Economic Commentary

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MENA Power Investment Outlook : Opportunities Patent; Challenges Less So

This commentary by Ali Aissaoui, Senior Consultant at APICORP, is published concurrently in the Middle East Economic Survey (MEES) dated 4 April 2014. The views expressed are those of the author only. Comments and feedback may be sent to: aaissaoui@apicorp-arabia.com.

1. Since the onset of the global financial crisis in 2007 lagging investment in MENA power has been a recurring leitmotif of our commentaries.[1] We have been concerned that underinvestment in this vital sector and the resulting shortfall in electricity supply could impede economic growth and exacerbate social frustrations. These concerns, however overstated they might seem at first, have clearly been vindicated in the wake of the Arab uprisings. At present, catching up with fast growing demand has become a policy priority in many countries within the region.

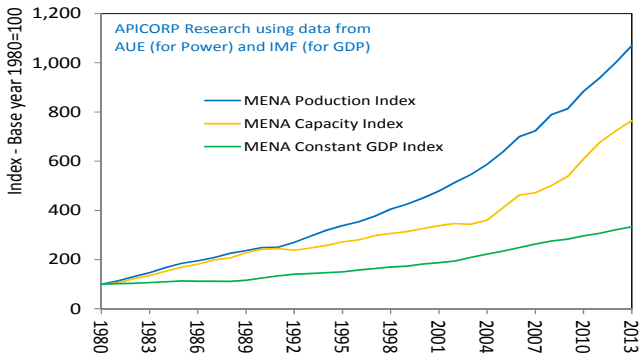
2. While this creates tremendous investment opportunities, it also poses significant challenges. The former are straightforward and relatively easy to identify, whereas the latter require a more thorough analysis. In order to elaborate this point, this commentary proceeds in three parts. The first provides an update of the growth pattern and performance of MENA power generation. The second evaluates medium-term capacity expansion and the investment capital required. The third discusses some of the critical issues policymakers need to address for this investment to take place effectively.

Pattern of growth and performance

3. Before proceeding, it is worth restating that, despite substantial investment in digital systems and automated data acquisition and processing, the information utilities have been willing to put in the public domain has remained scant.[2] Even though nineteen among the 23 MENA countries (excluding Comoros, Djibouti, the Palestinian Territories and Somalia) can be said to offer some simple, basic statistics, only a handful of them are able to communicate more elaborate data, and none of them has ever published a national load curve. The 19 countries that underpin our analysis account for the quasi-totality of installed power capacity. Among these twelve with a capacity higher that 5 GW represent 93% of MENA total.

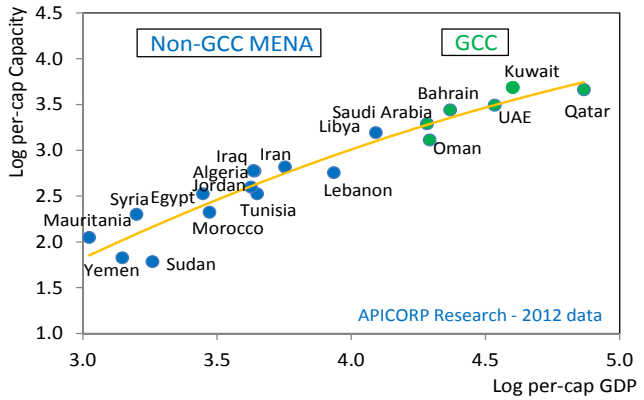
4. Nearly all countries have been struggling to meet fast-growing demand for heavily-subsidized electricity and desalinated water. As they became confronted with recurring incidents of system overloads, particularly during summer air conditioning peak, they have stepped up efforts to ensure adequate supply. As a result, MENA power capacity has increased at rates higher than 8% in recent years. This impressive growth can be better appreciated when put in a longer perspective. Figure 1, which contrasts the growth indexes of power capacity and electricity generation with that of economic output, is especially telling in this respect. Starting from the common base year of 1980, capacity grew faster than GDP in most of the 1980s, a period of relatively high infrastructure investment. Between the early 1990s and mid 2000s, capacity grew in parallel with GDP trend. In recent years, however, capacity has been expanding again at an increasingly faster pace, resulting in a record ratio of capacity growth to GDP growth of 2.3 in 2013.

Figure 1: Evolution of MENA Key Macro Power Indexes



5. Obviously, the pattern of growth varies by country due to the diversity of demographic structures and economic factors, as well as climate conditions. A cross-section regression analysis for 2012 (the year for which all statistics are available) highlights major variations. Figure 2 shows that, on a log-transformed basis, per capita capacity increases quasi-proportionally with per capita GDP, taken as a proxy for the key drivers of electricity demand growth. The wealthier the country and the larger the subsidies the higher electricity demand is. The fact that the regression curve is slightly concave is no evidence for inferring that the top ranking GCC countries are near saturation point. Saudi Arabia, which has the largest population and biggest economy in that group, is still in an economic lift-off period.

Figure 2: A Cross-Country Snapshot of MENA Power and GDP



6. As with any power generation system, the performance of MENA power can be expressed through key common factors. Among these, thermal efficiency, capacity factor and load factor are of particular importance for later discussion. While the former is straightforward, the difficulty of conceiving the two latter lies in the fact that due to considerable variations in

[1] MENA is defined to include the Arab world and Iran. Power generation in both Sudan and South Sudan is kept inconsequentially aggregated. Within MENA the Gulf Cooperation Council (GCC) area clusters together Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE.

[2] The Arab Union of Electricity offers a complimentary annual statistical bulletin, available online (www.auptde.org).

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electricity demand (a power system faces a high load during a short time and a relatively low load during most of the time) and the inability to store electricity in any useful amount, generators need to maintain a substantial back up reserve.

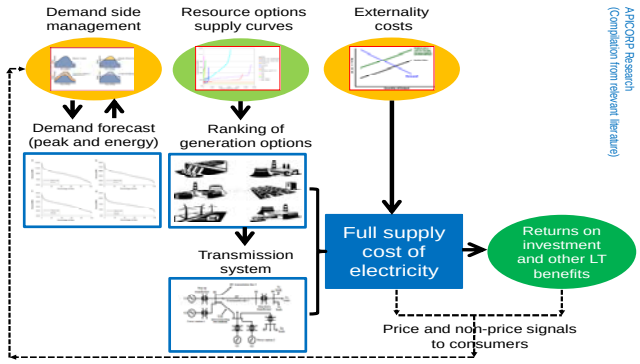
7. Thermal efficiency (TE) is a performance measure of the process of converting a fuel into heat then electricity. Using the scanty data compiled by the Arab Union of Electricity (supplemented by data on Iran), the region's TE weighted rate average appears to have improved from 32.6% in 2005 to 35.2% in 2012. Rates vary by country depending on the degree of penetration of high-efficiency combined cycle gas turbine (CCGTs) and local temperature patterns (the higher the ambient temperature, the lower power plant efficiency is). TE rates have been consistently uptrend and highest in 2012 in Egypt (41.9%), Jordan (40.2%), and Algeria (39.0%) and consistently downtrend and lowest in 2012 in Yemen (28.7%) and Iraq (25.6%). Finally, on either side of the region's weighted average and adjacent to it are TE rates for Iran (37.4%) and Saudi Arabia (33.0%).

8. The system capacity factor is a measure of asset utilization. It is calculated as the ratio of the electricity the power system actually generates to the electricity it could generate if capacity were fully operated all year round. For MENA as a whole, this factor has steadily improved from 40% in the 1980s and early 1990s to 50% currently. Similarly, the system load factor is calculated as the ratio of electricity actually delivered in a year to the electricity which would have been delivered if the peak load were maintained over the entire year; the closer to 100% the better. However, while a too low ratio may indicate an inefficient power system, which is currently the case in Yemen, Mauritania and to some extent Lebanon, a too high ratio may signal that the system is stretched to its limit and could collapse should peak demand end up being higher than anticipated. The latter is the case of Iraq, Jordan and to some extent Egypt. In between, systems in countries such as the UAE, Saudi Arabia and Algeria, which have been catching up on capacity fast enough, seem relatively sound.

Medium-term investment outlook

9. Optimal power supply planning is a specialized and complex field of energy economics. The determination of investment in different generation technologies to meet expected demand (characterized by a load duration curve) involves sophisticated long-term modeling and associated empirical data (Figure 3), which are beyond the modest scope of this commentary.

Figure 3: A Long-term Power Planning Framework



10. Instead, our purpose is to provide broad estimates of capital investment requirements so as to identify the opportunities and the challenges investors will be facing. Accordingly, a country-by-country analysis and projection of peak load demand and reserve capacity requirement leads to an aggregate capacity increment of 156 GW for the 5-year period 2015-2019, partly implicitly formed of combined power/water desalination plants. This increment corresponds to an average annual rate of capacity growth of 8.3%, which is in line with the rate that could have been inferred from the ratio to GDP growth of 2.3:1 noted earlier. But, as suggested by Figure 3, capacity requirements could be much lower if an effective demand-side management (DSM) was adopted with appropriate price and non-price signals.

11. Using current reference costs in the region, which reflect prevailing prices of engineering, procurement and construction (EPC) and project risk premiums, results in capital requirements for the expansion of MENA power generation of $188bn for the forecast period. Clearly, with such a simplified approach, expenditures for renewable and nuclear power generation are implicit.[3] Unexpectedly, capacity growth in the GCC is below that in the Mashreq. One explanation is that the GCC are expected to continue saving on reserve capacity following completion of their grid interconnection. The other is that countries such as Egypt, Iraq, Jordan, and Lebanon are foreseen to considerably speed up their investment. However, with growth remaining slightly higher than MENA average, GCC retains the lion's share of 40% of MENA capital requirements and nearly half that of the Arab world.

Table 1: MENA Power Gen Capacity and Investment, 2015-19

	2013 installed capacity (GW)*	*2013* electricity production (TWh)*	*Medium-term annual growth (%)*	*2015-19 capacity addition (GW)*	*2015-19 capital requirements (G$)*
Maghreb [1]	34.3	141.0	8.1	17.7	21.3
Mashreq [2]	68.3	321.6	9.5	42.9	55.8
GCC [3]	121.8	529.7	8.7	68.5	75.9
Rest of Arab world [4]	4.4	14.3	6.3	1.7	2.2
Iran	64.0	253.2	6.5	25.2	32.8
MENA Total	292.8	1259.8	8.3	156.0	188.0

2013: APICORP's estimates
Maghreb: Algeria, Libya, Mauritania, Morocco and Tunisia.
Mashreq: Egypt, Iraq, Jordan, Lebanon, PT and Syria.
GCC: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE.
Rest of Arab world includes Sudan (N&S) and Yemen, but excludes Comoros, Djibouti and Somalia for lack of data.
Compilations and projections by APICORP Research

12. Investment in power generation cannot be complete without factoring in capital expenditures in transmission and distribution (T&D). This comes from the need to develop adequate transmission and distribution networks to supply electricity to industries, businesses and households. Transmission grids consist of high-voltage lines designed to deliver bulk power from generation sources to large industrial and distribution loads, generally over long distances. Furthermore, low-voltage distribution networks deliver power to final consumers in urban centers and in rural areas, whenever socially desirable and economically viable.

13. Under this grid-supply architecture,[4] the determinants of T&D capital investment and upgrades vary from country to country, depending on the size and location of generation facilities,

[3] Civil nuclear power programs involve Iran and the UAE. In Iran, Bushehr I was officially inaugurated in 2010 and operated a year later, while Bushehr II and III are now in the pipeline. In the UAE (Abu Dhabi) Barakah I remains on schedule to commence operations in 2017.
[4] Off-grid supply may be more relevant for rural and remote areas.

distances to end users, the extent of development and density of urban areas, regional interconnections, as well as built-in redundancy to ensure system reliability. According to projections prepared by the IEA,[5] global investment in T&D infrastructure accounts for 43% of total power sector investment, with regional variations reflecting land occupation and population density. A reasonable transposition of relevant IEA's ratios to respectively the Maghreb, Mashreq, GCC and Iran, results in a MENA T&D investment of $128bn for the period 2015-19. As detailed in Table 2, this translates into total sector investment of $316bn, 59% in generation capacity and the remaining 41% in T&D.

Table 2: MENA Total Power Sector Investment, 2015-19

($ billion)	Generation (G)	Transmission (T)	Distribution (D)	Total (T,D)	Total (G, T, D)
Maghreb [1]	21.3	4.6	14.1	18.7	40.0
Mashreq [2]	55.8	10.8	25.5	36.3	92.1
GCC [3]	75.9	15.5	29.6	45.1	121.0
Rest of Arab world [4]	2.2	0.4	0.7	1.1	3.3
Iran	32.8	7.2	19.6	26.8	59.6
MENA Total	188.0	38.5	89.5	128.0	316.0

[1] Maghreb: Algeria, Libya, Mauritania, Morocco and Tunisia.
[2] Mashreq: Egypt, Iraq, Jordan, Lebanon, PT and Syria.
[3] GCC: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE.
[4] Rest of Arab world includes Sudan (N&S) and Yemen, but excludes Comoros, Djibouti and Somalia for lack of data.

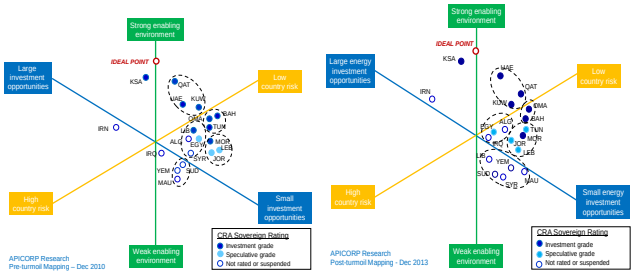
Compilations and projections by APICORP Research

Critical Issues and challenges

14. Investment of this magnitude will not be forthcoming unless key issues are addressed. Among these three are critical: investment climate improvement; fuel availability; and access to funding. The challenges each presents are beyond the capabilities and resources of any public utility or private power developer.

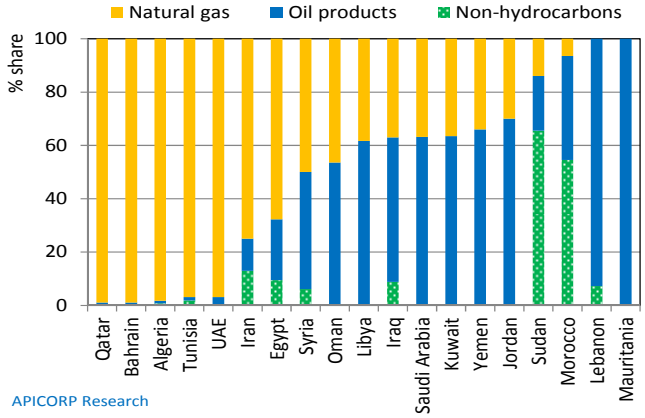
15. As far as the investment climate is concerned, persistent political turmoil in parts of MENA has adversely affected the region's business environment. Notwithstanding considerable uncertainty, our 'perceptual mapping' has been instrumental in providing a solid framework for assessing the impact of the turmoil on the region's energy investment climate (Figure 4). Except Saudi Arabia, which has retained its position in the prime quadrant and nearest to an 'ideal point' benchmark, our recent reassessment has revealed significant shifts in country positioning. Taking its cluster lead in the second quadrant, the UAE has established some distance between itself and both Qatar and Kuwait. The two remaining GCC countries, Oman and Bahrain, have managed to secure their positions in the third quadrant. Beyond the GCC, most countries have reshuffled into new clusters. Tunisia has joined a group of lesser investment appeal formed of Morocco, Jordan and Lebanon. Iraq has relatively improved its position by crossing into the third quadrant and bonding with Egypt and Algeria. Libya's position has deteriorated most, ending up in the least attractive quadrant as part of a cluster comprising Yemen, Sudan, Mauritania and now Syria. Finally, even though having moved into the prime quadrant, resilient Iran is still far from its peer-energy producer, Saudi Arabia.

Figure 4: Pre-turmoil (LHS) and Current (RHS) Mappings



16. The second issue is the availability of natural gas. Electricity can be generated using different types of technologies and fuels with a wide range of thermal efficiencies. Reflecting the region's resources endowment, MENA's power sector relies heavily on thermal plants fueled by hydrocarbons. In 2012, about 60% (55% in the Arab world) of output was generated using natural gas and 34% (40% in the Arab world) using oil products (Figure 5). The remaining 6% (5% in the Arab world) was from non-hydrocarbons, mainly hydropower (Sudan), coal (Morocco) and nuclear (Iran), not to mention the still negligible solar and wind.

Figure 5: MENA Electricity Generation by Fuels

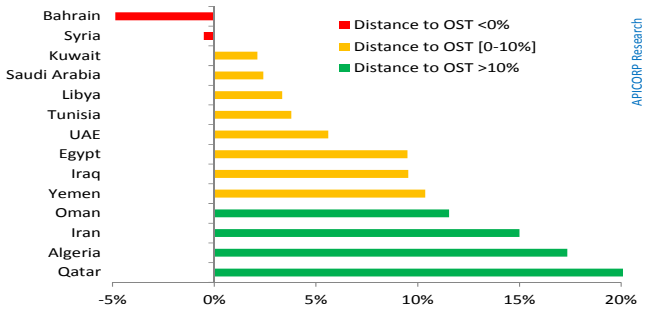


17. The power generation sector is the single most important industrial user of natural gas in key countries in the region. While this has many positive aspects, it also raises concern about reserves adequacy. Already, a perception of scarcity has been created by the fact that a number of apparently well-endowed countries have been unable to balance their domestic natural gas market, shifting a portion of supply to oil products or filling the gap with imports, both at a very high opportunity cost. Our analysis has confirmed that reserve depletion in these countries has reached a critical level.[6] This is particularly the case of Iraq, Egypt, Saudi Arabia, UAE, Kuwait, and Bahrain (Figure 6). At the extremes of this range, the case of Iraq underscores the need to focus on gas flaring while that of Bahrain suggests that the country is using more gas than it can possibly afford from domestic sources. So far, policy responses have focused on supply. A DSM response for both electricity and natural gas deserves as much determination and sense of urgency.

[5] IEA, *World Energy Outlook*, 2012. The relevant ratios drawn from this publication are expected to be validated in a forthcoming WEO 2014 Special Report on global energy sector investment to 2040, to be released on 3 June 2014.

[6] For a thorough analysis of the pattern of natural gas supply in the region, see Ali Aissaoui, 'MENA Natural Gas Endowment Is Likely to Be Much Greater Than Commonly Assumed' in APICORP's *Economic Commentary* dated December 2012.

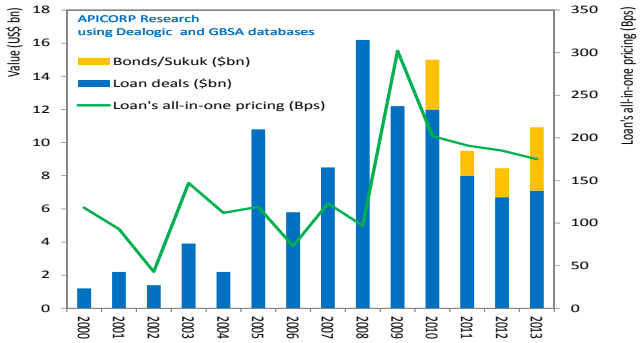
Figure 6: Distance to Optimal Gas Supply Threshold (OST)



18. The third issue is access to funding. Many governments in the region have long embarked on power sector reforms with the aim of improving efficiency and competitiveness as well as shifting part of the financing burden to the private sector. These reforms, which had originally some common features, have evolved in unexpected ways. Pioneer Oman, for instance, has in recent years required private power developers to raise capital in the domestic stock market through initial public offerings (IPOs). The rationale is to promote the participation of small investors and ultimately free up capital to reinvest in new projects. Otherwise, the emphasis has consistently been on a phased approach to competitive markets, allowing independent power or power/water producers (IPPs or IWPPs) in the generation segment whereas public utilities retain regulated monopoly over transmission and distribution.

19. Therefore, T&D has continued to be mainly financed from internal sources, including public utilities' retained earnings (if any) and state budget allocations. In contrast to T&D, most generation projects have been undertaken on a project finance basis. With still limited opportunities for raising funds via the capital markets and further inadequacies of the private equity funds industry, external financing has mainly been provided through the loan market. In the wake of the global financial crisis and subsequent negative loan supply shock, credits extended to MENA power and power/water sector have dropped by more than half from a record high of $16.2bn in 2008 to $6.7bn in 2012. They recovered slightly to $7.1 billion in 2013, while prices kept declining thanks to the increasing involvement of domestic and regional banks as well as export credit agencies (Figure 7).[7]

Figure 7: Loans and Bonds/Sukuk to MENA Power



20. Even assuming full recovery of the loan market, IPPs/IWPPs will continue facing financing challenges unless lenders relax the tighter measures they have enforced in recent years, which included lower debt to equity ratios, reduced loan tenors, stricter covenants, excessive risk allocation and onerous fuel hedging. Ultimately, what matters most to power project developers, whose assets have long economic life, is securing the longest loan tenors possible (+20 years). Unfortunately, under Basel-III capital requirements, the number of banks capable of such lending will be considerably reduced.

21. It is a regrettable fact that, since the advent of power sectors reforms, public utilities have been starved of funds in the belief that private investors will be forthcoming no matter how volatile and uncertain the investment climate turns out to be. Now that these investors are marking time, utilities are increasingly coming under pressure to fill the gap with the promise of more state budget funding. This is to the extent that fiscal space is available or, in the case of the hydrocarbon-exporting countries, oil prices remain above fiscal break-even levels.[8]

22. The bottom line is that public utilities will continue to be underfunded as long as they compete for scarce state budget resources. This is particularly the case of Iran, which embarked on ambitious energy pricing reforms in 2010 to *inter alia* lessen utilities' financing constraints. Despite these constraints becoming even tighter in the wake of the 2012 sanctions targeting oil exports and financial transactions, a new administration decided to slow down reforms and temper price increases. In this context, the Iranian utilities are unlikely to develop the self-financing capabilities previously envisaged.

Conclusions

23. To alleviate chronic power shortages MENA countries are striving to catch up and keep supply in pace with fast growing, heavily subsidized demand. In the absence of DSM measures and serious pricing reforms, the resulting capacity expansion should proceed at a growth rate of 8.3% per year, leading to a capacity increment of 156 GW during the five-year period 2015-19. Factoring in the associated investment in T&D brings the total amount of capital required for MENA power sector to $316bn.

24. Investment of this magnitude offers great opportunities while posing major challenges. In this latter regard our findings highlight three critical issues. The first results from the perception, in the wake of the Arab uprisings, of a deteriorating investment climate in most parts of the region. The second stems from the scarcity of natural gas in apparently well-endowed countries, while the third follows from the inadequacy of financing. These issues cannot be resolved without supportive policies in the corresponding areas: first, by improving the investment climate and the enabling environment for private investment; second, by providing the power generation sector with stable and affordable fuel options; and third, fiscal space permitting, by increasing state budget funding of public utilities, which have become the investors of last resort.

[7] A thorough discussion in "Financing MENA Energy Investment: Critical Issues and Challenges", APICORP's Economic Commentary, March 2014

[8] For the latest estimates of these prices, see Ali Aissaoui, 'Fiscal Break-Even Prices Revisited: What More Could They Tell Us About OPEC Policy Intent?', *MEES*, 13 August 2012.