It's coffee time for Jordan as it seeks new energy supplies

A recent decision by BP to pull out of the only gas field in the Hashemite Kingdom of Jordan has spotlighted the country's energy problems. Egypt, which used to supply enough gas to generate 80% of Jordan's electricity demand, is no longer a reliable supplier – the Arab gas pipeline has not been functioning since July 2013, after two years of continuous disruptions. Jordan, which imports 97% of its energy needs, has had to run its power plants on expensive diesel and heavy oil, and needs new solutions - and it needs them fast. *Gas Matters* writes that the only realistic short and medium-term solutions for Jordan's power generation are LNG and perhaps oil shale. LNG will be expensive, but it will buy the country the time it needs to review its other options, including, not least, its most economic, yet politically most difficult choice, whether to rely more heavily on pipeline gas from Israel.

Risha hopes die

When BP started drilling in the Risha gas field in eastern Jordan near the Iraq border in 2012, Jordanian politicians hailed the project as "one of the most important" developments for the country. In January 2014 however, after spending $240 million (€174 million) and drilling two exploration wells, BP told Jordan's National Petroleum Company (NPC) that it had been "unable to establish the technical basis for a development project either in the deep exploration target or the existing NPC-Operated Risha Gas Field", and handed back its interest and operation in the Risha Concession to NPC.

Jordan's Energy Minister H.E. Prof. Dr. Mohammad Hamed has told *Gas Matters* that BP's decision does not rule out subsequent development of the field by NPC alone or with another IOC [See interview].

Halted Egypt supply

Shortly after hearing the news of BP's exit, Jordan's Energy Minister decided to pay a visit to his neighbours in Cairo.

Jordan's domestic energy sources cover only 3% of its electricity needs and the rest has until recently been covered by Egypt (80%), with gas imports through the Arab Gas pipeline, and around 17% coming mainly from diesel and heavy oil imports from Saudi Arabia, Kuwait, the United Arab Emirates (UAE) and Iraq.

Egypt agreed to supply about 2.1 bcm/year to Jordan through the Arab Gas Pipeline (AGP) at a preferential price of around $2/MMBtu, under a 30-year contract signed in 2001. The pipeline to Jordan became fully operational in 2005.

By the time of the fall of the Hosni Mubarak regime in 2011, however, the AGP had already been sabotaged 15 times, causing severe disruptions to supplies to Jordan. Blaming some of the disruptions on the low price Jordan paid for its gas, Egypt increased the price to $5/MMBtu in 2011, but this did not halt the decline in Egyptian gas supplies to Jordan. As a result the proportion of electricity produced from natural gas fell from 90% in 2009 to about 20% in 2012, according to the National Electric Power Company (NEPCO). And since July 2013, gas supply from Egypt has completely halted, as repairs to the pipeline have moved slowly against the backdrop of security breakdown in the Sinai Peninsula.

"We hope that the Egyptian authorities will fix the pipeline soon. In fact, we have already asked them to speed up the process because our situation is critical," Jordan's energy minister told The Jordan Times on March 3, 2014.

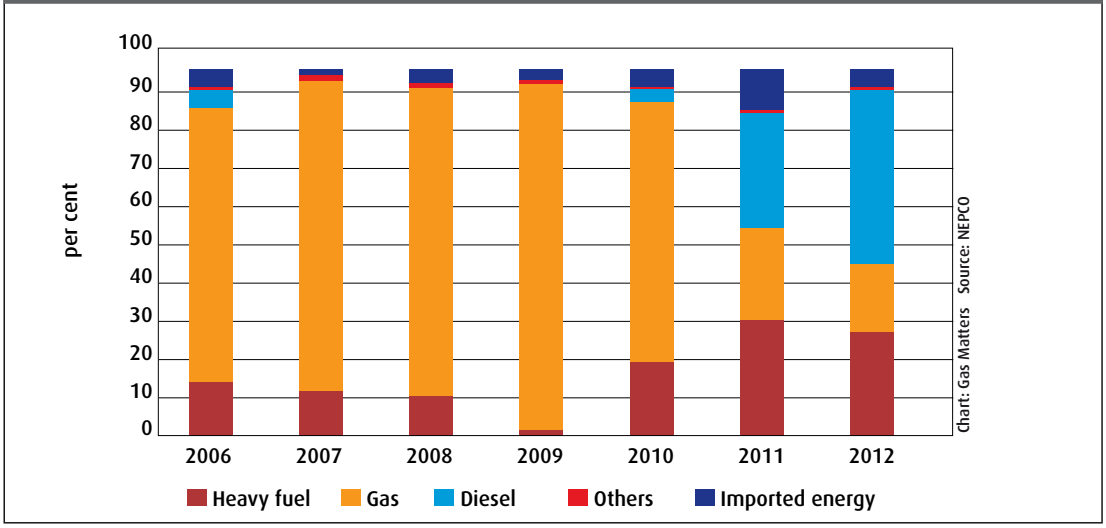
Immediate relief crucial

Egyptian pipeline imports into Jordan fell from a high of nearly 300 MMscfd in 2009, to 220 MMscfd in 2010 and 87 MMscfd in 2011, according to the 2012 annual report of Jordan's Central Electricity Generating Company (CEGCO).

Supply interruptions have cost Jordan $3-5 million/day, according to a recent report by U.S. Aid, because generating plant has had to run on diesel and heavy oil instead. Crude oil imports doubled between 2010 and 2011. Since oil costs about four times as much as pipeline gas from Egypt, NEPCO has incurred significant losses, increasing from 0.8% of GDP in 2010 to 4.9% of GDP in 2011.

The resulting decline in central bank reserves led Jordan in 2012 to ask for a $2 billion (€1.4billion) loan from the International Monetary Fund (IMF).

Electricity Produced by Fuel Type



Bigger and bigger

Jordan's energy bill is increasing. Electricity demand grew at 7.4%/year, slightly faster than GDP, in the ten years to 2010, which is typical of developing countries. This trend is likely to continue, setting the country on course to reach an electricity demand of 26,000 GWh/year by 2020 and 46,000 GWh/year by 2030.

In 2012, Jordan generated around 3,000 GWh from gas, but could have generated around 13,000 GWh if an additional 281 MMscfd of gas had been available. Some plans are underway which will alter the generation capacity available in Jordan. A new 573 MW tri-fuelled power plant which could run on gas is under construction, whilst a number of plants which can run on gas will be decommissioned by 2020.

Taking this into account, in order to keep its existing infrastructure running, Jordan would need to burn at least 336 MMscfd of gas in 2020. But if it were to build all the new generating stations and use gas as their fuel, Jordan would need an additional 192 MMscfd. This means that in order to satisfy electricity consumption of 26,000 GWh/year in 2020, Jordan could use a total of 528 MMscfd of gas – around 5.5 bcm/year, assuming a capacity factor of 65% and 43% efficiency.

Jordan's electricity production

Year	2004	2006	2008	2010	2012
Generated Electricity (GWh)	9,483	11,349	14,177	15,257	16,355
Capacity (MW)	1,643	2,076	2,524	3,008	3,312
Max Output (GWh)	14,393	18,186	22110	26,350	29,013
Capacity Factor (%)	66	62	64	58	56
Source: Gas Strategies, NEPCO					

Similarly, assuming 46 TWh/year of electricity output in 2030, Jordan will need around 7-10 bcm or 700 - 1,000 MMscfd of gas.

With hopes for domestic gas supply now dashed after BP's withdrawal from Risha, Jordan needs to look outwards for its gas supply and inwards to its other domestic energy sources.

Jordan's estimated gas-for-power needs

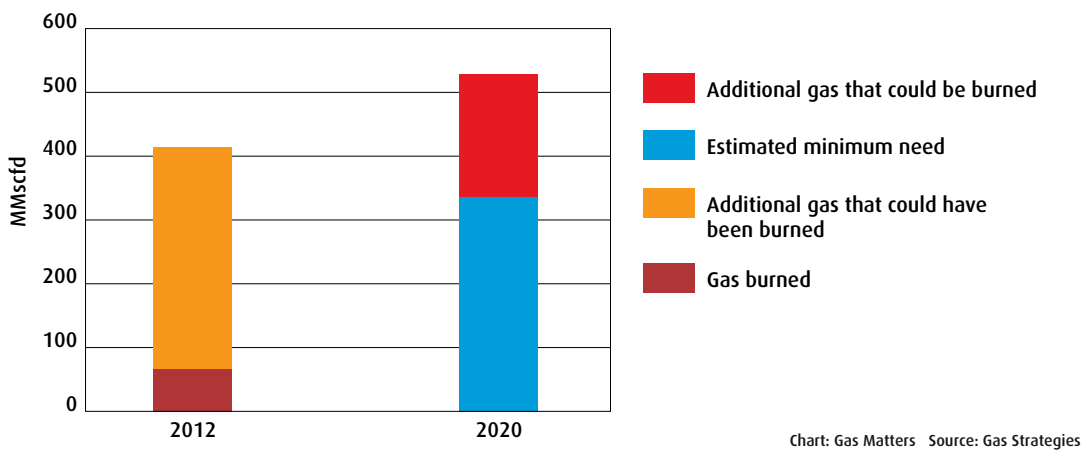


Chart: Gas Matters Source: Gas Strategies

Long term options

Jordan could choose to build power stations that run on other fuels than gas. The government is currently looking at several options, including nuclear, renewables, oil shale and even oil at affordable prices.

Jordan hopes to generate 30% of its electricity needs from nuclear plant by 2030, and in 2013 it said that it had chosen Russian state-owned Rosatom to construct two 1,000 MW nuclear reactors. However, Jordan is earthquake prone and water poor, which poses major environmental challenges to the development of a nuclear energy program. The enormous up-front investment also poses a significant financial obstacle. Gas Strategies estimates that the plant will not get built before 2030.

Jordan is meanwhile progressing renewable energy plans although, to date, solar projects – amounting to 200MW – are only in the feasibility study phase and only one wind energy project, the 30-40MW "Al-Khamshah" is advancing.

It is also discussing oil and gas imports from Iraq.

Energy ministers from Iraq, Jordan and Egypt met in Jordan on March 6, 2014 and shared coffee. This ceremonial coffee sealed an agreement to advance a series of regional energy 'megaprojects'. On announcing the deal, the Jordanian minister said: "We are looking into linking the natural gas fields in Iraq that are being developed to the Arab Gas Pipeline in Jordan".

The pipeline, going from Iraq through Jordan to Egypt, is expected to be operational around 2018 and is due to bring around 100 MMscfd of gas to Jordan "at reasonable prices". An oil pipeline to Aqaba was also discussed and would supply 150,000 bbls/d of oil to Jordan, a significant amount when compared to Jordan's imports of around 68,000 bbls/d of crude oil and 36,000 bbls/d of refined products in 2010, before imports accelerated with the closure of the AGP.

Whether gas will flow through the pipeline at all and at what volume depends on Iraq's non-associated gas production, which in turn greatly depends on the federal authorities and the Kurdistan Regional Government (KRG) solving their differences as well as local gas demand in Iraq.

Egypt supply unreliable

In both the short and long term Egypt remains an unstable source of energy for Jordan , because of security issues in the Sinai Peninsula and increasing Egyptian domestic demand (11%/year from 2001 to 2014).

Natural gas production in Egypt has been falling dramatically over the past four years and to guarantee supplies to domestic and industrial consumers the Egyptian petroleum ministry has been diverting gas from liquefaction plants in excess of the existing LNG pooling arrangements with majors such as BG Group.

Egypt is still exporting some LNG at Idku because the domestic diversions are almost at full capacity. "However, it is likely in the mid-term that Egypt will no longer be an LNG exporter," Middle East expert and energy consultant Justin Dargin told *Gas Matters*. "This is not just due to domestic diversions, this is also due to the decline of many of its fields that are exacerbating the basic issues."

Dargin said, however, that this does not necessarily affect supplies to Jordan. Once the AGP is fixed, at least in the short to medium term, it is likely that Egypt will resume exports to Jordan, Dargin said, explaining that the diversion of gas from LNG exports will be enough to cover domestic demand. Egypt has contracted to export around 240 MMscfd to Jordan, but this is only a quarter of the gas Egypt diverted from LNG exports to the domestic market - about 1 bscfd.

Middle East energy expert Laura El Katiri disagrees. "It is unlikely that Egypt will prioritize Jordan pipeline gas to LNG exports over the long term", she told *Gas Matters*. Egypt has already announced its intention to become an LNG importer and would have to pay over $10/MMBtu for LNG, double the price Jordan pays for Egyptian gas under its existing contract.

Dargin notes that under the $2/MMBtu and then $3/MMBtu contracts it had with Jordan, Egypt lost approximately $3.8 billion between 2005-2010. Much of the benefit of these sales was funnelled into profits obtained by the Jordanian treasury, private energy companies and individuals, he said. "It makes little sense for Egypt to export gas to Jordan based under these pricing schemes. However, in 2011, a new price was negotiated which would at least allow Egypt to recoup some of its economic losses under the previous pricing regime and to bolster crucial hard currency reserves".

Furthermore, there are certain geopolitical incentives. "Egypt has historical relations with Jordan, and joint interests in Palestine as well. These issues, taken together, drive Egypt to meet its export commitments to Jordan," Dargin said.

Nevertheless the prospect of 240 MMsfcd of Egyptian gas filling Jordan's pipelines is slim and too unreliable. Jordan has already paid a high cost for its reliance on one single gas supplier and the government is now instead focusing on diversifying its supplies.

Realistic short and medium term options

One of the most immediate ways in which Jordan could move away from very expensive oil for power generation and provide the extra 396 MMscfd that will likely be needed in 2020 is by importing LNG.

Last August, the government signed an agreement with Golar for an FSRU at the Red Sea port of Aqaba which could supply about 500 MMscfd, with a peaking capacity of around 700 MMscfd, about enough to cover Jordan's gas needs in 2020. The project is on track to come

online in 2015. Shell has been selected as the preferred bidder to enter negotiations to supply 150 MMscfd as soon as the project starts operating, Jordan's energy minister told *Gas Matters*.

The FSRU could be a stable, reliable bridging solution, rather than the main source of energy imports in the long-term, given Jordan's limited budget. Jordan's FSRU charter with Golar is for ten years, but has a five-year exit clause subject to an early termination fee, should cheaper sources materialise.

"We look at the LNG project as a temporary solution and a fast track solution for Jordan to reduce the impact of its energy bill for the coming five years which put a high burden on the budget of Jordan," the Energy Minister told *Gas Matters*.

LNG comes at a high price which may still continue to put a strain on the country's budget. Most likely, Jordan will have to pay around the same price as Dubai and Kuwait. In February 2014, the spot price of Qatari LNG delivered to Dubai was around $15.5/MMBtu and to Kuwait around $18/MMBtu. The cost of the FSRU has to be added, which could be $0.50 to over $1/MMBtu depending on throughput. Golar says that its earnings before interest, tax depreciation and amortisation will be $46 million/year. Operational costs will probably be an additional $7 to $10 million/year and the cost of the shipping berth and the pipeline to market will also have to be remunerated. This all adds up to a high price, suggesting that Jordan will still seek to diversify its supplies, even if LNG proves to be a stable import source.

Additional import capacity could be added later, as Kuwait has done, if cheaper sources materialize and Jordan could keep its FSRU for its flexibility, to help cover peak demand. But for its base load, it is likely to look at other, less expensive sources.

Oil shale for medium and long-term supply

The second best prospect for cheaper energy that Jordan has is its indigenous oil shale potential. As the Energy MInister says: "We are considering [LNG and oil shale], along with renewable energy as the best available solutions for Jordan in the medium term.

Oil shale, if heated to very high temperatures releases kerogen that can be stabilized, upgraded and processed into fuel. Across 60% of Jordan's territory there lie "huge proven and exploitable near surface reserves estimated at more than 50 billion tonnes", according to a report by the National Energy Research Center (NERC). Should these be commercially recoverable, they could become an important energy source and could potentially lead to energy self- sufficiency, according to NERC.

Plans exist to build power stations fuelled by oil shale. Attarat Power Company (APCO), partly owned by Estonia's Eesti Energia - which has decades of experience in oil shale to power - is currently negotiating a Power Purchase Agreement with the Jordan government for the construction of Jordan's first mine-mouth oil shale-fired power plant with a capacity of around 540 MW (gross).

In December last year, Eesti announced it had found a builder for the plant, and mandated the Bank of China and the Industrial and Commercial Bank of China to arrange debt financing and funding.

"Finalizing the first oil shale-fired power plant in the region definitely paves the way for others to come as well and there are currently several other companies investigating the feasibility of oil shale in Jordan," Eliis Vennik of Eesti Energia told *Gas Matters*. "Today it is still too early to predict the number of [future] oil shale fired power plants."

NEPCO has also signed an MoU with China's Lejjun Oil Shale Investments to build a 600 to 900 MW expandable oil shale power station .

APCO has been working on the power project since 2008 and the major milestones have so far included geological and hydrological exploration, combustion tests, engineering, procurement and construction tendering, financing activities and environmental impact assessment.

If construction starts at the end of this year, Jordanian customers could receive oil-shale-generated electricity in 2017.

The Israel paradox

Another option for Jordan's base load, cheaper than LNG, could be pipeline gas imports from its neighbour Israel which, in 2013, agreed to allow up to 40% of its gas reserves to be exported. Its Leviathan and Tamar fields in the Mediterranean hold about 30 tcf.

"Technically, Jordan could rely on Israel for its entire gas supply," El-Katiri told *Gas Matters*. "Jordan's market is compact, rather small and 2-4 bcm/year is really not a lot for Israel". The particularly attractive aspect for Jordan would be that Israel could be a stable, secure gas supply source. But it would also be the most politically difficult supply option for Jordan.

On February 19, 2014, Tamar operator Noble Energy announced the signing of a gas sales agreement with the Arab Potash Company and the Jordan Bromine Company, but expanding the arrangement to cover Jordan's power generation needs is likely to receive mixed support from the Israeli public.

El Katiri thinks that Israel will have a strong incentive not to disrupt supplies to Jordan. The countries signed a peace agreement in 1994 and it is likely that Israel will want to keep this relationship on best terms. And Jordan and the Palestinian territories are obvious first export customers because delivery would require only a few miles of pipeline.

Dargin agreed with El-Katiri. "I really don't think that will be an issue", he said, adding that security issues between Jordan and Israel are unlikely ever to be as bad as those affecting the Egyptian section of the AGP.

Yet the notion of buying gas from Israel remains domestically sensitive in Jordan. "Of course the Jordanian government needs to listen to public opinion [especially in the context of the Arab Spring], but it is not as officially hostile to Israel as Egypt," Dargin said. Both sides have strong incentives to start trading gas and the prospect of crippling blackouts or large domestic energy/power price increases could prevail over political animosity in Jordan.

Despite Noble Energy's expressed interest in the Jordan market, nothing has been agreed so far. The challenges that Israel and companies such as Noble operating Israeli's Tamar field will face are geopolitical and the final say in this matter will likely be with the Jordanian people.

But Dargin said: "They're in a really difficult situation and I really don't see who else could supply the gas at as convenient a price as potential pipeline gas from Israel. It really makes no economic sense for Jordan to import most of its gas needs as LNG. The Jordanian treasury would not even be able to afford it, to be frank about it".

"In the absence of the Egyptian gas option and any possible future gas coming from Iraq, Jordan's other main option is LNG, which will come in a lot more expensive than Israeli gas," said El-Katiri.

More coffee meetings

BP's withdrawal and Egyptian supply problems have put Jordan's reliance on one single source of energy under the spotlight. It is now facing a complex supply decision, but is not without options. What it could opt for is a matrix of different supply sources. LNG could cover its gas needs until 2020, but after that Jordan may need to come up with more affordable solutions for its power generation base load. As Energy Minister H.E. Prof. Dr. Mohammad Hamed told *Gas Matters*: "Jordan is looking for a cheap source of gas and once we have succeeded in finding this source we will not rely anymore on the LNG as its price is very expensive in comparison with prices of importing gas via pipelines".

To get there by 2020, Jordan needs to start building those solutions now. "Jordan is surrounded by countries which have enormous reserves of gas, so we surely look at these sources of gas in the neighbourhood countries to meet [domestic demand]," Dr. Hamed said. No wonder he had coffee with his Egyptian and Iraqi counterparts – more of these coffees are likely to follow. GM