Deal or No Deal? Natural Gas Supplies to Jordan

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1. INTRODUCTION

As a Jordanian expat, with a keen personal and professional interest in the energy policies in Jordan, I have been closely following the debate in the Jordanian media over the last few months regarding the supply of natural gas from Israel to Jordan. I have been exasperated by the amount of misinformation published and flabbergasted by claims made by so-called experts, who fabricate facts to deceive the public. I am not in a position to speculate what their motives might be but their actions have motivated me to write this piece and set the record straight.

There is a need to analyse the topic objectively, setting emotions, reactions and feelings aside. We must all be mindful of the facts and refrain from making fanciful claims.

Let us remember that this natural gas trade deal is not the first of its kind and history is full of examples where previous enemies collaborated, or even current enemies worked together for the greater good of both those interests. Recall that, at the peak of the Cold War, the Americans supplied the "evil" Soviets with their wheat needs and the Soviets supplied European NATO countries with the natural gas necessary to keep their economies rolling. Another notorious example was when Iran sourced its weapons from the so-called-then "Great Satan", i.e. the USA and Israel, during the Iran-Iraq War in the 1980s. Sometimes in politics, "the enemy of my enemy is my friend", and, "money makes the world go round".

Bearing this in mind, let's go back to the Jordanian-Israeli situation, take a brief overview of the state of the energy/power supply and demand in Jordan, then let's analyse the need for, and logic behind, the natural gas deal. Then let's look at all the alternative solutions proposed in the media to this natural gas deal.

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2. JORDAN'S POWER SUPPLY AND DEMAND OVERVIEW

Jordan's primary energy consumption is dominated by oil and natural gas which, combined, account for over 90% of the country's energy needs. However, with very limited oil and natural gas resources, 96% of primary hydrocarbon demand is met via imports.

Power generation (i.e. electricity) and transport sectors are the main consumers, with power demand representing just over 30% of the country's total energy demand. While this proportion is relatively stable, the amount has increased steadily as a result of an increasing population and the expanding economy. In numerical terms, the power demand has increased on average by 6-7% in the last 20 years. At the end of 2016 Jordan's power generation, installed, capacity stood at around 4.5 GW. Over 80% of this capacity can burn natural gas as fuel, (with the capability of either fuel oil or diesel being used as backup), while most of the remainder is oil fired. Renewable capacity can supply less than 10% of the total power demand, mostly from solar and wind, as well as tiny amounts from hydro or biogas.

Currently, most of Jordan's power generation capacity is operated by state-owned companies, but independent power producers are being actively encouraged to do so by the government. While power distribution is operated by several public and private companies, power transmission is monopolised by a single public company (NEPCO) which acts as a single buyer.

As can be seen, at the moment, the country's power generation comes from different sources. For the foreseeable future, the country will continue to rely on fossil fuels to fulfil its demands, although the share of non-fossil fuel contribution is growing, progress remains slow and, in my opinion, inadequate.

Since the Jordanian government has a duty to provide the country's power needs and to diversify its supplies; it has pursued relatively liberal policies in the power sector compared to its neighbours. At the moment, Jordan is recognised as the regional front-runner for power sector liberalization policies (unbundling, privatization). Furthermore, with Jordan's power demands expected to more than double from 2010 levels by 2023, and projected to reach 22 TWh, the government is scrambling to provide generation capacity to meet the increasing demand.

3. JORDAN'S NATURAL GAS SUPPLY AND DEMAND – HISTORICAL OVERVIEW

Unlike most Middle Eastern countries, Jordan is not blessed with economically feasible oil and gas resources. Until the mid-1990s, Jordan's power generation relied totally on fuel oil and diesel. Following a global trend adopted due to both economic and environmental reasons, Jordan has prioritized natural gas in power generation since 2003 as a way to decrease the costs of electricity generation. This strategic decision was taken in order to replace expensive imported fuel oil and diesel as primary power generation sources. In doing so, Jordan emulated other countries in the region such as Egypt, Israel, Kuwait and UAE.

Until recently, the power sector (which includes generation within industrial plants) was the only consumer of natural gas. This is changing slowly with other industrial establishments converting to gas. Following the construction of the first gas-fired capable power station in the mid-1980s, gas-

fired power capacity grew from 440 MW in 1995 to 3.6 GW in 2015. This translated to natural gas demand of over 300 MMscf/d in 2015 and is projected to reach 420 MMscf/d by 2020.

Initially, natural gas demand was met by local natural gas supply from Risha natural gas field in the Northeast of the country. However, as production declined and the field could not cover the country's needs, Jordan supplied its natural gas requirements by importing natural gas from Egypt via the Arab Gas Pipeline (AGP). Imports began in 2004 and increased steadily, peaking at 130 MMcf/d in 2009. By then imported natural gas accounted for over 90% of the power generation needs, while local production from Risha, which has declined to 20 MMscf/d, covers a maximum of 7% of the nation's needs.

Following the Arab Spring and the subsequent volatile security situation in Egypt, the gas supply became intermittent and volatile. In addition, skyrocketing Egyptian domestic gas demand has led Egypt to, initially, shut off its natural gas supply to Israel and then nearly all supply to the AGP, leaving Jordan largely without natural gas supply. Thus, to fulfil its obligations to generate electricity, Jordan was forced to revert to its backup plan of using fuel oil and diesel to generate electricity. This meant that natural gas share collapsed from 90% in 2009 to 18% in 2012, and then to a record low 7% in 2014. This unsustainable situation has massively increased Jordans energy bill straining the country's economy and forcing the government to increase electricity prices for consumers, which strained the volatile security atmosphere. To put it into numbers, power generation costs in 2013 were more than double the 2008–10 average.

Jordan rapidly developed a regasification liquefied natural gas (LNG) terminal at Aqaba that started operating in 2015, which by then was seen as the only short-term solution to the natural gas supply. LNG supplies rapidly reversed the declining share of natural gas in power generation, bringing it back up to 48% in 2015. Note that, even prior to the AGP cuts, a regasification terminal was on the cards and it was proposed as a way to diversify sources and achieve security of supply.

Since June 2015, LNG imports averaged 390 MMscf/d. They showed a seasonal pattern similar to the one seen in Kuwait and the UAE. Expectations were that imports would be strong for the first ten years of operation. However, natural gas pipeline imports from Israel (if materialised) will compete with LNG, and will likely be more commercially attractive. This will inevitably lead to a decline in LNG imports once the proposed pipeline imports begin.

In 2016, two deals were reached by Jordanian companies to import natural gas from Israel. First, in February, two Jordanian companies[2] agreed to buy at least 12 MMscf/d of gas over 15 years from Noble Energy and its partners from Tamar offshore field. This was followed in September by NEPCO who agreed a 15-year deal with Noble Energy and its partners to import 290 MMscf/d from the Leviathan offshore field. The combined flow can supply up to 40% of Jordanian power needs in 2023. The natural gas will be imported via a new pipeline. Note however that history tells us that, despite the reached agreements, we need to see implementation. Previous agreements, signed in 2014 to import Israeli gas via the pipeline, were subsequently superseded.

From the analysis above, we can see that natural gas is the best option to satisfy Jordan's power needs. However prudent policy planning calls for a mix of supply sources to realise the security of our supply goal. The ultimate goal is to be self-sufficient but, living in the real world, we know this

[2] The Jordanian government is a large minority stakeholder in both companies.

is not possible and a more realistic mix aim is where natural gas will be maximised while other sources will be also available and developed.

4. POTENTIAL NATURAL GAS SUPPLY TO JORDAN

Jordan needs to develop a policy where it can get its natural gas supplies from different sources. Multiple options are often the best situation, where natural gas can be sourced from different countries and with different means using multiple routes to satisfy the needs. This is the norm in many countries including the UK, China and Israel, where demand is met by a mix of local production, pipeline imports and LNG imports.

As stated earlier, until recently all Jordanian natural gas supply was used solely to generate power. However in the last year, some industries became natural gas consumers, and this trend is expected to expand. In the following section, I will look at the possible natural gas supply sources. Note though that given Jordan's history with Egyptian pipeline disruptions, it is unlikely that the country will rely entirely on another pipeline for all its future natural gas supply.

4.1. JORDAN'S LOCAL GAS SUPPLY

Current Jordan's proved gas reserves stand at 0.21 Tcf.[3] These sources are mostly located at Risha field. This local natural gas supply started production in 1989, peaked at 30 MMscf/d in 1998, and is now in decline. As stated earlier, the field's current production is just over 10 MMscf/d, supplying less than 7% of the country's needs.

The Jordanian government is still seeking to develop domestic conventional gas resources in the northeast. Concessions were given to several multinational companies, however there is little success to be reported, as the reserves appear to be technically challenging. In 2014 BP exited from the Risha field, the main target for increased Jordanian domestic production, where the government had hoped to increase domestic supply to 330 MMscf/d.[4] BP departed after it found no technical basis for development, and its withdrawal has damaged the prospects for domestic feedstock.

When it was first developed, the cost of Jordanian local natural gas supply stood at less than 2$/MMBTU. However the projected costs for future developments were as high as over 6$/MMBTU, thus, due to these high costs, the future project was deemed unfeasible and thus abandoned by BP.

4.2. PIPELINE SUPPLY FROM ISRAEL

Following several major natural gas discoveries in the last few years, current Israeli gas reserves stand at 7.1 Tcf.[5,6] A significant proportion of the reserves is owned by the American company

[3] BGR, Energiestudie 2016, Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen. Potential additional resources 12.3 Tcf.
[4] http://blogs.wsj.com/middleeast/2014/01/29/bps-risha-exit-means-slim-pickings-for-jordans-energy-needs/
[5] BGR, Energiestudie 2016, Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen. Potential additional resources 70.6 Tcf. Major fields are Tamar (11 Tcf), Leviathan (22 Tcf), Dalit (1 Tcf).
[6] To put it in context, Qatar's and Iran's reserves are 858Tcf and 1183 Tcf respectively.

Noble Energy, in partnership with the Israeli conglomerate Delek. This dominant ownership position has caused antitrust concerns and restrictions were imposed on the two companies by the Israeli government, forcing them to divest some assets and preventing them from participating in further bidding rounds.

These natural gas discoveries allowed Israel to become effectively self-sufficient since 2013. Currently, Israel's natural gas supply comes from Tamar's field initial two phases, natural gas from further phases in that field, as well as natural gas from the much larger Leviathan field, are yet to be fully allocated. In 2017 development plans for Leviathan, valued at 3.75 billion US$, were finalised. In February 2017, plans to develop a new cluster at Karish and Tanin has also been announced.

At the moment, Israel is awaiting bids in a new round of exploration blocks,[7] with results currently expected in 2018. As stated earlier, due to antitrust concerns, both Noble and Delek are reportedly ineligible to bid.

Despite all the discoveries, in an attempt to manage its domestic resources carefully, the Israeli government has been slow liberalising its natural gas sector. Israeli law stipulates that 60% of Israel's reserves would be retained for the domestic market, with the remaining 40% available for export. Thus the size of reserves is proving to be a continuous issue between the government and the fields' operators, as it can limit the size of allowed exports and thus affects the fields' development plans.

Mirroring the Jordanian story, the Israeli domestic power sector is converting from using dirtier hydrocarbons, i.e. coal and oil, to natural gas. This sector is the largest consumer of natural gas in the country. Initially, Israel's local production (started in 2004[8]) did not satisfy its needs and it had to import to meet the demand. It diversified its sources by importing natural gas from Egypt in 2008,[9] as well as constructing an LNG (Liquefied Natural Gas) import terminal, which started operation in 2012. Note however those LNG facilities were initially important when they were covering a short period of supply weakness, but their future role will be to supply periods of peak demand. Thus it is fully expected that LNG facilities and capability will be maintained as part of the mix to cover annual maintenance or in instances of unexpected disruptions to domestic natural gas production.

Due to the substantial size of the Israeli natural gas reserves, Israeli demand alone, even with its forecasted growth, cannot justify further gas fields' developments. Consequently, in order to justify further development, Israel needs to find export markets for its future natural gas production. Following several aborted plans to develop some of the fields as LNG projects, Israeli focus[10] has now shifted to developing multiple regional gas pipeline links. However, these plans suffered initial delays following several legal hurdles due to the concentration of gas reserve ownership. A legal settlement was reached between the operators and the government in 2015, paving the way for the

[7] An oil exploration block is a large area that is awarded to oil drilling and exploration companies by a country's government.
[8] Production started from Mari-B field, which, together with the smaller Noa and Pinnacles fields, is known as the Yam Tethys project.
[9] Egyptian supplies peaked in 2010 at 310 MMscf/d but proved unreliable, and were ultimately stopped in April 2012.
[10] This is driven mainly by corporations.

development of the Leviathan field to go ahead. In February of this year, the development plan[11] was approved. The field initial phase will produce 1.2 Bcf/d[12] and has scope for expansion to 2.1 Bcf/d. Production has been rescheduled to start from 2018 to 2019, although many analysts expect further delays. While all natural gas from Tamar's first two phases had previously been allocated to domestic buyers on long term contracts, it is clear that further development phases will need to find different markets for export.

From this analysis we can see that, despite what we are led to believe by some Arab media outlets i.e. that this gas deal is a new form of "colonialism" or control, it is, in fact, a mutually beneficial relationship.

In order to export its natural gas, which will utilise supplies from Leviathan and Tamar fields, Israel is considering several pipeline options to different countries. The main possible destinations are:

- Egypt, where the options include a reversal of the existing pipeline link with Egypt for domestic supply, as well as new undersea pipelines to Egypt to supply the country's under-utilised LNG liquefaction facilities in Damietta and Idku.
- Cyprus (and then possibly to Greece), or Turkey (via Cyprus or directly under the sea). However, a lack of inter-government agreement around East Mediterranean maritime claims could delay development of any offshore pipelines to Turkey and Cyprus.
- Jordan, in order to supply Jordan and the Palestinian Authority, only small extension pipelines would be needed from the existing Israeli grid.

As discussed earlier, natural gas from Tamar field was agreed to be exported to Egypt and Jordan. Initial agreements signed by two Jordanian companies to import Israeli natural gas from Tamar field in 2014 were suspended and then renegotiated to reduce the price. However during that uncertain time, in 2015 Israel approved two pipeline routes for the delivery of gas exports to Jordan.[13]

In the Leviathan field's case, to date, all contracts reached only cover approximately 50% of its production, thus far planning to supply local Israeli clients, Egypt's domestic market and its LNG terminals. The operator will need more contracts to cover the costs of its full production, with potential contracts pending both in Israel and Egypt.[14] Without additional contracts, the initial start date may be delayed. Consider two other factors; firstly that exporting gas to Egypt has complications and most probably will not materialise because of the current political factors, and secondly the latest gas discoveries in Egypt which may mean that supply from Israel is no longer necessary. As mentioned earlier, NEPCO of Jordan agreed to buy up to 25% of the field's initial production for 15 years.

The recently announced natural gas deal prices imported natural gas to Jordan at 5-6$/MMBTU. This amount is significantly lower than the price quoted for the, now-superseded, 2014 deal, which priced the natural gas at $7.5-9/MMBTU.[15] That deal included an allowance for the construction of

[11] The plan envisages a subsea system that connects production wells to a fixed platform located offshore with tie-in onshore in the northern part of Israel.
[12] The phase is divided into 2 sub-phases with Phase A producing 600 MMscf/d
[13] Israel approved a 15.5 km (9.6 mile) pipeline to Jordan in September 2015. The pipeline is an extension to the current Israeli grid.
[14] The Palestinians cancelled a contract in 2015.
[15] Much lower than the price it currently pays for crude oil in power generation

the associated pipeline between Israel and Jordan. At the time that figure was deemed reasonable as it was cheaper than LNG market prices, though it was more expensive than natural gas imported from Egypt.

To put the numbers in perspective, Israel paid $4–5/MMBTU range from 2009-2011 for its pipeline for natural gas imports from Egypt, while its LNG imports costs were reported to be as high as $18-20/MMBTU, (although costs have since fallen along with global spot prices). Likewise, Israel had to pay relatively higher prices when it ramped up its domestic production in 2010 and 2011 to compensate for faster depletion rates. Since 2014, its supply from Tamar averaged $5-6/MMBTU.

One claim, often published in the Jordanian media, infuriating public opinion, is that Jordan will be paying 10-15 billion to Israel directly. This is pure fiction. The numbers speak for themselves. The ownership of the Israel natural gas fields is private,[16] so the profits will go to shareholders. The cash paid goes to the operator, which is a private company based in Texas, whose shares are listed. The Israeli government revenue from the deal comes from taxes and royalties, which will amount to around 58% of the gross revenue minus all allowable costs, which include capital expenditure allowance, expenses, etc. This is the same system as that which operates in similar deals wherever they are made in the world.

4.3. PIPELINE SUPPLY FROM EGYPT

At the start of 2017, Egypt's gas reserves stood at 76 Tcf,[17] while this represents an increase on 2014 numbers, it is well below its peak. Egypt's gas production reached a peak in 2009 at 2.2 Tcf.

The decline coincided with a rapid increase in demand, where Egypt's power sector converted to natural gas, raising its share progressively to 83% in 2012. In 2011, Egypt began favouring the domestic market over its export customers. It started slowly cutting off most of its pipeline exports. Supply from Egypt to Israel was halted in 2012 and in 2013, it stopped supplying Jordan. In fact, the natural gas pipelines, from Egypt to Jordan and Egypt to Israel, were underutilized and since 2011, suffered numerous terrorist attacks causing significant damage, and repeated disruption. Finally, in 2012 Egypt reduced and then halted LNG exports (although a partial intermittent operation was resumed later).

In what appears now as a repeat regional story, by 2015, unable to meet its demands, some of Egypt's power generation was forced back to use fuel oil and natural gas share declined to 71%.[18] Egypt turned into a net natural gas importer. Initially, it imported excess LNG from Jordan in 2015 (in a reversal of the roles between the two countries) and then it rapidly increased its LNG imports since first imports arrived in Spring 2015. Moreover, after Israel thought it would turn the tables and start exporting gas to Egypt, instead, because of significant new discoveries (e.g. Zohr field in Egypt) and projections of growing domestic supply from existing fields, plans to import Israeli natural gas have gone on the back burner. Egypt's government expects to significantly increase domestic production and end LNG imports by 2021. However, this is not certain and some limited imports are expected to continue through 2030.

[16] The Leviathan partners (Noble Energy 39.66%, Delek Drilling 22.67%, Delek Group subsidiary Avner Oil 22.67%, Ratio Oil 15%)

[17] BGR, Energiestudie 2016, Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen. Potential additional resources 382 Tcf.

[18] Egypt uses gas also in many industries

Although Egypt used to be the main natural gas supplier to Jordan, a return to this position is highly unlikely. In fact, the possibility for Egypt to return to being a net exporter is very slim – unless there is an unforeseen increase in domestic production.

In the past, Jordan paid 2-3 $/MMBTU for imported Egyptian natural gas. The price initially agreed was too low, but subsequent agreements consistently increased the price to reach 5 $/MMBTU.[19] For Egypt, the absurdity of the situation became clear when looking at the different prices between Egypt's natural gas imports and exports, where the country paid almost double the price for its imports.[20]

4.4. PIPELINE SUPPLY FROM THE PALESTINIAN AUTHORITY

At the start of 2017, the Palestinian National Authority's natural gas reserves stood at 1 Tcf.[21,22] Since they were discovered in 2000, due to political uncertainty, they remain stranded and initial plans for their development have stalled.

Currently, the Palestinian Authority imports all its power needs from Israel and has no natural gas demand, although plans to utilise natural gas as the chosen fuel for power generation are in place, Israel has not given permission to develop it and the block holder (BG, now Shell) does not have final plans for development. Since the development of indigenous natural gas has stalled, the PNA will have to continue to import Israeli natural gas.[23]

This explains why the previous announcements made by some Jordanian officials concerning reaching agreements to import as much as 180 MMscf/d of Palestinian natural gas to Jordan, never materialised and are unlikely to in the future. Firstly, the resources need to be developed first, then the PNA will need its natural gas priorities supplying its own demand, and it will consider fulfilling its domestic consumption before considering exporting. If the natural gas to be exported, agreements need to be reached with Israel to allow the natural gas to pass through Israel, via the Israeli Grid. Even then, the volumes mentioned will only cover a proportion of Jordan's natural gas needs.

No price for the natural gas export to Jordan is mentioned. Thus it is not possible to determine its competitiveness in the supply mix.

4.5. PIPELINE SUPPLY FROM IRAQ

Iraq holds vast amounts of natural gas reserves estimated at 111 Tcf.[24] Despite these reserves, Iraq's natural gas infrastructure and usage remain underdeveloped and the majority of the

[19] The Egyptian agreement with Israel supplied the gas at cheaper rates.
[20] http://platformlondon.org/2013/04/01/egypt-to-keep-exporting-gas-to-jordan-despite-energy-crisis-searching-for-imports/
[21] http://www.palestine-studies.org/jps/fulltext/162608
[22] BGR, Energiestudie 2016, Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen. Potential additional resources 13.4 Tcf.
[23] In 2015, an agreement to supply Israeli gas to the PNA for power generation was cancelled.
[24] BGR, Energiestudie 2016, Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen. Potential additional resources 141 Tcf.

produced natural gas is either flared or re-injected to enhance oil recovery (EOR).

Historically, prior to 1990 invasion to use in EOR, Iraq exported natural gas to Kuwait. Recently, natural gas pipelines were constructed as export pipelines from Iraqi Kurdistan, or import pipelines linking the Iraqi and Iranian natural gas grids.

The saga of linking Iraq and Jordan via oil and gas pipelines is a very long one. While previous pipeline deals dated from as early as the 1980s never materialised, in 2016 Jordan and Iraq announced another pipeline project[25] and tenders were sought in early 2017. The latest proposal is a double pipeline to export Iraqi crude oil and gas via Jordan and provide Jordan with its oil and natural gas needs. The project is expected to provide Jordan with its energy needs and the rest of the resources would be exported to Egypt and other international markets via Aqaba. The routing of the pipe has been shifted closer to the Iraqi Saudi border to avoid unstable regions in Iraq. The natural gas pipe-line will be linked to the existing AGP to feed the Egyptian market.[26]

Many Jordanians opposing a gas supply deal with Israel have long argued that this pipeline project would be a feasible alternative to dealing with Israel. However, given numerous aborted pipeline projects between the two countries, one cannot be optimistic that this project will be different, therefore a deal must be considered.

No price for the natural gas export to Jordan is made public, however, estimates of around 4 $/MMBTU were mentioned. It is not clear if these numbers include transport costs.

4.6. PIPELINE SUPPLY FROM OTHER COUNTRIES

There is also talk of sourcing natural gas to Jordan from countries even further afield; suggestions include Cyprus, Iran, Qatar and even Lebanon. While all these suggestions are technically feasible, massive hurdles exist before it would be possible to make any of these visions materialise. All these visions depend on the collaboration of several countries, which alas seems improbable at present in the Middle East during these troubled times.

In the case of Cyprus, reserves at 4.5 Tcf[27,28] are relatively modest, although there are expectations that more discoveries will materialise. Furthermore, development plans for current fields have stalled. The Cypriot government is seeking to use Egyptian infrastructure as an outlet to export its natural gas. In order for this to happen, cooperation is key, as using existing inactive infrastructure will certainly reduce costs and be a win-win solution. In 2016, Cyprus signed an initial agreement with Egypt to transfer natural gas from its Aphrodite field to Egypt, which will have the option to supply its domestic market or re-export the natural gas via its liquefaction plants. One possible opportunity here is for Egypt to supply Jordan with Cypriot gas using its pipelines. If not, why not?

In the case of Qatar, proposals to build a natural gas pipeline to the Mediterranean and Europe via Jordan have never been advanced. Transport costs will erode any price advantages, unless Jordan is

[25] Capacity is 1 million bpd oil and 258 MMscf/d natural gas.
[26] http://www.thearabweekly.com/Economy/6277/Iraq,-Jordan-pipelines-in-the-works
[27] http://www.cyprusprofile.com/en/sectors/energy-and-environment
[28] BGR, Energiestudie 2016, Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen. Potential additional resources 8.8 Tcf.

used as a transit country and receives tariffs by allowing the natural gas to Europe through its territory to compensate.

In the case of Iran, the proposal is logistically feasible since the Iraqi and Iranian grids are already connected, thus any Iraq-Jordan pipeline will link Jordan to Iran pipelines. However, the prospect is currently a political impossibility. Iran has great ambitions to supply European customers, as well as Iraq and Lebanon, via several proposed pipelines will pass through Syria and Turkey. There is no potential for Jordan to act as a transit country to send Iranian natural gas to Europe, which means that higher transport costs will be a burden to Jordan.

Finally, the shadow of the sanctions re-imposed is a big risk.

Lebanon supplies are not an option as no reserves have been proven there yet, let alone developing or exporting them.[29]

4.7. LNG SUPPLY

Fundamentally, natural gas transport costs are cheaper by pipeline for shorter distances, up to 3000 km onshore and 2000 km offshore, giving economic advantage to pipelines over LNG.

LNG imports were originally proposed in 2010 as a more reliable gas supply source than the AGP(Arab Gas Pipeline). Following the secession of natural gas supply from Egypt in 2013, LNG imports became Jordan's only short term option for natural gas supply. Thus a regasification terminal in Aqaba was developed quickly and came online in May 2015.

As stated earlier, the terminal exhibited a seasonal profile similar to the UAE or Kuwait, but that differs from Egypt's profile, which is showing continuing growth. At the moment, excess Jordanian LNG capacity is exported to Egypt, as Jordan is piping gas through a reverse flow of the AGP.

In the first 18 months, the terminal imported cargoes from 11 countries, which include Nigeria, Trinidad, Tobago, Qatar, Equatorial Guinea, USA, Algeria and many European re-exporters.

Imports are expected to remain substantial through to 2030, although they will be reduced if the natural gas pipeline deal materialises. Also, the current exports to Egypt will inevitably stop when Egypt starts production from its new gas fields. However, expansion of Jordan's gas-fired capacity and projected natural gas demand will necessitate a small level of LNG imports to supplement proposed pipeline imports.

Thus, despite the potential for lower utilisation of the LNG terminal, Jordan needs energy diversification and security of supply. Accordingly the country will need to extend or replace its current LNG contract when it expires. However, possibly controversially, due to the expected pipeline supply from Israel, there will be no need to expand LNG import capacity to a second terminal.

At the moment Jordan pays 5-10 $/MMBTU for imported LNG. However as we know, this cannot be guaranteed, as LNG prices fluctuate. Since 2014 the prices reached a high of 20+ $/MMBTU and a

[29] BGR, Energiestudie 2016, Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen. Potential additional resources 30 Tcf.

low of 5 $/MMBTU. Therefore, while extending the LNG deal is feasible and workable. It can become more expensive and rise to more than twice the costs of imported pipeline gas, as the LNG price is forecasted to be volatile and fluctuate.

5. POWER MARKET SUMMARY: BESIDES NATURAL GAS WHAT ARE THE POWER GENERATION ALTERNATIVES?

Jordan has been pursuing an energy diversification strategy. This has become vital since the loss of the vital natural gas supply from Egypt which has been disrupted since 2011 and because the country cannot continue relying on importing costly fuels to meet its energy requirements. Jordan's aim of self-reliance is challenging but wise in the current climate. Besides natural gas, several options are being considered, including oil shale, nuclear, and renewables.

These alternatives to natural gas remain expensive, they face financing and technical challenges, some also meet local opposition and all carry different risks. I will just look at these options briefly.

5.1. OIL SHALE

Jordan has significant deposits of oil shale which cover over 60% of the country. The estimations of the deposits range between 30 and 70 billion tonnes and are of good quality. Plans to exploit these deposits go back to the late 1970s, with numerous studies commissioned to construct conventional combustion power plants. Various partners involved at various times were from Germany, Soviet Union, China and Canada to name a few, with several technologies being proposed. However, none of these projects were implemented for reasons too varied to go into now.

Since 2000 the Jordanian government has intensified its efforts to exploit these resources and offered several concessions to different international companies to develop the resources. The approach was open-minded, with the government allowing several experimental technologies to be piloted. Agreements were signed, to extract liquid oil from oil shale, with major oil and gas companies and/or to use the rock in an oil shale-fired power plant. While developments in the liquid oil extraction front were progressing slowly, development on constructing a power plant raced ahead, with the first plant expected to be operational by 2020.[30,31] The plant will have a capacity of 554 MW, sufficient to cover over 10% of Jordan's needs in 2020. Plans to construct other plants are in the pipeline.

It has to be noted that despite this progress, the latter solution is not sustainable either politically and environmentally. The high emissions produced contravene Jordan's COP21 commitments. Remember that a shale-fired power plant is equivalent to coal power station, which is very polluting and it goes against the global trend where coal fired power stations are discouraged.

Furthermore, besides the unfavourable economics extracting liquid oil from shale, all proposed processes require vast amounts of water. With the severe scarcity of water in Jordan, promoting such processes to extract oil is in fact completely irresponsible.

[30] http://www.jordantimes.com/news/local/construction-first-shale-power-plant-start-june
[31] https://www.enefit.jo/en/project

5.2. NUCLEAR

As Jordan has significant uranium deposits, proposals have been put forward since 2007 to build a nuclear plant with a capacity of up to 2 GW to increase self-sufficiency. However, the project suffered political and legal delays. Despite public assurances that the project is still active, in reality, it remains in the planning stage and its future is uncertain.

5.3. RENEWABLES

Jordan has set a 10% renewables target for its power supplies by 2020,[32] Renewables in Jordan are perused in two forms: solar and wind. Other forms (e.g. biogas, geothermal, hydro) are negligible. The number translates to 1.8 GW of which 800 MW is from solar and 800 MW from wind.[33] The policies adopted mean that the market conditions are relatively attractive for international players, both technology suppliers and project developers.

In terms of solar energy, Jordan has significant potential, with many areas experiencing solar radiation levels of well over 2,000 kWh per square meter annually, especially in the South. Jordan instigated a solar "hub" around Ma'an region. Several solar PV projects began operating in some of the best locations there. Projects are also encouraged elsewhere and some have already started.

In terms of using wind farms, resources appear to be attractive in parts of the country, where sites were identified with wind speeds of more than 8 m/s. Wind measurement data in Jordan suggests more than 1 GW of potentially viable sites.

Since 2012 the renewable capacity has quadrupled to reach 330 MW in 2016, although this is still below target. Solar has several advantages since solar availability is correlated to peak demand in summer, while wind may also help offset peak winter load generation. At the moment high power production cost from hydrocarbons and gradual increase in retail prices make solar PV and wind relatively cost competitive.

Land access is not a problem in solar PV projects since support for small-scale solar PV projects through a net metering scheme and energy wheeling is expected to lead to the build-out of solar PV by small consumers. On the other hand, land access can be problematic to develop larger wind power.

Grid constraints, causing transmission capacity bottlenecks that hindered further progress, are being addressed. An ongoing tender for the Green Corridor electricity grid project, intended to link renewable energy generation in the South of the country to population centres in the North, aiming to boost capacity by 1 GW, is underway. The project will be financed through multilateral loans and should be operational by 2018.

However up-front capital costs are considered a barrier, particularly for self-consumption systems. The lack of and the cost of financing have delayed implementation of several such projects.

[32] http://www.thenational.ae/business/energy/jordan-raises-solar-capacity-target-to-1000mw-by-2020
[33] https://www.pv-magazine.com/2016/10/21/jordan-initiates-the-green-corridor-tender-increases-pv-target_100026611/

This is likely to continue to have an impact on the pace of additions in the future. Furthermore, negotiating support schemes with the government is a time-consuming process.

6. CONCLUSIONS

From the brief analysis above, it is clear, that in both the short and the medium term, Jordan will need a reliable natural gas supply to fulfil its power needs and to diversify its energy resources. A lot has been written about the possible alternatives. As can be seen, apart from natural gas, none of them alone are an adequate solution.

Even though analysts forecast slower power demand growth due to energy efficiency policies, overall demand in Jordan will continue to grow. Thus the economic headwinds facing electric intensive economic sectors have to be addressed, while at the same time the government need to be sensitive to the weak household income growth and therefore be mindful of the power costs.

Consequently, several points need to be highlighted where alternatives to using pipeline natural gas or LNG are mentioned:

- The claim that potential natural gas production from shale gas resources can satisfy the kingdom's gas needs is unrealistic. The reserve amounts are not proved and the costs to produce gas are very high. Technically, Jordan does not possess the drilling rigs or fracking crews to start a sizeable fracking operation. Furthermore, the process needs substantial amounts of water, which again can prove to be a hurdle to development in Jordan.
- The claim that the decline in natural gas at Risha field is due to mismanagement, is untrue. While the lack of maintenance did indeed contribute to the decline in production, the field had reached its natural decline stage. Moreover, the huge numbers quoted by some media outlets as 'remaining natural gas reserves' are in fact resources, where in reality only a fraction of it is recoverable and at current natural gas prices, further expansion appears to be economically unfeasible.
- Renewable energy cannot satisfy 100% of the power needs for the foreseeable future and saying otherwise is optimistic at best, deluded at worst. While its share will certainly grow, it will continue to be a complementary source of power as it is intermittent and unreliable. Thus conventional fossil fuel power stations will continue to be relied upon to provide the base load power for the foreseeable future.
- Both oil shale and nuclear power stations require vast amounts of water, which is an extremely scarce resource in Jordan and, even though both projects may go ahead, the strain on water supplies will have a significant impact on the country as a whole.

It is evident that Jordan's prosperity will be connected to providing affordable natural gas supply. The lessons learned from the Egyptian natural gas disruption led Jordan to pursue diversification of supply policies. As a result, the Jordanian government is looking at a range of options to diversify its

energy supply, with piped Israeli gas representing a relatively inexpensive, if politically controversial, option.[34]

However, the relatively high cost of LNG imports, likely to be nearly double the expected cost of Israeli pipeline imports, means that Israeli gas remains attractive for financial reasons, despite political obstacles.

Consequently, the Jordanian government needs not to become emotional about these decisions. Decisions need to be based on accurate and factual information, which puts the country's prosperity first, and officials should ensure they have professional or expert sources for the information upon which they base their decisions. Officials should not bow to pressure as a result of listening to an uninformed, biased or ignorant media who warns of exaggerated dangers, and who base their decisions on ideological agendas. Moreover, the responsibility must be shared by the public, who might be influenced by the media and apply pressure on the government because they are misinformed or incited to do so by the media. They also need to check the facts before believing what the media tell them, and then choose how to respond wisely.

[34] Similar to any contractual obligation, a natural gas deal will inevitably include break clauses, so the claims that the contract ties the country are arguable. Just consider the Egyptian natural gas supply contract to Jordan as an example.