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## **Arab Use of Energy: Oil out, Renewable Energy in**

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The Arab world is on the verge of starting huge renewable energy (RE) programs (RE is defined for our purposes to include solar and wind power, and “waste to energy” technologies; but does not include hydro-electric energy). Once these programs are implemented, Arab countries would be among the world leaders in the use of renewable energy. This new trend is led by the GCC (Gulf Cooperation Council) states, primarily the United Arab Emirates (UAE) and Saudi Arabia. Yet it is gathering momentum in other Arab states as well, particularly Jordan and the North African states.

A first wave of new renewable energy projects, which are either under construction or in advanced planning stage, are expected to quadruple the 2012 total Arab RE capacity of about 1,000 Mega Watts (MW) during the next few years. Then, taking into account the published long-term RE programs, a stream of large new projects would significantly add to the total RE capacity. According to these programs, total Arab RE capacity is projected to be around 50,000 MW by 2025 (fifty times the 2012 capacity), and close to 100,000 MW by 2035. Hence, within the coming twenty-five years, the Arab share of the world’s total RE capacity is expected to exceed 10 percent, compared to its marginal share of world RE capacity today.

The Arab World’s new drive toward RE reflects real, urgent, and crucial needs. Arab electricity consumption has grown at an average rate of close to 10 percent annually during the last decade. It is forecast to continue growing at a rate double the global average during the current decade as well. GCC states have been the leading consumers, but other Arab countries such as Jordan, Egypt, and the North African states have also been using much more electricity in recent years.

Saudi Arabia's demand for electrical power (peak power demand) is expected to double during this decade, and triple by 2032 (from about 40,000 MW in 2010 to above 120,000 MW in 2032), while total Arab installed electrical capacity is forecast to increase from approximately 200,000 MW today to above 500,000 MW by 2032. The rapid growth of domestic demand for fuel-powered electricity, and for fuel in general, eats into the all-important oil exports of Saudi Arabia and other oil-exporting Arab states. Saudi Arabia has become the fifth largest oil consuming state in the world. In 2012 it consumed approximately 3 million barrels per day (bd) of oil, almost double the 2000 level. Its consumption exceeds that of Germany (which is slightly above 2.5 bd). In comparison, Israeli oil consumption was less than 250,000 bd, which is below one tenth of Saudi consumption. Only the U.S., China, Japan, and India consume more oil than Saudi Arabia.

Domestic consumption already accounts for one quarter of Saudi oil production. According to the Saudi Ministry of Oil estimates, if present trends continue into the next decade, close to one half of Saudi oil production will be consumed locally and Saudi oil exports will decline proportionally. Therefore, this massive rise in domestic oil consumption has become a major threat to the economic and political stability of the Saudi kingdom.

In response to this challenge, the Saudis' first move has been to gradually shift the Saudi electricity-production infrastructure from oil-fueled-power stations to natural gas. It has also increasingly switched to gas to power industrial enterprises. However, while Saudi Arabia produces large amounts of gas, and in spite of its decision to use Saudi gas solely for the domestic market rather than exports, the rapid growth of domestic demand has outpaced Saudi gas production. Consequently, Saudi Arabia is preparing to begin importing gas to supplement its local production.

The UAE, which is the second largest economy in the GCC, in terms of GDP, is also facing the same energy challenge and has adopted a strategy similar to the Saudi's. Although the UAE is, like Saudi Arabia, a large producer of natural gas, it has already become a net gas importer; and its gas imports are growing significantly from year to year.

Certain non-GCC states, such as Egypt and Jordan, face the same challenges. The economic burden of securing energy for their domestic markets has become a macro-economic threat and a major source of risk for their economic and political stability.

Egypt, which until just a few years ago was exporting a significant volume of oil, has become a net oil importer; and oil imports have become a serious burden, on top of Egypt's other mammoth economic challenges. Faced with this new problem, Egypt has

switched its entire electricity infrastructure from oil-fuels to natural gas. However, the continued upsurge of domestic demand for energy is rapidly exhausting Egypt's gas resources as well. Domestic consumption of natural gas has tripled over the last decade, from 16 billion cubic meters (bcm) of gas in 1999 to about 50 bcm a year today. As a result, Egypt had to cut its gas exports. Like Saudi Arabia and the UAE, it is expected to become a net importer of gas, beginning, in all likelihood, in 2014.

In Jordan, hydrocarbon imports (oil and gas) have always been a heavy burden on the Kingdom's economy. Since 2011, however, the combined effect of rising oil prices and the repeated disruptions in gas supply from Egypt has doubled this burden. Jordan's energy import bill jumped to more than 20 percent of its GDP in 2011, a dangerous proportion, which has had an immediate and severely destabilizing impact on Jordan's economic and political systems. While Jordan has managed to overcome the immediate crisis, thanks to increased aid from the Arab Gulf states, energy security remains the most menacing long-term threat to the Kingdom's economic stability. These challenges have prompted Arab governments to turn to RE — mainly solar and wind—as one of the pillars of their energy diversification strategy. Large RE projects have been incorporated into their long-term power development plans.

According to *Iqtisadi's* analysis of the development plans and the major long-term trends envisioned for the Arab RE markets, the share of RE power plants (solar, wind, and "waste to energy" plants) will constitute approximately 20 percent of Arab power generation capacity by 2032 (compared to approximately 0.5 percent in 2012). That is to say 100,000 MW out of total power generation capacity of 500,000 MW. In terms of financial investment, during the next two decades, investment in RE projects is expected to be more than \$20 billion a year, on average. Accordingly, investment in RE would amount to 35 percent of the \$60 billion in total annual investment projected for the Arab power sector as a whole.

Saudi Arabia's RE development program is, by far, the largest and the most ambitious. In 2011-2012, the Saudi Electricity Company invested \$10–12 billion per year in its power plants; and investments of \$12 billion a year are planned throughout this decade. Major public sector companies—such as Aramco and the Saline Water Conversion Company (which operates many of the Saudi sea-water desalination plants)—have their own independent multi-billion power investment programs planned for this decade. The non-governmental segment of the Saudi energy sector is rapidly developing, too: Local authorities, municipalities, and various large businesses (resorts and hotels, and mining companies, industrial enterprises, etc.) are generating a multi-billion stream of additional investments in independent power facilities each year. Total investment in the Saudi power sector is estimated at \$15-20 billion a year over the next two decades. This amounts to almost one third of total Arab investment in power generation.

The updated long-term energy plan of Saudi Arabia, which was announced early this year, is heavily weighted toward non-hydrocarbon sources of energy. During the next five years Saudi Arabia plans to invest \$30 billion in 15 “conventional” hydrocarbon power projects (mostly gas-powered), which are already in the pipeline. New projects, however, will be predominantly non-hydrocarbon. The Saudi plan for the power sector envisions a total of 72,000 MW of non-hydrocarbon projects to be constructed by 2032. 90 percent of the total of 80,000 MW of new power-generation projects planned for this period. Most of these new non-hydrocarbon projects are planned to be RE (54,000 MW out of 72,000 MW of planned non-hydrocarbon projects. The remaining 18,000 MW are planned to be nuclear).

The 2032 vision for diversified power production means that future production in Saudi Arabia will look entirely different from the situation today. Hydrocarbon-powered plants, which today account for 100 percent of Saudi power-production mix, at 60,000 MW, will be reduced to approximately 45 percent of total power production. The remaining 55 percent will come from RE plants at 54,000 MW (41 percent), and nuclear power plants at 18,000 MW (14 percent).

The first package of RE projects, at total capacity of about 3,000 MW (total investment of around \$10-15 billion), is expected to begin in the first half of 2014. Then a continuous stream of new RE projects is planned to follow at a pace of around 3,000-5,000 new MW per year. The initial projects are scheduled to be completed and begin operations in 2017-2018. A total of 25,000 MW of RE plants are expected to be completed and operating by 2025.

Saudi Arabia’s RE plans are the most ambitious, but the UAE has been the GCC leader in the field. Its flagship project, Masdar City, established the UAE as the regional trailblazer for the implementation and application of RE technologies. The international community has acknowledged the UAE’s ambition to become a prominent global player in the RE field by locating the headquarters of the UN’s International Renewable Energy Agency (IRENA) in Abu Dhabi.

The UAE continues to set the pace for the GCC RE development with this year’s inauguration of the Shams 1 solar power plant in Abu Dhabi, a 100 MW facility. The Shams 1 solar plant uses the advanced Concentrating Solar Power (CSP) technology, and it is among the first large CSP facilities operating in the world. Shams 1 will soon be followed by a second 100 MW solar plant in Abu Dhabi, named Nour. Dubai has followed Abu Dhabi’s lead by launching the first phase of the 1,000 MW Muhammad Bin Rashid Solar Power Park.

The UAE government is working to develop a comprehensive new road map for its RE drive, which is expected to be announced by the end of 2013. The strategic goal of this master plan would be similar to the Saudi plan: namely, shifting toward energy

diversification where half of the UAE's energy requirements will be supplied from RE power plants.

Among the non-GCC Arab countries, Jordan and Morocco are the furthest along in implementing their energy diversification programs. Egypt too had been making noticeable progress, until the uprising in 2011.

Jordan's revised master plan for energy aims at decreasing the share of imported oil and gas in its electricity supply from almost 100 percent today, to around 70 percent by 2020, and, further, to below 50 percent over the following decade. This plan is based on two main pillars: domestically produced oil shale, and RE. According to the master plan, most of the new power-generation capacity, 3,000-4,000 MW, which Jordan would need by 2020, will be powered by these two sources. Jordan's long-term plan for RE power plants is to build about 1,800 MW of RE generating capacity during the next two decades. The first package of projects is already under way; and more packages have been planned at a pace of 100-200 MW a year, for this decade and the next.

Morocco plans to increase its present capacity of 300 MW of RE power plants (not including hydropower) to 3,000 MW during the current decade. Similar to Jordan, the implementation of this program started in 2013. Just a few months ago construction began on the first phase of a 500 MW solar park, a 160 MW CSP plant, named Nour 1. A 300 MW wind-powered plant, the Tarfaya wind farm, is to follow shortly.

Egypt had been the most advanced Arab state using RE, with total installed capacity of above 600 MW in 2010 (not including hydropower). The majority of its production was generated in the Zafarana wind farm. Prior to the 2011 uprising, Egypt was in the midst of implementing an ambitious program which aimed to increase RE capacity to more than 3,000 MW by 2020. A large part of this new capacity was supposed to come from the expansion of the Zafarana wind farm. The long-term goal for Egypt's RE development plan was to have some 10,000 MW of RE power plants in operation by 2030. The status of these plans has become unclear, as a result of the political upheaval in Egypt. Nevertheless, the demand for greater production capacity still exists, and once the political situation in Egypt stabilizes these projects will likely come to fruition.

Considering the huge magnitude of the ambitious RE development programs, one can expect the pace of execution to be slower than planned. Nevertheless, given the critical importance of diversifying the power-generation infrastructure away from hydrocarbons, the strategic drive toward Arab RE can be expected to materialize, although somewhat less quickly than planned.

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