- Restructuring energy subsidies and adjusting domestic fuel prices have been a key objective of the government's reforms since 2004. Subsidy reform issues underline the importance of integrating energy policies with other policies for economic growth and social development. Furthermore, it stresses that adjusting energy prices and removing subsidies should not be considered as a once-and-for-all reform measure. If and when subsidies are phased out, it should be implemented gradually to avoid drastic price increases and with mitigating measures. A strategy for removal of energy subsidies should take energy efficiency and the value of fuels into consideration.

- While subsidy reform can help to correct some market distortions, Egypt's energy sector needs additional investment for large-scale projects such as natural gas field development, wind power parks, solar thermal plants; as well as more disperse measures for bringing industrial production up to international efficiency norms or even to best practice levels, developing domestic capacity to produce, install and maintain household solar systems, and build-in intelligent design concepts and efficiency measures in the massive amount of residential construction that is foreseen. The government can foster an attractive investment climate by creating the right fiscal and institutional conditions for potential investors.

- Improving energy efficiency is a key energy policy challenge in Egypt. While there is great potential in all sectors, in a country where private vehicles are rapidly becoming more common and where significant new construction is foreseen, transport and buildings merit particular attention from policy-makers.

- The consequences of energy production and use in all sectors are chief among environmental concerns in Egypt. They range from increasing greenhouse-gas emissions to air pollution from low-efficiency engines using hydrocarbon fuels, and to demands on scarce water resources.

- Water scarcity is a critical environmental problem. It is affecting Egypt's progress towards sustainable development. By 2030, the equivalent of a new Nile river will be needed to meet expected water requirements under business as usual assumptions. Water desalination appears to be, under certain conditions, an unavoidable option.

- Its geographic position at the crossroads of three continents provides Egypt great potential to have a larger share in international trade of oil and natural gas and be part of a wider electricity grid network. With its strategic location, existing infrastructure and many assets, Egypt is a good candidate to become a strategic gathering and dispatching as well as an economic centre for inter-regional energy trade. In the short to mid-term, Egypt can play a major role in securing part of the Euro-Mediterranean energy security and supply diversification objectives.

MEDITERRANEAN ENERGY PERSPECTIVES EGYPT

Egypt is a significant oil producer and a rapidly growing natural gas producer. Its strategic location makes it an important transit corridor for world energy markets.

Mediterranean Energy Perspectives - Egypt provides insights into the country's energy situation today and over the next two decades. It presents detailed data and analysis of interest to those who have a stake in both the supply and demand side of the energy equation. It is the first in-depth country review in OME's Mediterranean Energy Perspectives (MEP) series. The publication draws upon the extensive expertise of the Observatoire Méditerranéen de l'Energie (OME) and its members.

MEP-Egypt is a unique and comprehensive analysis of the energy sector in Egypt. It contains data from the early days of its energy industry up to today as well as a view on its evolution to 2030 based on the supply and demand model developed by OME (Mediterranean Energy Model). Current efforts related to renewable energy sources are carefully considered as they are key issues for the Egyptian energy sector and for the whole economic and environment future of the country.

MEP-Egypt presents:

- Historical and forecast data on the supply and demand balance for each segment of the Egyptian energy sector.
- Past, present and future of oil and gas exploration and discoveries.
- Oil and gas fields: production and development.
- Oil and gas production profiles and prospects to 2030.
- Detailed information on refineries, pipelines, LNG terminals and storage facilities.
- Evolution of electricity generation and installed capacity.
- Developments of innovative and renewable energy sources.
- Prospects for CO_2 emissions and sustainable development.
- Fiscal regime of the energy industry.
- Alternative energy scenarios: a Conservative scenario, a Proactive scenario and two High Economic Growth variants.

MEP-Egypt has been prepared by a joint-team of Egyptian industry experts and OME staff, supported by related companies, institutions and independent experts. Bringing this expertise together provides an important reference for industry analysts and investors who wish to get a complete picture and a full understanding of the energy industry and market in Egypt, the way they operate and their long-term perspectives.

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