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Lebanon's Gas Trading Options

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Introduction

Lebanon's exclusive economic zone (EEZ) forms part of the Levant Basin,[2] which has been estimated to hold up to 122 trillion cubic feet (tcf) (3.45 trillion cubic meters [tcm]) of recoverable natural gas, in addition to some 1.7 billion barrels of recoverable oil (US Geological Survey 2010). Lebanon's seabed could contain significant hydrocarbon potential; an initial estimate indicates up to 30 tcf of natural gas (about 850 bcm) and 660 million barrels of oil. Gebran Bassil, then acting minister of energy, raised these estimates to 95.5 tcf of natural gas and up to 865 million barrels of oil, in October 2013, although no exploratory drilling had been conducted (Reuters 2013). Spectrum—a Norwegian company that had carried out Lebanon's first 3D seismic survey in August 2012—has estimated the country's recoverable offshore gas reserves at 25.4 tcf (Wood 2013). Clearly these varying estimates are representative of considerable uncertainty.[3]

A long-term importer of energy, Lebanon could benefit tremendously from developing its prospective gas reserves by generating a new and potentially important stream of revenue, enhancing its energy security, and reducing air pollution by replacing fuel oil in power generation. But a long history of paralysis in the decision-making process due to the sectarian nature of the political system and long delays in the implementation of a suitable legal and regulatory framework, constrains Lebanon's prospects for short-term development of gas reserves,[4] taking the time period for possible Lebanese gas developments further into the mid-2020s. Therefore, in the short term, it is expected that Lebanon will import natural gas to help it gradually replace oil in power generation, and prepare the domestic market for what may yet turn into a fundamental turn of fortunes. The successful development of Lebanon's offshore gas resources could indeed turn Lebanon into a self-sufficient producer and a potential exporter of natural gas.

Central to the government's objectives of maximizing economic gain from the development of Lebanon's offshore gas reserves and providing the right incentive structure for international oil and gas companies to develop these resources will be decisions on whether to export part of Lebanon's hydrocarbon wealth, what share of reserves should be earmarked for export, and how to identify and secure export markets for natural gas. This paper provides an introduction to Lebanon's available options for the monetization of its expected offshore gas resources. While decisions concerning the destination of Lebanon's eventual hydrocarbon wealth—if and when this materializes during the 2020s—are key to putting the right policy framework in place, Lebanon will also need to consider interim solutions in order to secure gas for its domestic energy market until the country's own

2
The Levant Basin is bordered by Turkey, Syria, Lebanon, Israel, the Gaza Strip, Egypt, and Libya.

3
A number of companies have been acquiring data in offshore Lebanon. In 1993, 2D seismic surveys covering 508 linear kilometers off Tripoli were acquired by Geco Prakla. A data set from Spectrum (a Norwegian company that provides seismic surveys) includes 3D seismic surveys covering 5,360 km^2 (2012-13) and 5,172 linear km of 2D (2000-02). Petroleum GeoServices (also a Norwegian company) data sets include 3D seismic surveys covering 9,700 km^2 (2008-11) and 9,700 linear km of 2D (2006- 2012) seismic data. For more information, see Lebanese Petroleum Administration, www.lpa.gov.lb.

4
The final deadline for submissions to Lebanon's first bidding round has been delayed a number of times; from early 2014 to August 2014, and then into 2015. No results have been reported at the time of writing. Lebanon's progress on the issue can be followed on the Petroleum Administration's website at www.lpa.gov.lb.

offshore gas production is able to supply the domestic market. Lebanon's economy could significantly benefit from interim imports of natural gas; flexible liquefied natural gas (LNG) imports would be the most practical option given the current lack of regionally available pipeline gas supply options.

Lebanon's latecomer status within the East Mediterranean, both as a natural gas importer and as a potential gas producer and exporter, are likely to constrain its future policy choices. It is important to stress that the constraints affecting Lebanon in this sense are mainly driven by internal factors, due to the political polarization and fragile political consensus that have crippled key institutions for many years, in addition to delays and inefficiencies in the decision-making process that have already resulted in many lost opportunities. All the more important to an assessment of the different import and export options for Lebanon will thus be the timing of gas exports. In addition to these internal dynamics, the complex geopolitical landscape and long-term conflicts across the region will impact Lebanon's choices over possible monetization options.

The paper proceeds as follows: Section one begins with a discussion of Lebanon's import options, with a focus on the high degree of uncertainty concerning prospective decisions and a discussion on the advantages of flexible LNG. Section two examines Lebanon's various export options; these remain highly time sensitive, and are hence indicative only. Section three offers some conclusions and suggestions.

I Short-term natural gas imports for Lebanon

Natural gas has played a very limited role in Lebanon's energy mix. The main constraint to the penetration of natural gas in its energy mix has been a lack of access to gas supplies. Lebanon has no proven natural gas reserves and its options to import gas from neighboring countries have been limited. Furthermore, relatively low world market prices for oil during the 1980s and 1990s reduced the incentive to switch from the use of fuel oil in the power sector.

Rapidly growing electricity demand and higher prices for crude oil and petroleum products in international markets from the mid-2000s, however, contributed to a reconsideration of Lebanon's energy supply options throughout the last decade. As end-user electricity prices are essentially determined by the government (at levels significantly below the full cost of generation) the state-owned power generating sector budget can save a significant amount of money by switching from oil to gas. The Ministry of Energy and Water (MEW) estimates that at the price of $90 per barrel, Lebanon can save $1.9 billion on its annual fuel bill if it switches its power generation to gas (MEES 2013a). Figure 1 illustrates the size of the deficit associated with the level of

fuel prices incurred by the public electricity company Électricité Du Liban (EdL), using the example of $40 and $90 per barrel fuel costs for imported petroleum under a business-as-usual scenario.

Figure 1 **EdL deficit increases relative to rising fuel costs (in $US million)**

*O&M: Operations and Management

Source **Report published by the Lebanese Energy and Water Minister Alain Tabourian**

The prospects of Lebanon establishing its own offshore gas reserves and lower oil prices have not fundamentally changed this rationale. However significant Lebanon's eventual hydrocarbon reserves may ultimately turn out to be, their development and production is many years away, leaving a domestic gas supply gap over the short- and probably medium-term that may turn Lebanon into a net importer of natural gas well into the early 2020s. By this time, Lebanon would likely benefit from having begun to address some of its structural problems in the power sector, including: An urgent need to reform the power sector, a crackdown on illegal electricity connections, and an overhaul of social services that provide the most needy elements of society with stable, secure electricity access, including those living in shanty towns and informal living spaces.

The importation of natural gas, until Lebanon's own potential gas reserves are developed, could prove advantageous in light of its envisaged/hoped for self-sufficiency by the mid-2020s. While there is certainly potential for Lebanon's natural gas deposits to contribute to a more diversified energy mix and reduce import costs, the country will need to be prepared—with infrastructure in place and end-user

market sectors established—to absorb its own natural gas production when that time comes. Steps toward creating this state of readiness would include: Building new pipelines, converting some existing power plants to use natural gas, investing in new gas-fired power plants and, potentially, investing in other gas-based sectors. Importing natural gas during the rest of this decade could facilitate the shift toward natural gas, allowing a gradual switch from oil-fired to gas-fired power generation, as well as opportunities for research and development in areas such as the application of natural gas in the transport sector.

a Lebanon's gas import requirements could be large

Despite the potential penetration of gas in other sectors of the economy, the future evolution of natural gas demand will be strongly interlinked with that of electricity demand. From 2000 and 2009, electricity demand in Lebanon increased at an annual average rate of 5.3%, slightly higher than the average real GDP growth rate during this period. This average number, however, masks some important trends, as most of the growth in electricity consumption occurred in the earlier years of the period. For instance, between 2004 and 2009, net electricity consumption grew on average by 2.15% per annum while real GDP expanded at an annual average rate of 5.7%. This is atypical of a developing country such as Lebanon where electricity demand can generally be expected to grow faster than GDP. In fact, publicly available data on electricity consumption does not give an accurate reflection of the actual growth in electricity demand, due to the fact that a significant portion of demand is met by self-generation (mainly diesel powered), while a large portion of electricity demand remains unsatisfied due to a lack of capacity in power generation (World Bank 2008).

In Lebanon, installed power generation capacity effectively stagnated during the 2000s, increasing only marginally from about 2,292 megawatts (MW) in 2000 to 2,314 MW in 2009, equivalent to an average annual growth rate of only 0.25% during this period. EdL suffers from huge financial and operating losses, which have to be covered by direct transfers from the government. In 2008 and 2009, these transfers constituted 25% and 20%, respectively, of the government's primary expenditure (Daily Star 2013).[5] EdL also suffers from chronic under-investment, which has prevented it from modernizing its grid and expanding power generation capacity up to now. The slow pace of expansion in new generation capacity in the face of rapid electricity demand growth has had a large impact on the quality of electricity supply in Lebanon; estimates suggest that residential consumers suffer up to two hundred twenty days of interruption per year—the worst record in the MENA region. A similar situation prevails in the industrial sector which, despite heavy investment in private power

5 The Daily Star report suggests that out of the $2 billion annual losses incurred by EdL, nearly 15% is due to theft and technical losses and the remainder is due to the high cost of fuel.

plants for backup supplies, still suffers huge financial losses from power supply interruptions, with the average firm losing up to 7% of its sales value (World Bank 2008). Public investment in new generating capacity needed to meet this increase in electricity demand is unlikely to be forthcoming anytime soon; this suggests that even if (or when) its own natural gas supplies become available, Lebanon's electricity supply problem will be far from resolved.[6]

The Lebanese government has very ambitious plans to increase the share of gas in the power generation mix. A 2010 policy paper for the electricity sector prepared by the MEW proposes a diversified fuel supply, with an ambitious plan to increase the share of natural gas from its current level of zero to two-thirds of the fuel mix by 2030 (Bassil 2010). This, however, requires major investment, not only in the construction of new gas-fired plants, but also in changing the configuration of existing power plants. Lebanon has two Combined Cycle Gas Turbine plants (Beddawi or Dair Ammar and Zahrani) with an installed net capacity of 435 MW each, constituting about 50% of Lebanon's generation capacity. These plants can run on gas feedstock but have not been operating optimally due to a shortage of gas; in 2011, following the cessation of Egyptian gas imports, the share of gas in the fuel mix of the power sector declined to zero (Darbouche, El-Katiri and Fattouh 2012). Furthermore, Dair Ammar is currently Lebanon's only power plant that can burn gas without reconfiguration, making technical upgrades for Lebanon's three other power plants (Zahrani, Zouk, and Jiyyeh) necessary, in order for gas entering Lebanon's energy mix to be used efficiently (MEES 2013a, MEES 2014).

A 2010 ESMAP study estimates that Lebanon's gas demand will reach 2.6 bcm in 2020, increasing to almost 4 bcm/y by 2030 (ESMAP 2010). The MEW puts the figure at the higher level of 5.8 bcm/y by 2030 (Sleiman 2012). Although the MEW also has ambitious plans to extend the use of natural gas to the industrial, commercial, and residential sectors, and to convert the nation's ground transport fleets to compressed natural gas (CNG), in the timeframe of this study, it is unlikely that an appropriate distribution system will be in place. It is hence safe to assume that the power sector will remain the main source of gas demand. Regardless of estimates of Lebanon's potential gas demand, a key issue remains: How Lebanon can secure gas supplies to meet the expected increase in gas demand over the next decade.

6
The latest plans to build a 450 MW combined-cycle gas turbine and a 180 MW reciprocating engine unit have been postponed over allegations of corruption and the lack of a clear energy policy.

b Regional pipeline imports

The main historical barrier to raising the share of gas in Lebanon's energy mix has been access to gas supplies. Natural gas entered the energy mix for the first time in 2009 when the Arab Gas Pipeline (AGP), which also supplies Jordan, started supplying some 200 million cubic meters (mcm) of Egyptian gas to the Beddawi power plant.[7] However, the entry of natural gas was very brief. Since 2009, the flow of Egyptian gas has been subject to frequent disruptions due to delays in payments and more recently due to a series of explosions targeting the AGP. The last delivery of Egyptian gas to Lebanon was made in November 2010, while Jordan has since been subject to frequent delivery cuts, reductions in contract volumes, and parallel price rises (MEES 2012a). Egypt's unstable political situation and its growing domestic demand for natural gas have since cast severe doubt over its capability, or indeed willingness, to continue supplying regional partners with low-cost pipeline gas over the short and medium term; Israel has already experienced this, having seen its separate gas supply contract cancelled in April 2012 (Darbouche and Fattouh 2011 28–9, Platts 2012).

Other neighboring countries seem increasingly short of gas themselves. In 2003, Lebanon signed a 25-year contract with Syria to import about 1.5 bcm/y of natural gas (World Bank 2004). The Gasyle pipeline, a 32 km pipeline with capacity for 3 mcm/day stretching from the Syrian border to the Beddawi power plant, was completed in 2005. However, Syria has not been able to supply Lebanon with gas, as its production has not been sufficient to meet domestic consumption, and the country's ongoing civil conflict at the time of writing casts substantial doubt over Syria's ability to significantly change its natural gas supply picture within the next decade.

Iran has been discussed as a potential gas supplier to Lebanon (MEES 2012b, 18–19). A pipeline project carrying up to 25 bcm of Iranian gas to neighboring Iraq and Syria (the 'Islamic pipeline') could have turned into a lifeline for Lebanon's gas industry. However, since its announced construction launch in November 2012, the project has suffered from a series of funding issues and from practical above-ground issues related to the continuing complicated security situation in Iraq and, since 2011, the deteriorating political and security situation in Syria (MEES 2012d).

Similar considerations could be applied to eventual gas imports via Turkey, possibly with gas supplied by Russia, Azerbaijan, or Iraq. Plans for the connection of the existing AGP to Turkey have been discussed for many years and would, in practice, be straightforward and cost-effective, particularly when compared to more capital- and infrastructure-intensive LNG imports (MEES 2012b). However, the Iraqi

7 In reality, Syria supplied the gas via a gas swap agreement between Egypt and Syria at the time.

central government's plans to produce enough natural gas for export have slipped. Once again, political turmoil in Syria, Iraq, and also Turkey renders any prospects for a near-term progression of gas imports via Turkey from any supplier country more remote and at best years away, past the point at which Lebanon would aim to be importing natural gas.

c Flexible LNG imports

Given Lebanon's limited opportunities for securing pipeline gas imports from neighboring countries, LNG remains the country's only realistic option. Lebanon has announced plans to start importing flexible LNG from 2015 onward, expecting 12 years of imports until its own domestic production (currently earmarked for the 2020s) can replace imported LNG (MEES 2012c, MEES 2013b, c). These plans are not new; LNG has been considered an option since the 1990s, but the initially high construction costs for an onshore regasification terminal turned policy efforts toward securing lower-cost regional pipeline gas imports (LNG Intelligence 2013). Government forecasts project Lebanese LNG demand will amount to 1.7 mtpa by 2016, soaring up to 4.2 mtpa by 2030, despite no indication as of yet about how and whether LNG demand by 2015 will indeed be met by building LNG import capacity (LNG Intelligence 2013).

The MEW has meanwhile proposed the construction of a floating storage and regasification unit (FSRU) in offshore Lebanon's coastal areas (MEES 2012c). Designed as a stop-gap measure, the FSRU offers relatively shorter construction times than those otherwise associated with a permanent, onshore regasification facility, with some potential for additional, moderate cost savings. In 2013, Lebanon closed bids for two LNG tenders: One to install a build-operate-transfer (BOT) FSRU and the other for an LNG import contract. A shortlist of three possible FSRU candidates was reportedly prepared for submission by the MEW to the Council of Ministers in April 2014, with similar steps about to be taken for the LNG supply contract. However, endemic delays in decision-making tied to Lebanon's political deadlock (also affecting the now-stalled onshore pipeline system intended to link Beddawi, as the entry point for imported gas, to Lebanon's three other power plants) are casting doubt on when this plan might proceed (MEES 2014).

II Monetizing Lebanese Gas: Export Options for the Medium-Term

Assuming that Lebanon does eventually develop its natural gas reserves, the country will face an array of choices concerning how to monetize its hydrocarbon riches via gas exports. Lebanon's location in the Eastern Mediterranean, with good coastal and land access, provides it with a natural advantage for gas exports. Lebanon has a number of regional trading options (Darbouche, El-Katiri and Fattouh 2012, Fattouh and El-Katiri 2015). Export potential will be critical for securing the initial interest of foreign investors.
Lebanon's eventual export strategies will, to a large extent, depend on:

- The price range it is able to secure (this will be determined by the eventual size of its reserves, its production targets, and the cost of its gas production)
- The timing of its first gas exports, in view of surrounding gas market dynamics
- Other external factors, such as gas price levels in potential export markets by the time production begins

Lebanon's likely option of cooperating with neighboring Cyprus over shared LNG facilities may also impact Lebanon's export choices, provided these choices are indeed still available by the time Lebanese gas production is set to commence. While many foreign investors may indeed pressure Lebanon to consider LNG exports as a first priority, Lebanon will be well advised to consider carefully all available export options, including regional pipeline exports to the Middle East, as well as to Turkey (and possibly onward to Europe). The latter options may prove of particular value if Lebanon's eventual reserves prove to be significantly below current government estimates, thereby placing limits on the commerciality of LNG exports under long-term contracts.

Indeed, the degree to which all of these options will apply likely depends to a large extent on the timing of Lebanese gas exports and the country's ability to use the right time windows to enter into its preferred markets. Lebanon's already much-delayed offshore bidding round, the tendering process, and the length of time taken (from initial exploration, then appraisal drilling, production, and eventually export) all imply that current predictions of Lebanese gas exports being merely some four years away from the time of comments made in 2013 (in other words, with start-up in 2017) are at best ambitious, and indeed highly unrealistic. The Lebanese government's more recent discussion of an eight-year timeframe, with exports starting during the early 2020s, seems considerably more realistic, but may still be delayed by further political stalemate. By this time, Lebanon will

likely find itself in a fundamentally different market than it is today—it will be the last country in the region to choose how and where to market its natural gas, and it could hence be forced to target more distant markets.

a Pipeline options (I): The Middle East

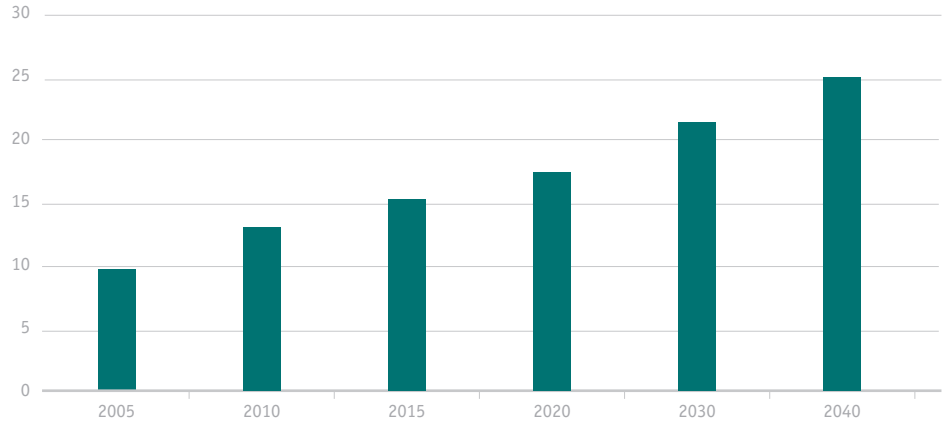
Traditionally, the first option considered for exporting natural gas has been via regional pipeline exports to neighboring countries in the vicinity of natural gas producers. While the natural gas trade has gradually been moving toward more flexible exports via LNG, there are good reasons to consider the pipeline option before all others, including:

- The general shortage of natural gas throughout the Levant region (hence, there are potentially receptive markets)
- Regional pipeline exports typically entail the lowest infrastructure costs, especially where exports are over land (rather than via sub-sea pipelines which tend to be more expensive), thereby promising (at well-negotiated contract prices) a high proportion of export rents to initial capital expenditure
- Lebanon's stable relations with neighboring countries (such as Turkey, Syria, and Iraq) strengthen its case as a logical gas trade partner with these countries which are, and will likely remain, important growth markets for at least another few decades
- Low infrastructure costs make the pipeline option affordable even to countries with limited public finances (with the additional benefit of reducing the reliance of newly producing countries on foreign partners). This also makes regional pipeline exports the most feasible export option for Lebanon in the event that reserves turn out to be smaller than expected and are not sufficient to allow for LNG exports. Pipeline exports therefore remain the most realistic fall-back-option in the event Lebanon's natural gas reserves prove to be significantly smaller than current government estimates

Lebanon is not short of gas-hungry neighbors, and given the MENA region's expected growth in natural gas demand over the coming decade (Figures 2 and 3), it may indeed find itself in the fortuitous position of being able to negotiate with several countries over pipeline gas exports once Lebanese gas comes on stream. This is likely to be the case even if gas exports commence no earlier than the 2020s, as the expected surge in natural gas demand across the Middle East—as a result of switches from higher-cost oil and oil products toward natural gas, and the expected rapid growth in electricity demand—is likely to continue throughout the 2020s and well into the 2030s (IEA 2013).[8]

8
IEA estimates indeed suggest that gross Middle Eastern demand for natural gas—including Lebanon's immediate neighborhood in the Mashreq, together with Iraq, Iran, and countries in the Arabian Peninsula—may overtake US demand for gas by 2030.

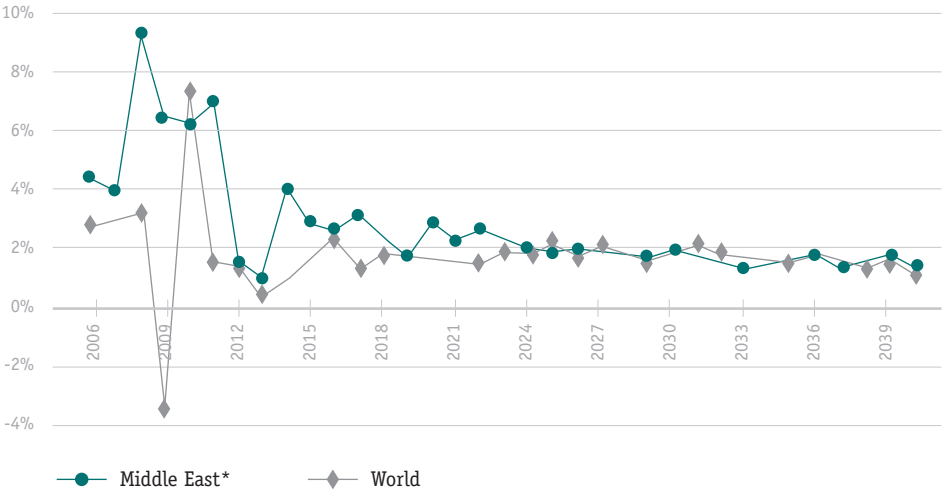
Figure 2 **Projected natural gas demand in the Middle East* (bcf), 2010–2040**



*The Middle East includes Bahrain, Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates, and Yemen

Source **EIA (2014)**

Figure 3 **Projected natural gas demand growth in the Middle East (%), 2010–2040**



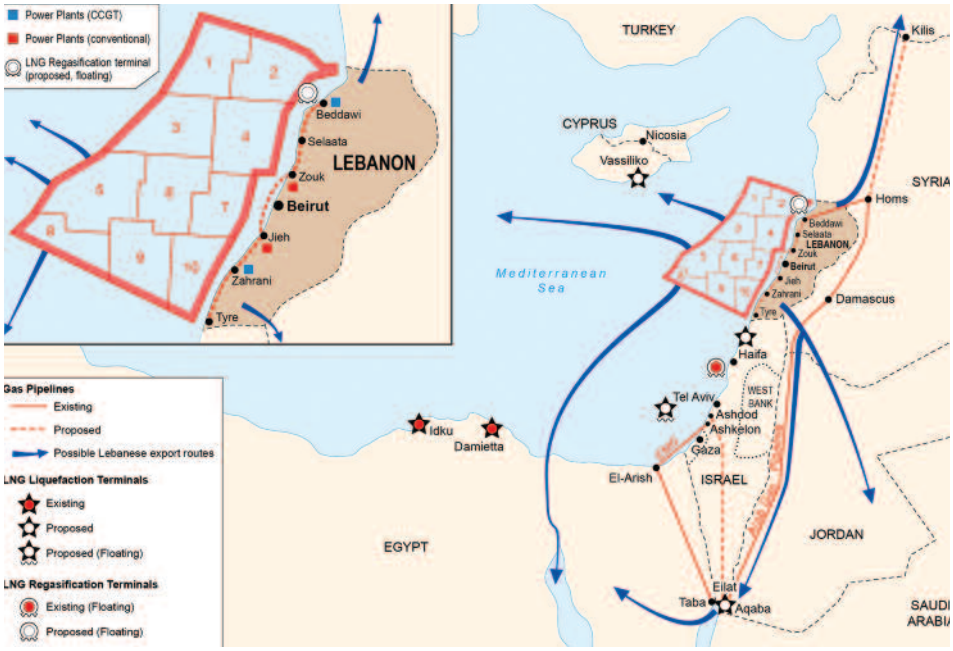
*The Middle East includes Bahrain, Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates, and Yemen

Source **EIA (2014)**

The markets of Jordan and Egypt, Lebanon's southern neighbors, could be particularly favorable in terms of low initial infrastructure costs, as they are already connected to Lebanon via the AGP (Figure 4: Lebanese natural gas trading options). A lack of Egyptian gas for export since the early 2010s (Aissaoui 2013, El Katiri 2013) and poor prospects for future Egyptian gas supplies to the region, mean both Jordan and Egypt could become markets for any new Levantine gas supplies, though the discovery of the new gas field Zohr in offshore

Egypt, estimated to hold up to 30 trillion cubic feet of gas, would limit Egypt's gas imports. Originally transporting Egyptian gas toward Jordan and Lebanon, the AGP could be used to reverse-transport Lebanese gas toward both markets, subject to a small but comparably inexpensive linking of Lebanon to the pipeline. The option obviously entails costs and complications—notably as the route is long and subject to political disruptions, including in Lebanon's direct neighbor Syria and, in the case of gas exports to Egypt, on the Arabian Peninsula.

Figure 4 **Lebanese natural gas trading options**



Source **Oxford Institute for Energy Studies**

Nevertheless, the commercial potential of regional exports to Egypt and Jordan is so attractive that currently even Israel has been seriously considering the option—a development which, if it materializes, may yet render all talk about Lebanese gas exports to these countries redundant, as Israel will have captured these markets by the time Lebanon could be in a position to export (Globes 2013). This will naturally require that a cost-reflective price is paid by both importing markets to their supplier—one far above current domestic price levels in both Egypt and Jordan. But in the absence of significant capital expenditure associated with pipeline infrastructure, ample scope exists for pipeline supply contracts, with prices at a significant discount compared to any contracted LNG, while providing healthy margins to gas exporters. The incremental natural gas needs of the Jordanian and Egyptian gas markets—the latter being self-sufficient to some extent

while continuing, on a net basis, to export some volumes of gas under existing long-term LNG contracts—are relatively small, and may not exceed the 5–10 bcm level by the mid-2020s.

Its relatively uncomplicated relations with various neighboring Arab countries also predestine Lebanon—unlike Israel, its only other current competitor on land in the East Mediterranean—to consider gas exports to other neighbors in the Middle East, particularly Syria and Iraq. While both countries may yet develop their own natural gas reserves over the medium and longer term, to become self-sufficient producers of gas, they both face medium-term supply gaps, creating opportunities for Lebanese gas throughout the 2020s (Alsumaria 2013, EIA 2013a, EIA 2013b).[9] Furthermore, since neither country has diplomatic relations with Israel at the time of writing, Lebanon could fill an important role as a geographically close supplier of natural gas, maximizing the value of its exports through low transport costs via regional pipelines, while offering prices which are competitive with both pipeline gas transported over longer distances from Inner Asia and high-cost contracted LNG imports. Both Iraq and Syria, at the time of writing, continue to be entangled in severe domestic instability resulting from the post-2003 removal of Saddam Hussein's regime in Iraq, and the political infighting that broke out in Syria in early 2011 as part of the Arab Spring uprisings that have shaken much of the Arab world since 2010.

While the above export options may be short in term, they also promise regional low-cost possibilities. They are particularly attractive if smaller-than-expected natural gas reserves in offshore Lebanon do not favor high-volume, long-term contract options.

Some of the biggest challenges which could prevent Lebanon from realizing the commercial advantages of these regional export options will lie within the country itself. The primary challenge will be in Lebanon's ability to provide a domestic contracting framework to foreign investors—one that is sufficiently competitive and stable to allow for the development of gas resources tied to pipeline export options that involve some political and commercial uncertainty. A further challenge is presented by the need to stabilize the country's domestic political situation and its gas contracting frameworks—rendering Lebanon a desirable, reliable, and stable gas exporter to potential regional clients. Political instability inside Lebanon, in the form of contracting indecision, can in this context be as harmful as the threat of sabotage of infrastructure, leading to scenarios similar to those encountered by Egypt with regard to its pipeline infrastructure in the Sinai Peninsula prior to, and following, the Mubarak regime's displacement in 2011 (Zawya 2012a). Lebanon's regional gas exports will also depend strongly on whether potential regional export partners find and

9
The latest available data for Syrian gas imports for 2011 suggests a drop of Syrian exports from Egypt from 24.4 bcf in 2010 to 8.5 bcf (about 235 million cubic meters) in 2011. Although political turmoil in Syria is likely to temporarily impact Syrian gas demand downward (owing to the economy's collapse during 2012/13), demand is likely to recover quickly once stability is restored. Iraq, while formally not yet a net importer, is thought at the time of writing to have been importing Iranian gas informally and is likely to increase these volumes throughout the 2010s subject to insufficient domestic gas production within Iraq.

contract alternative gas sources by the time Lebanon decides to negotiate over regional gas exports—probably no earlier than by the end of the 2010s at the current pace of exploration and production licensing. The ability of negotiating parties on both sides to agree on gas prices, a contentious issue that has previously prevented other regional neighbors, such as the GCC economies, from agreeing on mutually beneficial regional gas pipeline trade (Fattouh and El-Katiri 2015) will also be of great importance.

b Pipeline options (II): Turkey and Europe

Lebanon's pipeline export options are not limited to the Middle East alone. Its proximity to Turkey, and thereby to European markets, also offers the potential for Lebanese gas exports northward, supplying the Turkish market and/or feeding into regionally sourced pipeline options toward Europe.[10] The potential benefits could be multiple:

- Turkey's explicit interest in becoming an energy hub for pipeline gas toward Europe renders it a potential key transit market for European pipeline gas from the East Mediterranean as well as the Caspian Sea, thus presenting an ample opportunity for Lebanese gas to feed into the European market
- Pipeline gas to Turkey promises significantly lower initial infrastructure costs than an LNG plant (as seen above in the discussion of pipeline export options to the Middle East) especially as part of the pipeline infrastructure (up to the Syrian border) is already in place; it would also be a viable commercial option even in the face of lower-than-expected natural gas reserves
- Pipeline options could also complement Lebanese LNG, particularly where ample reserves offer potential for parallel export options, as is currently being considered in Israel

Both Israel and Cyprus have already been exploring the option of northward pipeline gas exports, and while the political complications concerning Turkey–Cyprus relations may yet preclude Cypriot gas from entering the European market via the Turkish route, Israel and Turkey are understood to hold very serious interest in the exploration of mutual gas trading advantages (Gloystein 2012, Linke and Vietor 2010). Lebanese gas may eventually benefit from preferential economics given the availability of a land route via Syria, rather than a sea route, an option that Israel does not have. Turkey also offers an attractive market option in its own right, given its healthy historical growth rates, and a local gas price range superior to anything offered by alternative Middle Eastern markets at present (Republic of Turkey Ministry of Foreign Affairs 2013).[11]

10
Existing pipelines in Turkey need to be upgraded or new pipelines should be built to allow for gas transit to Europe.

11
The Turkish government estimates that Turkey's total energy demand (as well as its demand for natural gas) will more than double from its 2011 levels by 2020, to some 59 bcm of natural gas, through a dedicated policy of diversifying suppliers and supply routes.

The Turkish option with its European link may also prove highly attractive from a geopolitical point of view. Lebanese gas exports to Europe offer Lebanon the profile of being a European energy supplier irrespective of the export volumes. Similarly, gas trade links with Turkey may provide Lebanon with a valuable regional ally and contribute toward constructive regional integration. Unlike the case of exports to the European market, the Turkish market looks commercially realistic irrespective of other supply sources.

However, several issues will determine the viability of this option by the time Lebanese gas production comes on stream. European and Turkish gas demand both constitute a significant source of uncertainty given the range of other supplies—pipeline and LNG options—that will appear on the horizon during the early 2020s (Darbouche, El-Katiri and Fattouh 2012, Honoré 2010). Not only has European gas demand slumped in the early 2000s, but a number of planned pipeline projects—ranging from South and Blue Stream to Nabucco, to the ramping up of the recently inaugurated North Stream pipeline from Russia—are all competing over the European market share. This renders the Southern Corridor (into which Lebanese gas would feed) far from a 'done deal' (Linke and Vietor 2010, Ratner et al. 2013, Giamouridis and Paleoyannis 2010, PÖYRY 2010).[12] Turkish market demand may similarly decelerate, or the country may secure ample gas supplies from alternative suppliers by the early 2020s; such supplies could range from LNG, to Israeli (and perhaps Cypriot) gas, to new gas supplies from Iraq, and even from Iran as international sanctions have recently eased.[13]

Pricing mechanisms, including Europe's accelerated moves toward gas-to-gas pricing under long-term contracts, may eventually offer small gas exporters more variable, and possibly lower, returns. This issue is particularly acute for Lebanon, whose offshore gas reserves may yet prove to be higher in cost than those of alternative European gas providers such as Russia (Stern and Rogers 2011, 2012; Stern 2009). All these uncertainties raise the essential question of whether the Turkish or European gas markets will eventually offer Lebanon the sort of returns it desires for its gas exports, drawing attention to the LNG option.

c The LNG option

Both for the government and for international investors, LNG is probably the most attractive option for exporting Lebanese gas for several reasons:

- LNG offers Lebanon the most flexible option for exports of its natural gas, allowing access to extra-regional markets such as Europe and current premium markets in East Asia (where record LNG prices in

12
The Southern Corridor is a European initiative aimed at diversifying the European Union's gas mix by transporting gas to Europe from the Caspian region and the Middle East. It is not clear precisely which countries will be linked to the initiative as the corridor remains in the very early stages of planning.

13
Upon publishing this report, the Iran nuclear deal has reached implementation day, after the International Atomic Energy Agency verified that Iran is in compliance with all restrictions on its nuclear program required by the joint comprehensive plan of action. Iran will now receive relief from a range of US and EU sanctions linked to the nuclear program, including many targeting the oil sector, but other US sanctions will remain in place.

2013 promise a multiple of those price ranges achievable via pipeline exports in the East Mediterranean)
- LNG can be supplied both via long-term contracts and, additionally, on a spot market basis, promising additional returns for producers with some flexible production capacity or seasonal surpluses
- LNG is also an attractive option politically, for it would place Lebanon on the map of global gas market suppliers, a geo-strategically desirable position irrespective of the volume of Lebanese LNG exports

The LNG export option, however, remains subject to many uncertainties. One of the key uncertainties relates to the actual size of Lebanon's gas reserves, together with its potential production rate, the size of domestic demand, and hence the actual volume of gas that would be available for export under a typical long-term contract. The production of Lebanese LNG will require sufficient reserves, production, and allocations of its natural gas production to export markets—locking in Lebanese gas under long-term export contracts for about 15 to 20 years. Assuming Lebanon could prove up a resource base comparable to that of Cyprus and Israel—in the range of 5 to 30 tcf proven, recoverable reserves (Darbouche, El-Katiri and Fattouh 2012)[14]—Lebanon's initial LNG potential could amount to 5 to 10 mtpa (6.8–15.5 bcm), a small volume but large enough to render one to two LNG trains commercially viable.[15]

By the time Lebanese LNG might be ready for export—currently the mid-2020s—the country will also be competing with a number of new market entrants, many of them with considerably more weight over key markets in Asia/Pacific and Europe. These new sources of LNG are primarily:

- Australia (expected to bring some 56 mtpa on stream by the early to mid-2020s)[16]
- East Africa (20 mtpa by the early 2020s, 30–40 mtpa by 2028)[17]
- (potentially) North America (up to 125 mtpa)[18]

Existing contracting for Australian and East African LNG means that a significant share of the market by the early 2020s will already be locked into long-term supply contracts by the time Lebanon could be in a position to begin serious consideration of LNG exports. This means that Lebanon's ability to capture premium markets through LNG might not materialize within the given time frame. Nor may Lebanon, by then, be in a position to capture the sort of price ranges it would likely be looking for—a problem Cyprus, too, has found to be an increasing obstacle to its own, delayed and currently uncertain, LNG plans (Stern 2014).

Alternative markets, of course, exist. Europe may turn out to be Lebanon's best option as a destination for gas exports. However, the

14
Cyprus' resource estimates for block 12 (following appraisal drilling in October 2013) confirmed a resource range of 5–8 tcf, although analysts have suggested that the six offshore blocks tendered out so far by Cyprus could hold as much as 40 tcf of overall gas resources, based on initial seismic findings. Total Israeli gas discoveries so far amount to about 30 tcf, including the 19 tcf Leviathan field and the 9.7 tcf Tamar field.

15
This is comparable to Cyprus' potential LNG output by the early to mid-2020s, based on one to two producing blocks.

16
Authors' estimates based on Henderson and Ledesma (2014).

17
Authors' estimates based on Ledesma (2013).

18
Authors' estimates based on Henderson (2012).

basis of pricing for European LNG differs from that of East Asia, possibly resulting in considerably lower price ranges than those realized in Asian premium markets, at least while current pricing mechanisms and linked oil price levels persist. It is in this context that Lebanese policymakers will need to consider carefully, when the time is right, whether LNG really does offer Lebanon the best commercial deal for its natural gas, or whether regional pipeline options may indeed provide better value for money.

Lebanon may also consider other options for exporting LNG—not from its own coastal liquefaction facility, but by making use of existing, or likely upcoming, regional export hubs. The first option worth considering is, without a doubt, the export of LNG via shared facilities with Cyprus, Lebanon's regional East Mediterranean gas neighbor. Sharing LNG export facilities with Cyprus could offer significant cost savings if technical, commercial, and political obstacles can be overcome. Joint monetization between Lebanon and Cyprus, with a view to LNG production, might become viable at a much later stage, depending on the size and location of any new discoveries in offshore Lebanon and Cyprus (Giamouridis 2013).

Cyprus and Israel have been engaging in high-level discussions over the possibility of sharing, and thereby pooling, regional LNG exports via Cyprus (an option that has also gained political support from external partners such as the European Union) though the chance of such an outcome remains low. The combined LNG potential of an Israel-Cyprus hub could, by the mid-2020s, reach between 10 and 25 mtpa (up to 35 bcm), thereby creating a larger regional export hub. Such a hub would be able to secure market share on a basis that separate Cypriot, Israeli, and Lebanese LNG exports might be unable to match.[19] Lebanese gas, too, could form part of such a regional LNG option, offering Lebanon significant infrastructure-related cost savings, with existing contract structures and export experience locally present by the time Lebanese gas would likely join in. As desirable as this option would be commercially, political hurdles would limit its likelihood.

Another option could see Lebanese gas being directed to two Arab neighbors and their export facilities: Egypt or Jordan. Egypt already has two LNG export terminals. These are currently underused, owing to Egypt's own domestic gas needs and limited forthcoming new natural production. While Lebanon's delayed natural gas development will likely deprive it of the more immediate, and lucrative, option of exporting gas to Egypt to help the country fulfill its existing LNG export contracts, the option to use Egyptian LNG export facilities in the event Egyptian production does not use up their full potential still exists over the long run (Reed 2014). Similarly, Jordan is likely to be receptive to an LNG export facility at its Aqaba port, offering a favorable LNG

19
Authors' estimates.

export location with easier geographical access to Asia. Both options naturally involve a sub-set of questions to be resolved; these include transit and export fees for the country providing export facilities and, for Egypt's case in particular, the security of gas pipelines (in view of the frequency of pipeline attacks on the Sinai Peninsula over the past few years). Once again, Lebanon may face a reduced option set due to its latecomer status; Israel has been exploring the same options and is likely to reach an agreement before Lebanon is even in a position to negotiate how to market its natural gas.

If Lebanon eventually decides in favor of an LNG development based inside its own territory (either onshore or, perhaps more commercially viable in the 2020s, offshore), Cypriot LNG could provide a viable financial model that would apply to Lebanon's similarly difficult public budgetary situation. Cyprus, given its financial bailout by the European Union in early 2013, has chosen a financing model that sees the operating company Noble (and potentially other companies) pay for the high-cost development of both upstream capacity and liquefaction facilities at Vassilikos (Giamouridis 2013). Foreign company operators are compensated via the eventual revenue/profit stream, Cyprus' national hydrocarbon company CNHC participates as a partner and receives a minimum share in profits, and the state receives general profit taxes (Giamouridis 2013, 16–18). This model offers countries such as Lebanon, with limited budgetary resources, the ability to develop LNG capabilities, although the share of profits payable to foreign operators will naturally be larger than under a scheme that involves investment risk-sharing with a national hydrocarbon company partner.

III Conclusion: The Way Forward

The road to Lebanon becoming a gas producer is a long one, fraught with many uncertainties. In the next few years, its government will be confronted by many complex decisions. One of these relates to the monetization of its gas reserves, assuming a successful outcome to future exploration if and when this materializes. The size of the reserves, the timing of their development, and the balance between the use of gas to meet domestic demand and for export purposes, will ultimately determine whether Lebanon will be able to consider gas exports. The discovery of small commercial gas resources could provide Lebanon with an opportunity to feed primarily into its domestic market and develop small-scale exports into neighboring countries—Turkey, Syria, Egypt, and Jordan. In a more favorable scenario—in which discovered resources correspond more closely to initial government estimates—Lebanon could eventually consider an LNG export strategy, bearing in mind the various opportunities and constraints that LNG may face by the time Lebanon enters the market.

The considerable uncertainty regarding the passing of relevant legislation, and the response by initially interested companies to the multi-year delays in Lebanon's bidding round, imply that Lebanon is still very far from being able to plan for export revenues in the future. With no resolution to Lebanon's continued political deadlock in sight as of yet, prospects for exploration work in offshore Lebanon any time soon are still remote. By the time Lebanon may be in a position to start production (by the mid-2020s) the country will face very different regional and global gas market dynamics from those seen today. This makes our discussion above indicative of the opportunities currently available and, if there are further delays to Lebanon's upstream development, of opportunities lost.

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