



FOREIGN AND SECURITY POLICY PAPER SERIES 2015

JORDAN'S ENERGY SUPPLY OPTIONS THE PROSPECT OF GAS IMPORTS FROM ISRAEL

Simon Henderson

G | M | F The German Marshall Fund
of the United States

STRENGTHENING TRANSATLANTIC COOPERATION

© 2015 The German Marshall Fund of the United States. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means without permission in writing from the German Marshall Fund of the United States (GMF). Please direct inquiries to:

The German Marshall Fund of the United States
1744 R Street, NW
Washington, DC 20009
T 1 202 683 2650
F 1 202 265 1662
E info@gmfus.org

The views expressed in GMF publications and commentary are the views of the author alone.

GMF Paper Series

The GMF Paper Series presents research on a variety of transatlantic topics by staff, fellows, and partners of The German Marshall Fund of the United States. Comments from readers are welcome; reply to the mailing address above or by e-mail to info@gmfus.org.

About GMF

The German Marshall Fund of the United States (GMF) strengthens transatlantic cooperation on regional, national, and global challenges and opportunities in the spirit of the Marshall Plan. GMF contributes research and analysis and convenes leaders on transatlantic issues relevant to policymakers. GMF offers rising leaders opportunities to develop their skills and networks through transatlantic exchange, and supports civil society in the Balkans and Black Sea regions by fostering democratic initiatives, rule of law, and regional cooperation. Founded in 1972 as a non-partisan, non-profit organization through a gift from Germany as a permanent memorial to Marshall Plan assistance, GMF maintains a strong presence on both sides of the Atlantic. In addition to its headquarters in Washington, DC, GMF has offices in Berlin, Paris, Brussels, Belgrade, Ankara, Bucharest, and Warsaw. GMF also has smaller representations in Bratislava, Turin, and Stockholm.

About the Foreign and Security Policy Program

The Foreign and Security Program (FSP) at GMF comprises a stream of activities furthering objective analysis and debate on geopolitical questions of transatlantic concern. The program spans regional and functional issues, from NATO affairs to energy security, including challenges and opportunities in Europe's East, the strategic environment in the Mediterranean, and the role of Turkey as a transatlantic partner.

Cover photo: Dead Sea Between Jordan and Israel. © Richmatts/istockphoto

JORDAN'S ENERGY SUPPLY OPTIONS
THE PROSPECT OF GAS IMPORTS FROM ISRAEL

FOREIGN AND SECURITY POLICY PAPER SERIES

OCTOBER 2015

Simon Henderson¹

Preface	iii
Introduction	1
Jordan's Energy Dilemmas	2
Jordan's Current Energy Balance	3
Import Options.	6
Jordan's Domestic Energy Options.	10
The Way Forward	12

¹ Simon Henderson is the Baker Fellow and director of the Gulf and Energy Policy program at the Washington Institute for Near East Policy.

PREFACE

In the latest of GMF's policy papers on Eastern Mediterranean Energy, Simon Henderson analyses the options facing Jordan to close the country's considerable energy supply gap. This gap widened as Jordan's economy has continued to grow and as up to 1 million refugees, mainly from Iraq and Syria, have placed growing demands on the Kingdom's energy supply and public finances. Under these circumstances, international assistance from the United States, the European Union, and other members of the international community urgently needs to be stepped up. So far, the authorities have managed Jordan's scarce energy supplies skillfully, avoiding power outages that would have a destabilizing political effect, especially at a time when the government has announced its intention to phase out subsidies on electricity and a number of basic commodities.

The situation in the country is fragile, however, with the influx of refugees affecting its delicate population balance. Jordan is active in coalition efforts to weaken the self-proclaimed Islamic State group but its resources are limited. In these difficult conditions, it is particularly important to come to closure in Amman's long deliberations over energy import options.

Simon Henderson's paper confirms that gas imports from Israel are Jordan's best option. These require only a modest investment in infrastructure as the distances to be covered by new pipelines are

short. Company-to-company agreements can help to alleviate objections to importing gas from Israel that have been voiced by certain political groups and segments of the public. The king and his advisers seem committed to this course even if they are prudent in expressing their commitment publicly. They may, however, grow more reluctant if political relations between Amman and Jerusalem continue to deteriorate and if there are further delays in establishing regulatory certainty for the gas industry in Israel.

The United States and the European Union, which have an interest in regional stability, should continue to exercise discreet diplomacy with a view to seeing that the preliminary agreements on imports of gas from Israel that have been signed are fully implemented. Israeli and Jordanian leaders should refrain from statements and acts that can call into question all that has been achieved between the two countries since the Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan was signed in October 1994. If a climate of political trust is restored, energy cooperation can reinforce political links between Israel and Jordan and help bring a modicum of stability to a troubled region.

Sir Michael Leigh
Senior Fellow
The German Marshall Fund of the United States

1 INTRODUCTION

Jordan depends on imports for most of its energy requirements and has had to develop close relations with its suppliers. Nonetheless, its energy supplies have been subject to repeated disruption. In response, the Jordanian authorities hope to develop the country's own energy sources: renewables like solar and wind, as well as shale and nuclear. At the same time, a new source of energy is opening up: imports of natural gas from Israeli offshore fields in the Mediterranean Sea. This is an attractive option for the country's political authorities but is contested, at the street level, by Jordanians who are resentful of Israel's continued occupation of the West Bank.

The Jordanian government finds it difficult to make a strategic decision on energy while the country

faces the threat posed by the self-proclaimed Islamic State group (ISIS), which is active along its borders with Syria and Iraq. The many refugees from these countries in Jordan place additional demands on the country's energy supply and impose a major budgetary burden. They also place further strains on the country's fragile population balance. Jordan has a large Palestinian population and Amman continues to have responsibilities for Muslim shrines in Jerusalem. Skirmishes between Palestinians and Israeli security forces concerning the holy places in Jerusalem in September 2015 have reinforced public opposition to economic dependence on Israel. Thus Jordan's energy security dilemmas need to be considered in the context of its diverse geopolitical challenges.

2 JORDAN'S ENERGY DILEMMAS

The Kingdom of Jordan possesses few energy resources of its own and has traditionally looked to its Arab neighbors for energy supplies. The discovery of natural gas in the Eastern Mediterranean has provided the country with new options. Gas from Israeli offshore fields offers the potential of alternative supplies in significant quantities. This could strengthen the country's energy security at a time of increased regional turbulence. In April 2015, the Israeli government approved an agreement to supply natural gas from its Tamar field to two Jordanian industrial companies to fuel power plants at their facilities near the Dead Sea.¹ Additional quantities of Israeli gas could flow if a non-binding letter of intent to supply Jordan's National Electric Power Company (NEPCO) with gas from the larger Leviathan field, signed in April 2014, leads to an effective agreement.² In the future, gas supplies from Israel could be supplemented by gas from the Gaza Marine field if political circumstances permit this resource to be developed.³

¹ Sharon Udasin, "Israel approves gas export deal with Jordan," *Jerusalem Post*, April 2, 2015, <http://www.jpost.com/landed-pages/printarticle.aspx?id=396038>.

² Sharon Udasin, "Israel's Leviathan signs preliminary deal to sell Jordan 15-year gas supply," *Jerusalem Post*, March 9, 2014, <http://www.jpost.com/landedpages/printarticle.aspx?id=374332>.

³ Simon Henderson, "Natural Gas in the Palestinian Authority: The Potential of the Gaza Marine Offshore Field," German Marshall Fund of the United States, Washington DC, March 2014, <http://www.gmfus.org/publications/natural-gas-palestinian-authority>.

Jordan has had bad experiences with its energy suppliers in the past. Pipeline supplies of Saudi Arabian oil ceased in 1990, when Jordan supported the Iraqi invasion of Kuwait. Iraqi oil then replaced Saudi oil until Saddam Hussein's regime was overthrown in 2003. Egyptian gas, priced below the market rate, started flowing the same year. Supplies of Egyptian gas became increasingly intermittent, however, because of sabotage of the pipeline across the Egyptian Sinai peninsula after President Hosni Mubarak was deposed in 2011. Heavy fuel oil and diesel bought on international markets have since filled the gap. But these sources of energy are highly polluting and caused large budget deficits while prices were high. The government has been able to manage electricity supply so as to prevent blackouts but demand has increased steadily. This reflects both economic growth, which remains positive despite regional shocks, and the influx of refugees, estimated at up to 1 million, representing a 12 percent addition to Jordan's population.

Eastern Mediterranean gas, principally from Israel, could resolve Jordan's supply problems, being potentially reliable, relatively cheap and clean. King Abdullah is said to favor this option but does not advocate it publicly, in light of popular opposition to reliance on Israel. Senior policymakers in the Kingdom seek to keep open alternative proposals, such as oil and gas pipelines from southern Iraq or imports of liquefied natural gas (LNG), despite their drawbacks.

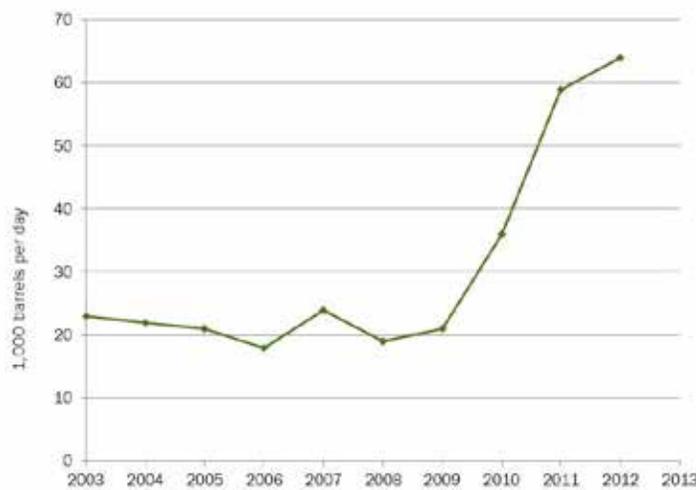
3 JORDAN'S CURRENT ENERGY BALANCE

The kingdom's population is estimated to be over 8.1 million, a figure swollen by up to 1 million refugees mostly from Syria and Iraq.⁴ Its own proven oil reserves are negligible, less than 1 million barrels in all, while its natural gas reserves are of the order of only 200 billion cubic feet.⁵ There are large deposits of oil shale, but so far commercial exploitation is limited. An oil shale-fired power station is planned. (Oil shale is a bitumen-like solid distinct from liquid shale oil, which, like shale gas, is trapped in geological formations and can be released by "fracking." Oil shale is recovered by open-pit mining.) It is unlikely that Jordan's oil shale is a viable fuel for generating large quantities of electricity.

Electricity in Jordan is generated by heavy fuel oil, petroleum products, and natural gas. In 2014, the cost of the necessary imports accounted for more than 40 percent of the national budget.⁶ In an effort to ease the burden, the government is committed to eliminating subsidies on electricity by 2017, with compensating payments to the needy.

Reliance on natural gas, imported from Egypt, fell from 89 percent in 2009 to 17 percent in 2012, because of sabotage of the pipeline in Egypt. The

Figure 1: Jordan: Imports of Refined Oil Products



Source: U.S. Energy Information Administration

shortage was met by imports of diesel oil and heavy fuel oil, which, in 2012, accounted for 49 percent and 29 percent, respectively, of fuel for power generation. As a consequence, the state-owned electricity generation company, the National Electric Power Company (NEPCO), made huge losses, in 2011 amounting to 5 percent of gross domestic product (GDP).

Jordan's demand for electricity can be expected to rise as the country's economy continues to grow. Estimated installed capacity for electricity generation in 2013 was 3,193 megawatts (MW) and consumption was 14.56 billion kilowatt hours. Comparable figures for Jordan's neighbor, Israel, with a similar sized population, were 16,250 MW (2014 estimate) and 59.83 billion kilowatt hours (2014 estimate), more than four times greater.⁷

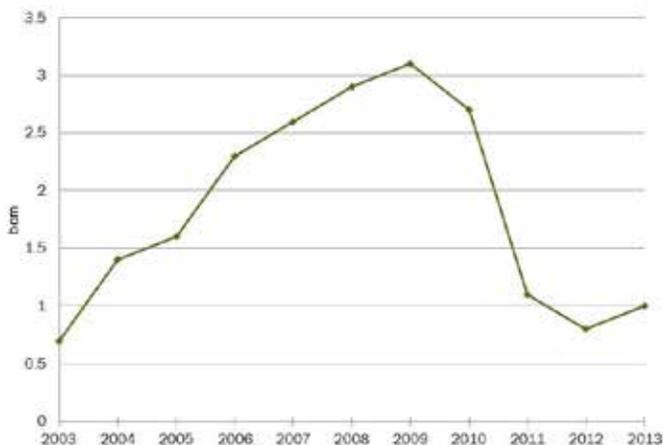
⁴ The World Factbook, Central Intelligence Agency, July 2015, <https://www.cia.gov/library/publications/the-world-factbook/geos/jo.html>.

⁵ U.S. Energy Information Administration (EIA), "Jordan international energy data and analysis," March 2014, <http://www.eia.gov/beta/international/analysis.cfm?iso=JOR>.

⁶ Ibid.

⁷ The World Factbook, Central Intelligence Agency, 2014, <https://www.cia.gov/library/publications/the-world-factbook/geos/is.html>.

Figure 2: Jordan: Natural Gas Imports (bcm)



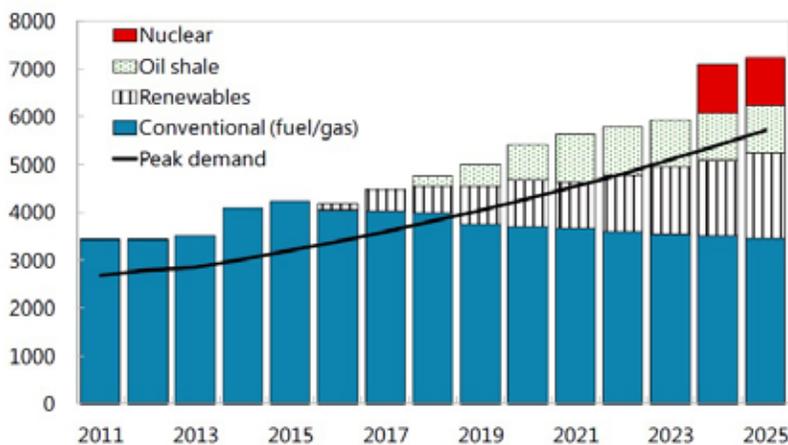
Source: U.S. Energy Information Administration

Jordan's National Electric Power Company's 2014 annual report notes that generating capacity had risen to "about 4,000 MW by the end [of 2014]," an increase of 26 percent. This large increase was achieved by bringing into operation two independent power generation projects, known as IPP3 and IPP4, with respective capacities of 570 MW and 241 MW. Both are sited close to Amman and are "tri-fuel," meaning they can use diesel oil, heavy fuel oil, or natural gas.

The largest power station in Jordan is at Aqaba on the Red Sea coast, with a total generating capacity of 656 MW. Originally built as an oil-fueled power

station, it switched to natural gas after the construction of the Arab Gas Pipeline, linking Egypt with Jordan via a short undersea pipeline. The second largest is at al-Qatrana, 100 km south of Amman, which has a generating capacity of 373 MW. It is designed to burn natural gas but can also use diesel oil. The Rehab power station, 70 km north of Amman, has a capacity of 297 MW. The Hussein power plant, 30 km north-east of Amman, serves the Zarqa industrial area, providing 198 MW; it is reliant on diesel or heavy fuel oil. The Risha power plant, 350 km east of Amman, close to the border with Iraq, has a capacity of 150 MW and is powered by natural gas from the local Risha field.

Figure 3: Potential Long-Term Generation Capacity and Peak Demand (in MW)



Source: NEPCO, Electricity Regulatory Commission, and IMF staff estimates

Around a dozen industrial facilities in Jordan, including cement, phosphate, and fertilizer plants and Queen Alia airport, the main international gateway, have their own power plants.

The Jordanian government has been successful in maintaining the provision of electric power without reported interruptions. Renewables should make a contribution to meeting peak demand by 2017, and oil shale, by 2021, according to a recent IMF study.⁸ But these additional sources will be insufficient unless significant new supplies are added to the fuel mix.

⁸ Andrea Gamba, “Potential Long-Term Generation Capacity and Peak Demand,” Working Paper 15/115, International Monetary Fund, 2015, <https://www.imf.org/external/pubs/ft/wp/2015/wp15115.pdf>.

4 IMPORT OPTIONS

Natural Gas from Egypt

The interruption of supplies of natural gas from Egypt and the influx of refugees are the major causes of Jordan's recent economic difficulties. Gas imports from Egypt could, in principle, be resumed if Egypt is able to satisfy its own domestic demand and again produces a surplus for export. This is unlikely to occur, however, until the mid-2020s at the earliest, even after ENI's large gas discovery in the offshore Zohr field.⁹ Most of the sabotage in the Sinai Peninsula targeted the branch of the pipeline leading to Israel, but the line south to the Red Sea and then underwater to the Jordanian port of Aqaba, known as the Arab Gas Pipeline, was also repeatedly interrupted. Gas volumes fell from 2.5 billion cubic meters (bcm) in 2010 (the last full year of the Mubarak regime) to around 0.8 bcm in 2011, when Muhammad Morsi of the Muslim Brotherhood took over as president. Supplies via this route stopped completely in mid-2013, forcing Jordan to use fuel oil for power generation, which, at the time, was six

Figure 4: Arab Gas Pipelines



times more expensive than the Egyptian gas, which had generated 80 percent of Jordan's electricity.

Oil and Gas Supplies from Iraq

Despite the advance of ISIS forces from northern Iraq to the border with Jordan, a proposal continues to exist for the construction of 2.5 million barrels per day (b/d) oil pipeline, and a parallel gas

⁹Nikos Tsafos, "Egypt: A Market for Natural Gas from Israel and Cyprus," The German Marshall Fund of the United States, Washington DC, October 2015, revised edition, <http://www.gmfus.org/publications/egypt-market-natural-gas-cyprus-and-israel>.

pipeline, from Iraq through Jordan to Aqaba. Intended for export, the oil and gas pipelines would also supply the Jordanian domestic market with a planned 100,000 b/d of oil and 1 bcm of natural gas per year.

Originally proposed in 2012 with financing from the Chinese state-owned CNPC, the estimated cost has risen from \$8-10 billion to \$18 billion. In 2015, a new route was suggested to avoid the territory seized by ISIS. Instead of going directly through Anbar province, the proposed new line would avoid the main population centers by running along the Iraqi-Saudi border before entering Jordanian territory. However, this option is unlikely to be implemented in the foreseeable future in light of the political situation in Iraq.

Natural Gas in the Form of LNG

In the summer of 2015, imports of liquefied natural gas (LNG) began at the Red Sea port of Aqaba, using the Golar Eskimo, a floating storage and regasification unit (FSRU) moored at a specially constructed pier. This allows Jordan to buy natural gas from regional suppliers such as Qatar and the United Arab Emirates. The FSRU has been contracted for ten years with an option to terminate after five and is connected to the Jordan Gas Transmission Pipeline.¹⁰ The gas is being supplied to Jordanian power plants at a rate of up to 500 million cubic feet per day, about 5 bcm per year if supplies are maintained. It is, however, a back-up system rather than the primary provider. Nevertheless, the FSRU is making an important contribution to Jordan's energy security. In the summer of 2015, Jordan was even able to re-export regasified LNG to Egypt via the Arab Gas Pipeline, transported by reverse flows from Aqaba to el-Arish on the Mediterranean coast of Sinai. Jordan

has profited from Egypt's growing demand for gas, taking advantage of low prices for LNG cargoes.

Gaza Marine

The so far unexploited Gaza Marine field, which lies offshore the Gaza Strip, contains an estimated 1 trillion cubic feet of natural gas. In principle, it is owned by the Palestinian Authority (PA), in Ramallah in the West Bank, rather than the Hamas administration that controls the Gaza Strip. One option for exploitation is to export the gas to Jordan via a pipeline across Israel but this seems a distant prospect given the current political tensions between Israel, the PA, and Hamas. However, such a scheme has the commercial merit of having a customer (NEPCO) that would pay, thereby enabling the project to attract investment and financial guarantees. Politically, the Hamas authorities would have to accept that the revenues from the field would accrue to the PA rather than themselves.

The business plan implicit in such a deal is that Jordanian customers would pay for electricity generated from the gas, enabling Jordan's NEPCO to pay the BG Group-led consortium supplying the gas. The PA would also need to renegotiate with BG Group to extend its concession, which would otherwise expire during a projected 15- to 20-year project lifetime. (In April 2015, Shell announced plans to buy BG Group, increasing the possibility that the Gaza Marine concession may be sold off as a surplus asset, adding further uncertainty to the project. The full takeover is subject to regulatory approval from various countries so is unlikely to be completed until early 2016.) Overall, this option appears highly improbable under existing political circumstances.

Supplies from Cyprus

In September 2014 Cyprus Energy Minister Giorgos Lakkotrypis visited Jordan to discuss

¹⁰ "Golar Eskimo Changes Hands," *World Maritime News*, January 21, 2015, <http://worldmaritimeneews.com/archives/150023/golar-eskimo-changes-hands/>.

cooperation in the fields of renewable energy and natural gas with his counterpart Muhammad Hamed. The two signed a memorandum of understanding aimed at exchanging information and expertise relating to energy production, oil and gas exploration, infrastructure, and environmental protection. The arrangement also covered the study of prospects of Jordan importing natural gas from Cyprus.

Hamed stated that technical teams would meet to discuss volumes and price, and Jordan indicated it would sign a letter of intent with Cyprus before the end of the year to buy natural gas. An agreement on purchase would then be signed in 2015. No further progress has been reported, however.

In the absence of significant new discoveries offshore Cyprus, a commercially viable means still needs to be identified to develop its Aphrodite field. Despite the attractiveness in principle of exports from Cyprus to regional markets, including Jordan and Lebanon, a number of significant political, commercial, and technical obstacles would first need to be overcome. For the time being, therefore, this option cannot be considered realistic.¹¹

Supplies from Israel

In business terms, Jordan is an obvious market for Israeli gas. Pipeline distances are short; potential linkages between the Israeli pipeline network and Jordan's are measured in mere tens of kilometers. The largest prospective customer, Jordan's National Electric Power Company (NEPCO), is a reliable partner with a reputation for ensuring its customers pay their bills. The major challenge from Jordan's perspective is political: public opinion, as represented by individual members of its

parliament and professional associations, which act almost as political parties in the kingdom's limited democracy, are vocally opposed to the expansion of economic ties with Israel. But King Abdullah and the Royal Court, which in the Jordanian system are decisive influences, are reported to favor gas imports from Israel. They are likely, however, to remain cautious in public pronouncements on the issue.

The first public indication of Jordan turning to Israel for gas was the initial agreement reached in February 2014 for the supply of modest quantities from the Tamar field to two Jordanian state-controlled companies, the Arab Potash Company and the Jordan Bromine Company, located on the southern shores of the Dead Sea. Gas is expected to start flowing in 2017 after the construction of a pipeline extension from the southern branch of the Israeli pipeline network. The agreement provides for the supply of relatively small volumes of gas, averaging around 0.12 bcm annually over a 15-year term, valued at some \$500 million.¹² In September 2015, Israel's National Planning and Building Commission approved the route of the underground pipeline from the end point of the Israeli gas pipeline system to the Jordan border immediately to the south of the Dead Sea.

King Abdullah is reported to have made the original decision to explore the possibility of buying Israel gas during his April 2013 visit to the United States. In an interview in September 2014, outgoing Noble Energy CEO Chuck Davidson said, "I was invited to a meeting with King Abdullah in Washington, during which he informed me he would like to buy gas from Israel now that Egypt had stopped selling. Quiet negotiations were initiated with the participation of American and

¹¹ This question is examined in more detail in Anastasios Giamouridis, "Natural Gas in Cyprus: Choosing the Right Option," The German Marshall Fund of the United States, Washington DC, September 2013, <http://www.gmfus.org/publications/natural-gas-cyprus-choosing-right-option>.

¹² Sharon Udasin, "Tamar partners sign export agreement with Jordanian firms," *Jerusalem Post*, February 19, 2014, <http://www.jpost.com/Enviro-Tech/Tamar-partners-sign-export-agreement-with-Jordanian-firms-341908>.

Israeli government representatives. We began modestly with the supply of gas to the potash plant on the Jordanian side of the Dead Sea.”¹³

In May 2015, King Abdullah opened a session of the World Economic Forum at a Jordanian resort on the Dead Sea, in the presence of an Israeli delegation, stating, “This Forum is about grasping these opportunities in building a future for this region by creating a framework for prosperity and peace.” He referred to “new projects in urban development, water infrastructure, and a diversified, long-term energy platform. Public-private partnerships are key in bringing all these projects to fruition.” Without making an explicit mention of Israel he went on to state, “We cannot be sidetracked by regional turmoil.”

The deal for the supply of gas from the Leviathan field to Jordan, announced in September 2014, in the form of a “non-binding letter of intent,” would involve a 15-year contract with annual deliveries of 3 bcm. This would be sufficient to meet the bulk of Jordan’s current electricity generation needs. The value attached to the contract in news reports was \$15 billion, though the price has yet to be negotiated. Noble Energy said the price would be “based primarily on a linkage to [international] oil prices.”¹⁴

¹³ “You have not yet internalized the natural gas revolution,” by Sever Plotzker, Mamon (financial supplement of Yediot Ahronot), September 24, 2014. Page 2. (In Hebrew).

¹⁴ Simon Henderson and David Schenker, “Jordan’s energy decision: Go with Israel.” The Washington Institute for Near East Policy, September 3, 2014, <http://www.washingtoninstitute.org/policy-analysis/view/jordans-energy-decision-go-with-israel>.

The signing of the Leviathan agreement, originally planned to take place in Washington, DC at the end of January 2015 during a visit by King Abdullah, was postponed because of regulatory uncertainty in Israel. The need to buy gas from Israel is controversial for the Jordanian government, which prefers that agreements to bring gas from both Tamar and Leviathan to Jordan be concluded by private sector operators. Jamal Qammouh, the head of the energy committee of Jordan’s lower house of parliament, claimed in January 2015 that Jordan had suspended talks with Noble.¹⁵ But executives from Noble Energy and Delek visited Jordan the same month to provide reassurance that the Leviathan deal was still viable.

Regulatory uncertainty in Israel has delayed the development of Leviathan and the expansion of Tamar. Meanwhile the political climate affecting relations between Israel and Jordan has deteriorated. Nonetheless exports of gas from Israel to Jordan remain the most convincing option for closing Jordan’s energy supply gap in the future.

¹⁵ Mohammad Tayseer, “Jordan Halts Talks on \$15 Billion for Israeli Gas,” Bloomberg Business, January 4, 2015, <http://www.bloomberg.com/news/articles/2015-01-04/jordan-halts-talks-on-15-billion-accord-to-i>.

5 JORDAN'S DOMESTIC ENERGY OPTIONS

With the advance of technology, other energy options have opened up for Jordan, although their contribution to electricity generation would, even if successful, not displace the country's basic reliance on natural gas.

In January 2014, the international oil and gas company BP announced that it had decided, after a technical evaluation, to abandon a gas project to expand the Risha field in Jordan, near the border with Iraq. The field, originally discovered in 1987 and fueling a local power station since 1989, had been Jordan's main hope for boosting the supply of domestic natural gas. But after spending \$240 million and drilling two exploration wells, BP decided that such expansion was not viable.¹⁶

Meanwhile Jordan continues with plans to build a power station using locally mined deposits of oil shale, of which the country has large deposits. Work is proceeding on the construction of a \$2 billion oil shale-fueled power plant at Attarat, using Estonian technology. The 470 MW facility is expected to start operation in late 2018. Funding will be provided under a \$7 billion memorandum of understanding signed in September 2015 between Jordan and China. The agreement allocates \$1.7 billion for the Attarat plant with a further \$1 billion for an additional unspecified 1,000 MW power plant. This could be another oil shale burning plant that Jordan's Ministry of Energy has proposed for construction at Karak, west of Attarat. Although oil-shale power generation is an established technology in Estonia, there are doubts that it can be scaled up to the more ambitious plants envisaged by Jordan. A further question is the need for copious amounts of water in the shale oil process and whether this option can be profitable when the oil price is less than \$50 per barrel.

¹⁶ Summer Said, "BP's Risha Exit Means Slim Pickings for Jordan's Energy Needs," *The Wall Street Journal*, January 29, 2014, <http://blogs.wsj.com/middleeast/2014/01/29/bps-risha-exit-means-slim-pickings-for-jordans-energy-needs/>.

There are also plans to expand wind farm facilities in Jordan, which in 2014 had a nominal capacity of only 1.4 MW, as well as solar power facilities. A 52.5 MW solar installation is being built at Ma'an in the south of the country. A wind installation with capacity for around 120 MW is being developed at Tafila, also in the south. Jordan's National Energy Strategy has the goal of making renewables account for 7 percent of the national energy mix by 2015 and 10 percent by 2020. Agreements have been signed to build generating capacity of 560 MW utilizing wind and solar power financed by \$850 million worth of international investments.

Backing for renewables has been an attractive option for foreign aid. In the summer of 2015, the World Bank announced a \$250 million loan facility to help Jordan make the transition to renewable energy and more efficient use of water. The loan facility covers solar photovoltaic equipment for poor households. In September 2015, the U.S. Agency for International Development (USAID) signed an agreement for grants worth \$429.7 million to support a variety of sectors of Jordanian economy, including \$231 million for budgetary support. USAID is the Kingdom's number one donor.

The most ambitious and controversial idea for Jordanian domestic energy generation is the project to build two nuclear power plants with Russian financial assistance and technology. Jordan has substantial deposits of uranium ore, although Russia has traditionally supplied the fuel for its exported nuclear power plants and insisted on the fuel returning to Russia for reprocessing.

The Jordanian nuclear project calls for the supply of two pressurized water reactors to be installed at a site close to Mafraq, about 65 km from Amman. An initial project development agreement with Russia's Rosatom for two 1,000 MW reactors was enhanced in March 2014 by an intergovernmental agreement.

A feasibility study is being conducted on the proposal, which includes a water cooling system that would use the product of a nearby wastewater treatment plant. A construction contract could be signed by early 2016, with the first plant operational by 2022. The cost of the plant — around \$10 billion — would be shared between Rosatom (taking 49.9 percent) and the Jordanian government (50.1 percent).¹⁷

One of the principal concerns about the project relates to the cooling water. The site is far from the sea and Jordan has no major rivers. Doubts have been expressed about whether the output of the nearby wastewater plant will even be sufficient to provide cooling for just one 1,000 MW reactor.¹⁸

¹⁷ “Iran Reveals Impact of Bushehr Outages, UAE and Jordan Pass Nuclear Milestones,” *Mees*, October 10, 2014, <http://archives.mees.com/issues/1552/articles/52006>.

¹⁸ “Jordan Gets Russian Backing for Nuclear Plans,” *Mees*, April 3, 2015, <http://archives.mees.com/issues/1576/articles/52595>.

The wastewater plant has a water output of 68,000 cubic meters per day. The International Energy Agency gives a figure of water withdrawal of 1.8 million cubic meters a day for a 1,000 MW plant. Even allowing for recycling, this implies 180,000 cubic meters per day, or nearly three times what is available. Even if these issues can be resolved, the first power plant is not expected to be in operation before 2024. The second would only be producing power in 2026.

In response, the Jordan Atomic Energy Commission argues that some U.S. nuclear plants in Arizona already use wastewater for cooling. Even the high capital cost need not to be an obstacle if foreign investors can be found, as the cost of electricity production is competitive with other methods, according to the JAEC. Jordan is currently looking for investment partners for the proposed nuclear plants, a search that may prove elusive.

6 THE WAY FORWARD

In 2015, Jordan faces a broad range of energy options for power generation. Israeli natural gas remains the most logical option for satisfying Jordan's energy demand, but the delays in the development of the Leviathan field and the expansion of Tamar cast a shadow over this. Looking to Russia for nuclear power cooperation and China for shale-oil finance would imply a major change in Amman's preferred foreign partners, until now principally the United States, a crucial facilitator in Amman's relations with Israel.

Natural gas from Israel remains Jordan's best option, despite the doubts and hesitations that have

been expressed by some groups in the Kingdom. To respond to demand in Jordan, Israel needs, above all, to establish the regulatory certainty that will encourage investors to proceed with the development of the country's natural gas resources. The United States and European Union should encourage Israel to create the conditions that will permit the expansion of the Tamar field and the development of the Leviathan field, with a view both to domestic consumption and to exports to Jordan and Egypt.

G | M | F OFFICES

WASHINGTON • BERLIN • PARIS • BRUSSELS
BELGRADE • ANKARA • BUCHAREST • WARSAW

www.gmfus.org