Fiscal restraints to keep MENA nuclear power on sidelines

In the face of rising electricity demand, nuclear power should enable MENA states to diversify their sources of energy and reduce their carbon footprint. But the outlook is mixed: while six countries have nuclear projects under way, planned or proposed, raising power generation capacity by 39GW, Oman, Qatar and Kuwait have cancelled proposed nuclear projects in the wake of the Fukushima disaster. Fiscal constraints are one of the major barriers to progress, and the expectation is that nuclear power will account for only 3% of Middle East electricity generating capacity by 2040.

Sustained increases in electricity demand in tandem with continuing demographic growth have prompted a number of MENA states to consider alternative sources of power generation, including nuclear. For countries in the GCC, nuclear power would free up more oil and gas for export, while net energy-importing countries like Egypt and Jordan would be able to secure long-term energy and reduce their import bills.

Yet at present, nuclear power facilities with capacity of just 5.6GW are under construction. Only a further 6.4GW are likely to come online by 2030. The International Energy Agency (IEA) estimates that by 2040, the region’s nuclear industry will account for only 3% of electricity generation, with oil and gas accounting for 70%.

Several factors make the nuclear option attractive. Nuclear plants emit considerably less greenhouse gases compared with fossil fuel-fired capacity and help reduce their carbon footprint. Cost competitiveness has improved in recent decades, allowing nuclear technology to become a serious component of energy diversification strategies. Nuclear also advances human capital and promotes employment in a new energy sector.

But development of the nuclear sector to a level at which it competes with oil and natural gas will be both complex and expensive. Countries with ambitions to build nuclear power plants will need to find funding, attract human capital and put in place clear and stable regulatory frameworks. Governments will need to prove to the global community that their nuclear programmes are peaceful and ensure public acceptance of their programmes. Public acceptance in the region is generally higher than that in Europe, and in the UAE, this helped support the implementation of its programme.

The political ramifications of a nuclear industry in the region also need to be addressed. Following the lifting of Iranian sanctions, there were concerns on how countries in the region would pursue their individual programmes and proposals were made to use the next decade to agree on region-wide restraints. These include banning the separation of plutonium from spent fuel, limiting the level of uranium enrichment, and placing enrichment plants under multinational control.

Nuclear can be cost competitive

Nuclear projects require substantial upfront capital but exhibit lower operational and fuel costs over their lifetime - typically 50 years. Upfront capital costs range from $30n-6bn/GW of installed capacity, more than double the cost of equivalent coal- or gas-fired plants. Investment decisions are therefore heavily dependent on the availability of finance and government support.

Nuclear can be competitive against other sources of base load power. The levelised cost of electricity (LCOE) for nuclear increases at higher discount rates, given nuclear is capital intensive. At a discount rate of 3%, nuclear is more competitive than coal and gas. At 7%, nuclear remains competitive. Only at 10% does nuclear become less attractive.

### Uranium reserves - tonnes

<table>
<thead>
<tr>
<th>Production cost</th>
<th>&lt; 40</th>
<th>40 - &lt; 80</th>
<th>80 - &lt; 130</th>
<th>130 - &lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>$/kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algeria</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>19,500</td>
</tr>
<tr>
<td>Egypt</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,900</td>
</tr>
<tr>
<td>Iran</td>
<td>-</td>
<td>-</td>
<td>4,400</td>
<td>-</td>
</tr>
<tr>
<td>Jordan</td>
<td>-</td>
<td>-</td>
<td>40,000</td>
<td>-</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>65,700</td>
<td>82,900</td>
<td>50,500</td>
<td>-</td>
</tr>
<tr>
<td>Russia</td>
<td>-</td>
<td>42,300</td>
<td>463,600</td>
<td>183,300</td>
</tr>
</tbody>
</table>

Source: IEA
While nuclear is often seen as a source of long-term power supply, this is contingent on the ability of project owners to secure large stocks of uranium. Currently, only four countries in MENA have proven uranium reserves. But, at an average price of $69/kg this year, production in the region remains uneconomical. Therefore, countries considering nuclear will have to rely on uranium supplied largely from outside the region.

**UAE leads GCC diversification drive**

The UAE nuclear programme has been dubbed a model for nuclear newcomers. Cooperation with international bodies like the International Atomic Energy Agency (IAEA) was extensive while the country built up its programme. The UAE established a Nuclear Energy Program Implementation Organization, which set up the Emirates Nuclear Energy Corporation (ENEC). Abu Dhabi even agreed to forgo domestic enrichment, obtaining its nuclear fuel from reliable and responsible international suppliers and returning radioactive waste.

The UAE is the only GCC state with nuclear plants under construction. At the heart of the country’s nuclear strategy is the construction of the Barakah nuclear power plant. Korea Electric Power Corporation is building four 1.4GW power plants at a cost of $20bn, with another $20bn allocated for the operation of the plants during their 60-year lifetime. The construction of the first and second reactors is complete and the third is under way. The first of the four plants is scheduled to begin operations in July 2017, with an additional reactor coming on line each year until 2020, ENEC expects the four nuclear reactors when on-line will meet up to a quarter of the UAE’s power demand. Over the coming decades, the UAE hopes to add a further 14.4GW of nuclear capacity, but no firm plans have yet been announced.

**Saudi Arabia planned big**

Economic growth, a rising population and sustained periods of low energy prices have driven high power-demand growth in Saudi Arabia. Despite recent increases in energy prices and efforts to improve energy efficiency, the country still needs an additional 34GW of generation capacity by 2020.

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**MENA nuclear programmes (GW)**

The King Abdullah City for Atomic and Renewable Energy (KACARE) was established in 2010 to develop renewable and nuclear energy for the country. To date, KACARE has signed preliminary agreements with South Korea, China, France, and Russia. The kingdom’s initial nuclear plan aimed to produce 18GW of power by 2032, accounting for 14% of total demand (123GW). The recent announcement of the Saudi 2030 Vision revised down these plans. The new plan is to install 3GW of nuclear by 2030, 1.5GW in the eastern region and 1.5GW in the western region. These plans have not been officially announced and much obscurity surrounds the body that will implement the programme, with indications that KACARE will be dissolved and a new entity will take over the country’s new renewable and nuclear programme.

**Nuclear among Jordan’s options**

Jordan’s Committee for Nuclear Strategy, established in 2007, envisaged nuclear power providing as much as 30% of the kingdom’s electricity needs by 2030. The Jordan Atomic Energy Commission (JAECE) and a regulatory body were also set up. In 2014, JAECE chose Russia’s Rosatom to develop the first nuclear project: two 1GW plants in Quayr Amra, 70km southeast of Amman. Construction of the two reactors is scheduled to begin later this year, the first to start up in 2024 and the second in 2026 – at a total cost of $10bn. Water scarcity and funding are among several challenges Jordan will face but it has devised a strategy to address these concerns by providing for water desalination and by promoting public-private partnerships.

**Iran enters a new phase**

Iran was the first country in the region to introduce nuclear power. Its 1GW Bushehr plant was commissioned in 2011, delivering power to the grid two years later – nearly twenty years after the initial agreement between Tehran and Moscow was signed.

The next two phases of the project, estimated to cost $11bn, are expected to proceed more smoothly given the lifting of sanctions earlier this year. Each will add 1GW of capacity and will be under execution by the end of the year, with the first phase to be commissioned in 2023 and the second two years later. Plans for Rosatom to build another 4GW are under discussion while a $10bn deal for China to build an additional 2GW was reportedly finalised during President Xi’s visit to Iran earlier this year. The country has selected 16 potential sites for new plants, mainly on the Gulf coast.

Iran and the European Commission will launch their first nuclear safety cooperation project this year to enhance the capabilities of the Iran Nuclear Regulatory Authority. They will undertake stress testing for existing and planned nuclear power stations as well as a feasibility study for establishing a nuclear safety centre in Iran.

**North Africa relies on Russia**

One clear trend in the development of the nuclear industry in MENA states is the major role played by Russia. Rosatom is involved to a greater or lesser extent in five of the six MENA nuclear or would-be nuclear power-producing states. Only the UAE is relying exclusively on South Korea to develop its sector.

The Russian state firm in late 2014 agreed to construct a 1GW plant in Algeria – the target date for completion is 2029. The Russians also agreed to train Algerians and facilitate the activities of the Algerian Nuclear Engineering Institute. In Egypt, agreements were signed with Russia in November 2015 for the construction of four 1.2GW nuclear plants at Dabaa in the Nile Delta, 120km north of Cairo. The first unit will cost $8bn and is
due for completion in 2022. Russia will fund the first unit through a 35-year soft loan. In Tunisia, Rosatom also signed a memorandum of understanding in 2014 to support the development of nuclear energy infrastructure and the formation of joint working groups to determine joint projects.

**Nuclear challenges mean slow progress**

Rising domestic demand in the MENA region and the pressure to reduce its carbon footprint could boost nuclear development. Nevertheless, the likelihood is that financial, technical and political problems will cause delays.

Governments considering the nuclear option must budget for high initial investment costs. At a time when governments are rationalising spending, nuclear will trail behind conventional sources of power development in the near future. Reduced credit ratings make it difficult for governments to access cheap finance. In the case of the UAE, the main reason behind its success was the government’s ability to finance the entire programme without relying on local or external debt or equity.

Nuclear plants are typically larger than existing non-nuclear plants and need sophisticated grid systems to integrate the power generated, meaning that investments in grid infrastructure can be substantial. Although this might not be a particular problem for the UAE and Saudi Arabia, it will prove challenging for Egypt and Jordan, which are struggling with inadequate grid infrastructure.

Finding the right sites to locate nuclear plants is also a problem given cooling requirements and security risks. Aqaba, on the Red Sea, was an obvious choice for Jordan, with seawater on hand for cooling; but was eventually rejected on environmental grounds. In Saudi Arabia, three possible sites were identified, two on the Red Sea coast (Jizan and Tabuk) and one on the Gulf. The relative proximity of Jizan to the border with Yemen will rule it out because of the ongoing conflict in that country.

MENA countries are increasingly favouring renewables and coal as a means of diversifying their power generation mix.

Renewable energy is viewed as an attractive option by a public sceptical about nuclear. However, renewables technologies cannot offer the scale, productive capacity or reliability given their dependence on intermittent sun and wind. The case for nuclear in MENA is made more difficult at a time when more developed countries such as Germany are implementing strict timelines to phase out nuclear, with similar approaches taken in Italy and Spain. Between 2000 and 2013, the share of nuclear in global power generation dropped by 6% from its peak in the late 1990s.

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MENA states contemplating nuclear development will need to assure their citizens that sufficient safeguards are in place to avoid accidents like that experienced by Japan at Fukushima in 2011. They will need to establish the appropriate infrastructure, such as nuclear law, regulatory bodies, and safety measures. Establishments such as ENEC in the UAE and Jordan’s JAEC are a step in the right direction but there is still a long way to go.

Nuclear power is putting down roots in the MENA region, but its full potential is unlikely to emerge before the middle of the century, and even then it will continue to face fierce competition from other energy sources. The smooth progress so far of the UAE’s nuclear programme is no guarantee that other states, particularly those without the benefit of substantial revenue from hydrocarbon exports, will find the going so easy.

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