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Shale Gas in Algeria
No Quick Fix

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Acronyms and Abbreviations

ALNAFT: Algerian National Agency for the Development of Hydrocarbon Resources
AQIM: Al-Qaeda in the Islamic Maghreb
ARH: Hydrocarbon Regulatory Authority (Algeria)
bcm: Billion cubic meters
BP: British Petroleum
DRS: Department of Intelligence and Security (Algeria)
EIA: U.S. Energy Information Administration
EPA: U.S. Environmental Protection Agency
EU: European Union
FIS: Islamic Salvation Front (Algeria)
FLN: National Liberation Front (Algeria)
ft: Feet
FRR: Fond de Régulation des Recettes
GDP: Gross domestic product
GW: Gigawatt
IMF: International Monetary Fund
IOC: International oil company
IS: Islamic State
LNG: Liquefied natural gas
LPG: Liquefied petroleum gas
MENA: Middle East and North Africa
mmBtu: Million British thermal units
Mm^3/y: Million meters cubed per year
NWSAS: North West Sahara aquifer system
OGJ: Oil & Gas Journal
OPEC: Organization of the Petroleum Exporting Countries
RND: National Rally for Democracy (Algeria)
tcf: Trillion cubic feet
USD: U.S. dollar
UAE: United Arab Emirates
WRI: World Resources Institute

Introduction

The Ukraine crisis has left policymakers around the European Union scrambling for ideas on how to diversify away from Russian energy supplies, in particular natural gas.[1] By now it has been well documented that despite a political desire for change, there are no quick fixes to the EU's energy dependence, and as such it is unlikely that a significant reduction of Russian supplies will happen in the foreseeable future.[2] In its search for supplies from anywhere but Russia, European Commission officials have eyed a number of countries in the region, including Algeria.[3] The country's national oil and gas company Sonatrach has long been one of the most significant external suppliers of natural gas to European Union member states, in particular Spain and Italy, together with Russian Gazprom and Norwegian Statoil. In addition, assessments by the U.S. Energy Information Administration highlight that Algeria may sit on one of the world's largest recoverable resources of shale gas.[4] Intuitively, one might think that enhanced energy trade would provide a win for all here.

As usual, the reality is more nuanced. Algeria faces significant domestic challenges, most recently the balancing of its budget in light of relatively low oil and gas prices. In addition, developing unconventional energy resources outside the United States has proven to be a challenging endeavor, as illustrated in countries as diverse as Poland, China, and Argentina.[5] Though we expect that in due time several countries around the world will in fact extract unconventional oil and/or gas, there is currently little reason to believe that a boom akin to that of the United States will be replicated elsewhere.

Several of the alternatives to Russian natural gas, however plausible, have been documented extensively. These include, in particular, ramping up

[1] It is worth noting that policy debates and market realities do not necessarily align, see for instance Andreas Goldthau and Tim Boersma, "The 2014 Ukraine-Russia Crisis: Implications for Energy Markets and Scholarship," *Energy Research & Social Science* 3, September 2014, pp. 13-15, http://www.sciencedirect.com/science/article/pii/S2214629614000607.

[2] Tim Boersma, Tatiana Mitrova, Geert Greving, and Anna Galkina, "Business As Usual: European Gas Market Functioning in Times of Turmoil and Increasing Import Dependence," The Brookings Institution, October 2014, http://www.brookings.edu/research/papers/2014/10/european-gas-market-import-dependence.

[3] In recent months, diplomatic efforts have intensified: In May 2015, Commissioner for Climate Action and Energy Cañete visited Algiers, launching a High Level Dialogue on Energy Matters with Algerian Energy Minister Yousfi. Meanwhile Spain, France and Portugal have created a High Level Group on Interconnections for South-West Europe, in order to accelerate progress towards the Energy Union goal of integrating the Iberian Peninsula into the internal European market. The parties argue that if interconnections such as the MidCat pipeline across the Pyrenees are built, this would open the possibility of bringing more North African (Algerian) gas into the EU's internal market.

[4] "Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States," U.S. Energy Information Administration, last updated 13 June 2013, http://www.eia.gov/analysis/studies/worldshalegas/.

[5] For a detailed assessment of the challenges that Poland faces, see Corey Johnson and Tim Boersma, "Energy (In)Security in Poland? The Case of Shale Gas," *Energy Policy*, vol. 53, February 2013, pp. 389-399, http://www.sciencedirect.com/science/article/pii/S0301421512009536.

LNG imports, in part from the United States, and importing resources from the Eastern Mediterranean and the so-called Southern Corridor.[6] Our data indicate that, as important as these alternative supplies may be, none of them is expected to push Russian natural gas out of the supply mix.[7] Yet relatively little has been written about increasing imports of natural gas from Algeria, a void that this paper aims to fill. This study focuses in particular on the development of the shale gas potential in Algeria. We pay special attention to unconventional energy resources because, as we will discuss in more detail, conventional energy production has stagnated in the country since the early 2000s. This paper starts by giving a broad introduction to Algeria, the status of its economy, the prominent role that hydrocarbons play in it, and a brief history and overview of its energy industry. We then discuss several factors that may be beneficial to shale gas development, such as geological conditions and initial test drilling results along with decades of proven experience in hydrocarbon extraction. Subsequently, we turn to some of the challenges the industry faces, including local protests, the overall security situation, red tape, and demand for natural gas, particularly in Sonatrach's traditional markets in southern Europe, but also domestically. We end with a brief discussion of our findings and concluding remarks.

Our research is based on primary and secondary data. We have interviewed stakeholders from the public and private sector during fieldwork in Algeria in March of 2015. In addition, we have interviewed experts in Algeria, the United States, Europe, and the Middle East, and have studied existing literature and available policy documents and news coverage. We are grateful for all those who took the time to discuss the case of Algeria with us. However, the contents of this paper solely reflect our views, and any errors remain our own.

[6] The basic idea being to bring natural gas from the Caspian region, and possibly at some point Iran, through Turkey into the European Union.
[7] Boersma, et al., "Business as Usual: European Gas Market Functioning in Times of Turmoil and Increasing Import Dependence."

Algeria: Petro Politics on the Mediterranean

While a full accounting of Algeria's political economy is beyond the scope of this paper, the political dynamics at play must be noted. Commentators on Algeria often identify several pillars of the Algerian regime: the powerful military and intelligence services, civilian political "clans," and the immense hydrocarbon revenues provided by state-owned oil and gas conglomerate Sonatrach.[8] Many Algerians refer to these factions collectively as *le Pouvoir*—the powers that be. Any effort to develop Algeria's shale gas resources will ultimately have to deal with these centers of power, alongside (unexpectedly) the Algerian public.

The Algerian regime stands out as particularly opaque and authoritarian even in a region known for opaque, authoritarian regimes. Clement Moore Henry and Robert Springborg classify it as an archetypal "bunker regime"—almost a military outpost in a "potential state of war" with Algerian society, even as competing political clans maneuver within the state "bunker" to secure power.[9] This competition has manifested itself over the decades as ongoing and intense bureaucratic infighting within the Algerian state. Even during the 1960s, which saw broad consensus on moving toward greater nationalization of resources, Planning Minister Abdullah Khodja and then-Minister of Industry and Power Belaid Abdessalam sparred over the course of Algerian economic development, as the latter's heavy-handed policies of rapid industrialization played havoc with broader efforts to develop a diversified economy.

Of greater importance, though, are struggles between Algeria's political leadership, the armed forces, and the powerful Department of Intelligence and Security (DRS), the country's main intelligence services. Previously, the DRS tried to blackmail the presidency by publishing investigations into high-profile corruption cases. This brings public pressure against the political leadership to take visible action to "clean up government"—as was the case in 2010, when corruption allegations helped bring down Energy Minister Chakib Khalil. During a broad cabinet shuffle in May 2015, several ministers were replaced (energy, transportation, and finance ministers) that were connected peripherally or directly to ongoing corruption trials.[10] Additionally, departing Energy Minister Youcef Yousfi had attracted criticism for

[8] John Entelis, "Algeria: Democracy Denied, and Revived?" in *North Africa's Arab Spring*, ed. George Joffé, London: Routledge 2014, p. 161; Lakhdar Ghettas, "Just What is Happening in Algeria?" *Situation Analysis*, no. 7, London School of Economics and Political Science IDEAS, 2010.
[9] Clement Moore Henry and Robert Springborg, *Globalization and the Politics of Development in the Middle East,* Cambridge University Press, New York, 2010, pp. 113-114.
[10] Abdallah Brahimi, "Algeria's Cabinet Reshuffle," *Sada*, Carnegie Endowment for International Peace, 2 June 2015, http://carnegieendowment.org/sada/2015/06/02/algeria-s-cabinet-reshuffle/i9cn.

his poor handling of protests in In Salah against exploration of shale gas as well as a failure to increase energy-sector investment or production despite securing revisions to the country's hydrocarbons law.[11]

President Bouteflika has been successful in at least partially restricting the power of the military over the course of his fifteen years in office, retiring or re-assigning several high-ranking generals while sweeping aside abuses on both sides of the Algerian civil war through amnesties. In recent months, he has scored internal victories against the DRS, with his administration removing or arresting key intelligence officials and even replacing the powerful and long-serving head of the DRS, Mohamed Mediene, or Toufik.[12] Yet these private successes have been greatly overshadowed by President Bouteflika's declining health and lack of public leadership—he has barely appeared in public since a 2013 stroke, even as economic challenges have mounted.

ENERGY INDUSTRY AND ENERGY POLICY

As Abdulwahab Alkebsi notes in a recent article, the performance and revenues of any state-owned enterprise are inextricably caught up in the politics of whichever regime controls the state in question.[13] This is clearly the case in Algeria, where Sonatrach has been at the center of domestic power struggles for over three decades. It is both a valuable prize fought over by the political clans of the Algerian regime and a major source of state revenues used to quell social unrest, whether through subsidies and government employment or through funding the country's expansive security and military services.[14] While some foreign investors have no doubt grown accustomed to the difficulties of operating in Algeria—in both the political and physical environment—authoritarian "gridlock" between various political factions will likely slow the pace of economic reform. It also has the potential to scare off individual investors.

As much as any part of Algeria's present leadership, Sonatrach is a venerable holdover from the early days of Algerian independence. The discovery of oil predates independence. Colonial French authorities first prospected for oil after the First World War and then, after World War II, put in place the institutional framework that led to discoveries of major oil and gas reserves in 1956.[15] The company was created under state control in 1963 as a means of securing Algerian interests following the eight-year war for independence, ensuring Algerian gas and oil would be used to benefit Algeria first and foremost.

The resulting revenues were seen as a key driver to socialize the Algerian economy, expand state control, and develop government capacity. They were also intended to position Algeria as a great economic power in the Southern Mediterranean, making up for the damage and destruction of the long war for independence and erasing the colonial legacy of more than a century of French

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[11] Said Djaafer, "Remaniement Ministériel: Youcef Yousfi ou le Départ de l'homme de Schist [Cabinet Reshuffle: Youcef Yousfi, The Departure of the Shale Gas Man]," *Huffpost Maghreb*, 14 May 2015, http://www.huffpostmaghreb.com/2015/05/14/remaniement-youcef-yousfi_n_7284038.html.

[12] Carlotta Gall, "Algerian President Fires Intelligence Chief in a Shake-Up of Security Forces," *The New York Times*, 14 September 2015, http://www.nytimes.com/2015/09/15/world/africa/algerian-president-removes-feared-intelligence-chief.html.

[13] Abdelwahab Alkebsi, "Can There Be Good Middle Eastern State-Owned Enterprises?" *The Washington Post*, 7 May 2015, http://www.washingtonpost.com/blogs/monkey-cage/wp/2015/05/07/can-there-be-good-middle-eastern-state-owned-enterprises/.

[14] Though it should be noted that this does not equal total compliance from the population–see the ongoing hundreds, if not thousands, of small-scale protests in any given year (Azzedine Layachi, "The Changing Geopolitics of Natural Gas: The Case of Algeria," James A. Baker III Institute for Public Policy of Rice University, November 2013, pp. 14-17, http://belfercenter.ksg.harvard.edu/files/CES-pub-GeoGasAlgeria-110113.pdf).

[15] Ali Aissaoui, *Algeria: The Political Economy of Oil and Gas,* Oxford University Press for the Oxford Institute for Energy Studies, 2001, p. 43.

rule.[16] Algeria implemented an import-substitution strategy in the 1960s, based on the idea that development of a strong heavy oil industry would spur the manufacturing sector to provide domestic replacements for expensive imports.[17] To date, this strategy has not borne fruit (as seen in the continued lack of economic diversity).

The Algerian regime gradually expanded the scope of the company's operations, nationalizing all oil and gas holdings by the 1970s. Nationalization was incentivized by continued dissatisfaction with the role of France in the country, but more broadly with a deep discontent with foreign dominance in the oil and gas sector. These decisions helped determine the structure of the industry and the role of the state, and by doing so, Algeria started a broader trend amongst its Organization of Petroleum Exporting Countries (OPEC) government peers.[18] From the 1960s through to the early 1980s, hydrocarbon revenues fueled a rapid increase in Algeria's national standard of living in the country while positioning Algeria as a strong power among the non-aligned world.

Though foreign involvement in the hydrocarbon sector has been eased since Algeria came under global financial pressure in the mid-1980s, current Algerian hydrocarbons legislation maintains a sense of this resource nationalism by mandating that Sonatrach retain at least a 51 percent stake in any venture. Writing in 2001, Aissaoui describes a reform-minded government eager to move to a more competitive market model, so that Sonatrach could dedicate itself to economic objectives, rather than remaining beholden to political priorities.[19] Passed shortly thereafter, the 2005 hydrocarbons law—strongly advocated by then-Minister of Energy and economic reformist Chakib Khelil and passed by the Algerian parliament—would have significantly liberalized the hydrocarbons sector by permitting exclusive operations of international oil companies (IOCs) in Algeria, with only a 20 percent optional stake reserved for Sonatrach. Likewise, the proposed legislation would have turned Sonatrach into a commercial company, relieving it from several obligations such as tax collecting, regulations, and organizing bidding rounds for exploration activities. In order to orchestrate these activities, two agencies were established: the Hydrocarbon Regulatory Authority (ARH) and the Algerian National Agency for the Development of Hydrocarbon Resources (ALNAFT). The latter is responsible for managing new bidding rounds and overseeing contracting.

The executive branch under President Bouteflika, however, dragged its heels in implementing the law and ultimately reinstated Sonatrach's monopoly over oil exploration, production, and implementation by decree in 2006, requiring a 51 percent stake be reserved for Sonatrach in any Algerian concession.[20] Moreover, the supplementary budget law of 2009 installed a windfall tax on surplus profits when crude oil prices exceeded $30 a barrel.[21] While a subsequent 2013 revision to the Hydrocarbons Law provided broad tax incentives for investment as well as further incentives and guidelines for exploiting unconventional gas resources, Sonatrach's majority-stake requirement remains untouched.

Sonatrach activities allegedly have also become the target of political maneuvering, with corruption cases involving the company's dealings over

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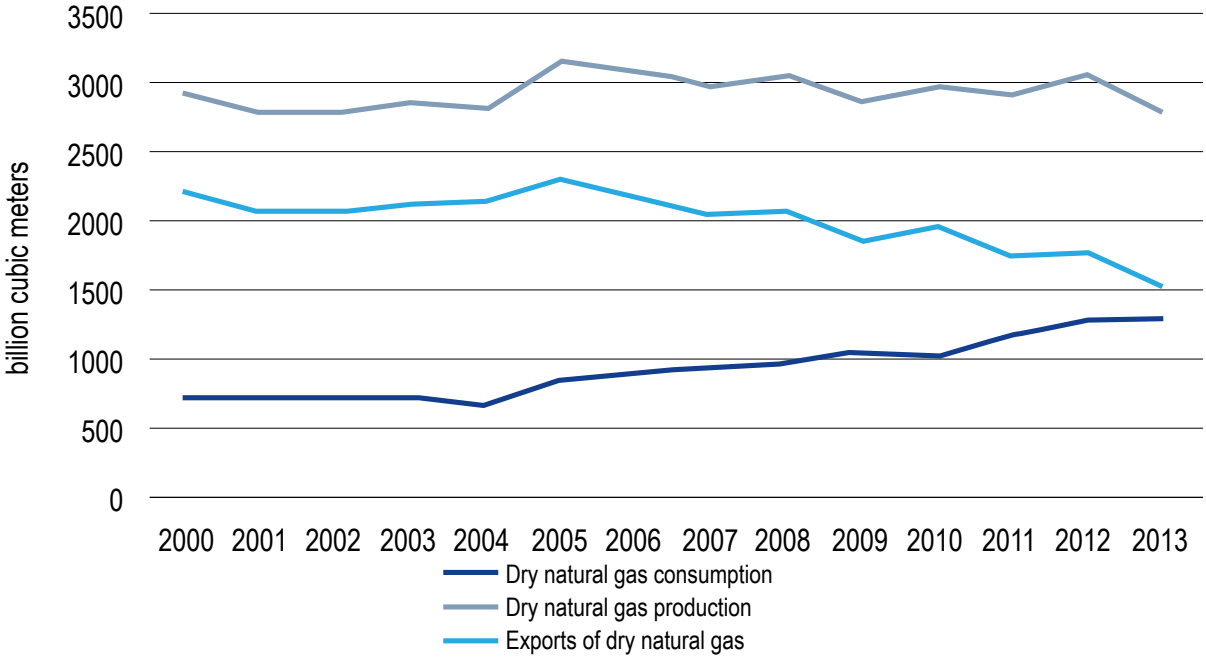
[16] John Entelis, "Sonatrach: The Political Economy of an Algerian Institution," *The Middle East Journal*, vol. 53, no. 1, Winter 1999, p. 10.
[17] Layachi, "The Changing Geopolitics of Natural Gas: The Case of Algeria," p. 14.
[18] Aissaoui, *Algeria: The Political Economy of Oil and Gas*, p. 85.
[19] Ibid., p. 202.
[20] Francois Krotoff and Nicolas Bonnefoy, "Hydrocarbons Legislation in Algeria: Back to Square One?" in *International Oil and Gas Finance Review 2007,* Euromoney Yearbooks, London, 2007, pp. 57-62, http://www.la.utexas.edu/users/chenry/oil/2006/syll-2006%20Hydrocarbons%20Law%20Algeria.pdf.
[21] Layachi, "The Changing Geopolitics of Natural Gas: The Case of Algeria," p. 29.

the past several years widely seen as politically motivated attacks.[22] A 2010 corruption case initiated by the DRS led to the removal of Sonatrach's CEO, three of the company's four vice presidents, and ultimately Minister of Energy Khelil, who currently resides in the United States while allegedly evading corruption charges back in Algeria.[23] The case has dragged on in Algerian and foreign courts, involving European companies such as Italy's Eni and its subsidiary Saipem.

While the legacy of resource nationalism in Algeria cannot be discounted, other factors will certainly come into play should prices remain low. Even during the period over the past decade which saw both high oil prices and the collapse of prices during the financial crisis in 2008, production levels of oil and gas stagnated and even declined, while domestic consumption has eaten away at exports (see **Figure 1**). Furthermore, despite long-standing policy aims to diversify the economy, Algeria remains heavily dependent on these exports to earn foreign currency, with hydrocarbons forming 97 to 98 percent of all export revenues in recent years.

If hydrocarbon prices remain low, the Algerian regime will be under pressure to reconsider the stringent terms Sonatrach currently offers to foreign investors and its investment climate more broadly.

Figure 1: Production, consumption, and exports of dry natural gas in Algeria, 2000-2013 (in BCM)[24]



Source: U.S. Energy Information Administration

[22] Lahcen Achy, "T'adilat al-qanun al-jaza'iri lil-mahruqat la tufi al-matlub [Algeria Needs More Than Hydrocarbon Law Amendments]," *al-Hayat*, 22 January 2013, http://alhayat.com/OpinionsDetails/474729; George Joffe, "The Political Roots of Algeria's Corruption Scandals," *al-Araby al-Jadeed*, 18 May 2015, http://www.alaraby.co.uk/english/politics/2015/5/18/the-political-roots-of-algerias-corruption-scandals#sthash.SXPIB6pQ.dpuf.

[23] "Algérie: non, Chakib Khelil n'est pas américain [Algeria: No, Chakib Khalil is not American]," *Jeune Afrique*, 4 March 2015, http://www.jeuneafrique.com/225903/politique/alg-rie-non-chakib-khelil-n-est-pas-am-ricain/.

[24] Data from "Algeria – International Energy Data and Analysis," U.S. Energy Information Administration, last updated 5 February 2014, http://www.eia.gov/beta/international/country.cfm?iso=DZA.

Falling prices in the 1980s eventually forced market reforms under the government of then-President Chadhli Benjedid, with IMF and World Bank support, and gave way to greater engagement with American, French, and other oil companies. This engagement continued to expand during the 1990s, despite the outbreak of a veritable civil war in Algeria.[25] Additionally, there is a clear realization on the side of Sonatrach that foreign expertise will be required to get new supplies on-stream, especially when it comes to the technically difficult process of exploiting shale gas deposits. The key question, then, is how quickly the often-discordant arms of the Algerian government are willing or even able to move to make changes this time around.

ENERGY POLICY: SHALE GAS

In February 2013, amendments to the 2005 Hydrocarbon Law were introduced with the aim of boosting exploration and development and exploiting non-conventional resources.[26] One key shift was to base revenue taxes on profitability rates, not cash flow, incentivizing the development of smaller or more marginal energy projects (including shale). The changes also support greater exploitation of unconventional resources through a lower royalty tax (5 percent), and longer exploration and exploitation periods for new licenses compared to those granted for conventional resources. The new law furthermore prioritizes domestic consumption: Domestic demand must be met before exports can be considered. Operators determine up front how much gas will be destined for the national market, and how much will be sold internationally. Foreign companies will receive the international price for natural gas, with the difference between the international price and the domestic price paid by the Algerian treasury. This policy may give foreign investors some confidence about future investments, but it also puts another constraint on the national budget—a key consideration given Algeria's present finances (see below).

Despite these efforts to entice investors, only four out of 31 blocks on offer were awarded in an early 2014 bidding round. Sonatrach's CEO went on record saying that his company and the government were considering improving the conditions for a new bidding round scheduled in the second half of 2015, though at first glance the conditions seemed fair.[27] Historically, a number of IOCs, such as BP, Statoil, and Anadarko have operated in Algeria, as have major service companies such as Schlumberger and Halliburton. A number of companies accustomed to working in Algeria find current conditions, while perchance not ideal, sufficient to ensure profits while extracting oil and/or natural gas. However, if the Algerian government wants to develop its unconventional gas resources successfully, then it requires more competition to bring the costs down. That means attracting more, and new, foreign companies. It is unlikely that the current institutional framework, with Sonatrach's majority share in each individual project, can facilitate such competition.

In addition, it is uncertain whether Sonatrach and the Algerian government remain committed to the exploration of unconventional gas. As described below, drilling the first exploration wells in the country proved to be contentious, resulting in sustained local protests. Anecdotal evidence suggests that public dissatisfaction with the government's handling of the protests was a contributing factor in former Energy Minister

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[25] Henry and Springborg, *Globalization and the Politics of Development in the Middle East*, pp. 126-129; James D. Le Sueur, *Between Terror and Democracy: Algeria Since 1989,* New York: Zed Books Ltd., 2010, pp. 101-110.

[26] See "Qanun 13-01 [Law 13-10]," *Official Journal*, Government of Algeria, 24 February 2013, http://www.joradp.dz/FTP/jo-arabe/2013/A2013011.pdf.

[27] Simon Falush, "INTERVIEW – Algeria plans oil and gas bidding round by Q3 2015 – Sonatrach," *Reuters*, 10 December 2014, http://www.reuters.com/article/2014/12/10/algeria-oil-bidding-idUSL6N0TU3R520141210.

Yousfi losing his position in May 2015.[28] More anecdotal evidence suggests that the new Minister, Mr. Salah Khebri, is more interested in conventional low risk projects and short-terms results rather than uncertain, controversial, and long-term shale gas development.[29] While abandoning support for unconventional gas exploration is not a given, shale gas will almost certainly be a lower priority for this new minister.

ECONOMIC OUTLOOK

In a 2013 overview of Algeria's political situation, Lahcen Achy warned against Algeria's over-reliance on hydrocarbons given the historical precedent of the 1980s price drop. Writing ahead of the 2014 oil price collapse, he noted that "it is ominous that the decline in international oil prices in the mid-1980s significantly contributed to Algeria's precocious Arab Spring, the 1988 popular protests, and breakdown of Algeria's state-society relations."[30]

While it remains to be seen whether the current collapse in oil prices can match its forerunner in duration or magnitude, for the time being it does not seem to be motivating the myriad branches of the Algerian government to undertake significant reforms. At the same time, we observe that several major IOCs have publicly expressed that they anticipate a low-price environment for a number of years.[31] Algeria amassed substantial foreign reserves during the preceding years of high energy prices, and intuitively one may conclude that the country can ride out the current losses in export revenues for a number of years. Additionally, Henry and Springborg have cited the inability to formulate rational, coherent economic policy as a key feature of "bunker" regimes such as Algeria, with regime in-fighting one of the key reasons why the Algerian government was unable to mount an effective response to the late 1980s drop in oil prices.[32]

Still, the Algerian government will face increasing pressure to address the country's economic concerns. The country remains heavily reliant on hydrocarbons both for government revenue (some 60 percent) and as a generator of foreign currency (with hydrocarbons representing about 97 percent of export earnings, as noted above), while importing much of its food, medicine, and manufactured goods. Algeria's economic fortunes and the finances of its state are thus heavily reliant on both the amount of hydrocarbons it can export and the price it can get when it does so. Oil and gas production had begun to taper off even before the 2014 price drop, even as Energy Minister Yousfi forecasted a 100 percent increase in annual production by 2023.[33] It is doubtful that there will be a huge increase in production in the near term: Natural gas production has stagnated since 2000 in the range of 80 to 90 billion cubic meters (bcm), even as the Algerian state's economic commitments (and the number of its citizens) have grown.[34]

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[28] Amir Akef, "Algérie: l'exploitation controversée du gaz de schiste fait tomber le ministre de l'énergie [Algeria: Controversial Exploitation of Shale Gas Leads to Fall of Energy Minister]," *Le Monde*, 15 May 2015, http://www.lemonde.fr/afrique/article/2015/05/15/algerie-l-exploitation-controversee-du-gaz-de-schiste-fait-tomber-le-ministre-de-l-energie_4634102_3212.html#o1MxPBxgO0Fx5Tl1.99.

[29] Ali Titouche, "Salah Khebri, nouveau ministre de l'énergie: L'ultime choix pour surmonter la crise [Salah Khebri, the newest energy minister: the latest choice to overcome the crisis]," *ElWatan,* 19 May 2015, http://t.co/C6uHMuaU6S.

[30] Lahcen Achy, "The Price of Stability in Algeria," Middle East Center, Carnegie Endowment for International Peace, April 2013, p. 18.

[31] Joe Carroll, "Exxon CEO Says Expect Low Oil Prices for Next Several Years," *Bloomberg Business*, 21 April 2015, http://www.bloomberg.com/news/articles/2015-04-21/exxon-ceo-says-expect-low-oil-prices-for-next-several-years.

[32] Henry and Springborg, *Globalization and the Politics of Development in the Middle East*, p. 114.

[33] Maher Chmaytelli and Lananh Nguyen, "Algeria Gas, Oil Production to Double in 10 Years, Yousfi Says," *Bloomberg Business*, 1 October 2013, http://www.bloomberg.com/news/articles/2013-10-01/algeria-gas-oil-production-to-double-in-10-years-yousfi-says.

[34] Simone Tagliapietra and Georg Zachmann, "Reinvigorating the EU-Algeria energy cooperation," Bruegel, 9 June 2015, http://www.bruegel.org/nc/blog/detail/article/1642-reinvigorating-the-eu-algeria-energy-cooperation/.

Worse, Algeria's gas exports are at risk of being eaten away by mounting domestic consumption, driven in part by greater use of natural gas in industry and household use, but above all, by higher demand for electricity, with over 90 percent of the country's power plants reliant on natural gas.[35] Peak electricity demand in the summer of 2014 was expected to be 12.5 GW and, in turn, was expected to increase to 20 GW in the period until 2017.[36] Arguably one of the key drivers of domestic energy demand growth is a major part of Algeria's domestic spending: subsidies. Prices for oil-related products (be it gasoline, diesel, or LPG) and natural gas and electricity are all regulated and tend to be low even for the subsidy-heavy Middle East and North Africa (MENA) region. In 2014, for example, the pump price of gasoline in Algeria was roughly $1.02 per gallon, closer to the price in wealthy Gulf oil producing states (such as Kuwait, at $0.83 per gallon) than neighboring Morocco ($5.22 per gallon) or Egypt ($3.33 per gallon).[37] The total cost subsidies in 2012 was estimated at over $22.2 billion, or 10.9 percent of Algeria's GDP. According to the IMF, prices for natural gas in Algeria may be the second lowest in Africa after Libya. They are also likely the second-lowest in the MENA region, again after Libya.[38] In its Article IV consultations with the Algerian government, the IMF observed that curbing domestic energy consumption, essential for boosting foreign currency revenue, would require phasing out subsidies and addressing smuggling.[39]

For its part, Sonatrach is under pressure to bring new fields into production, to meet both domestic demand and foreign contractual obligations. In the coming years, a number of new fields are expected to come on stream,[40] which is expected to slow the negative trend that has been in effect since 1996, resulting in modest growth of 0.4 percent.[41] The need to expand production has also fueled domestic interest in exploiting unconventional gas resources, which according to a study commissioned by U.S. Energy Information Administration (EIA), may be the world's third largest, at 707 trillion cubic feet (tcf).[42] Energy Minister Yousfi made development of shale reserves a key part of his overall energy strategy, while Prime Minister Abdelmalak Sellal cited shale gas exploitation as necessary "to ensure Algeria's energy security" in outlining the government's priorities in 2014.[43]

The Algerian state is badly in need of new revenues, given that it has more economic commitments than ever in the wake of the region-wide uprisings and demonstrations of the Arab Spring. Pledges of additional government spending formed a key part of Algeria's resilience to more

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[35] Calculated from statistics cited by the International Energy Agency, "Algeria: Electricity and Heat for 2012," accessed 14 July 2015, http://www.iea.org/statistics/statisticssearch/report/?country=ALGERIA&product=electricityandheat.

[36] U.S. Energy Information Administration, "Country Analysis Brief: Algeria," last updated 24 July 2013, p. 16, http://www.eia.gov/beta/international/analysis_includes/countries_long/Algeria/algeria.pdf.

[37] Prices calculated from World Bank, "Pump price for gasoline (US$ per liter)," World Development Indicators, accessed 14 July 2015, http://data.worldbank.org/indicator/EP.PMP.SGAS.CD.

[38] Ali Aissaoui, "Algeria's Natural Gas Policy: Beware of the Egypt Syndrome!" *Economic Commentary,* vol. 8, no. 7, APICORP Review, July 2013, http://www.apic.com/Research/Commentaries/2013/Commentary_V8_N7_2013.pdf.

[39] "2014 Article IV Consultation – Staff Report; Press Release; and Statement by the Executive Director for Algeria," International Monetary Fund, IMF Country Report no. 14/341, p. 17, https://www.imf.org/external/pubs/ft/scr/2014/cr14341.pdf.

[40] Simon Falush, "Algeria Plans Oil and Gas Bidding Round by Q3 2015 – Sonatrach," *Reuters,* 10 December 2014, http://www.reuters.com/article/2014/12/10/algeria-oil-bidding-idUSL6N0TU3R520141210.

[41] International Monetary Fund, "Algeria: 2014 Article IV Consultation - Algeria," p. 6.

[42] EIA, "Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States."

[43] Lies Sahar and Tamsin Carlisle, "U.S. companies keen to invest in Algerian unconventional oil, gas: Moniz," *Platts*, 2 June 2014, http://www.platts.com/latest-news/oil/algiers/us-companies-keen-to-invest-in-algerian-unconventional-26800180.

widespread civil unrest in 2011 to 2012, along with some limited (but heavily circumscribed) venues for political speech and the effective deployment of security forces. The resulting increases in state salaries and subsidies drove up government spending by over 30 percent in 2011 and a further 20 percent in 2012, helping to buy the state what Frédéric Volpi refers to as a "grudging" political quiescence—small-scale strikes, riots, and demonstrations have continued, although rarely on a scale that seriously worries the regime.[44] Yet these commitments, barely sustainable even with high oil prices, pose an immense burden on an increasingly cash-strapped government, which projected a deficit of roughly $52 billion for 2015, over 22 percent of GDP. While part of this will be offset by funds drawn from the Fond de Régulation des Recettes (FRR), Algeria's fiscal stabilization fund, continued deficits, and low oil prices will rapidly deplete even this financial buffer (estimated at some $66 billion at the close of 2014).[45] Algeria's substantial foreign currency reserves have also been hit hard by the drop in oil prices, falling some $40 billion since the end of 2013, to reach $159 billion at the end of the first quarter of 2015.[46]

Even though in recent years the Algerian authorities have been more transparent about the level of subsidies, to date there has been tremendous hesitance regarding even modest reforms. While Algeria's fractured regime may see the writing on the wall and try to tackle subsidy reforms—following regional neighbors such as Egypt and Morocco—easier short-term solutions will likely involve public-sector hiring freezes, cuts to social spending, and efforts to boost hydrocarbon output, no matter how far-off the returns seem to be.

[44] Frédéric Volpi, "Algeria Versus the Arab Spring," *Journal of Democracy,* vol. 24, no. 3, July 2013, p. 110.
[45] Ali Aissaoui, "The Threat of a Possible Crisis," *Oil Magazine*, no. 28, 19 May 2015, pp. 44-46, http://www.abo.net/oilportal/topic/view.do?contentId=2434733.
[46] Hamind Ould Ahmed, "Algeria's Central Bank Says Foreign Reserves Fall $19 bln in First Qtr," *Reuters*, 14 July 2015, http://af.reuters.com/article/algeriaNews/idAFL5N0ZU2QS20150714.

Shale Gas Extraction: Favorable Conditions, Significant Challenges

Algeria unquestionably holds an enormous potential for shale gas development, including favorable geology and an extensive existing gas industry. Yet despite its vast resources there are a number of challenges—such as social unrest, water concerns, water concerns, security, political instability, and bureaucratic red tape—that will give potential investors cause for concern. In this chapter, we analyze these key issues and their likely impact on the future of shale gas in Algeria.

GEOLOGY

In 2013, an EIA-sponsored study estimated that Algeria holds 707 tcf of technically recoverable shale gas resources and 5.7 billion barrels of shale oil.[47] Though it is important to remark that this is merely an initial assessment,[48] these estimates place the country's resources of shale gas far above its proven conventional gas reserves, estimated at 159 tcf for 2014.[49] The unconventional hydrocarbon basins hold two main formations: the Silurian Tannezuft Shale and the Devonian Frasnian Shale.

Of the seven basins containing shale formations, several lie in the east, with the Ghadames basin extending from Algeria's borders with Tunisia and Libya. Other basins, in central Algeria, hold mainly gas and relatively little oil. Key areas include the Timimoun basin, with an estimated 152 tcf in technically recoverable gas resources (see **Table 1** for a full account). In 2014, two exploration wells were drilled in the nearby Ahnet basin (estimated 60 tcf in gas resources), with results from preliminary testing deemed "very promising" by then-Minister of Energy Youcef Yousfi.[50]

The average organic-rich net thickness of the reservoirs ranges between 54 feet and 297 feet, and the depth of the basins runs from 3,300 to 16,000 feet, with an average depth of 8,800 feet. Depth varies significantly across the identified basins: The resource-richest basin (Ghadames), for example, lies quite deep, at 8,000 to 16,000 feet. In

[47] EIA, "Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States."

[48] Further exploration may significantly alter the figures, as has been the case in Poland, where initial estimates were significantly more optimistic than later assessments, which were based on results of several dozens of exploration wells that had been drilled.

[49] Conglin Xu and Laura Bell, "Global Reserves, Oil Production Show Increases for 2014," *Oil and Gas Journal*, 12 January 2014, http://www.ogj.com/articles/print/volume-112/issue-12/special-report-worldwide-report/global-reserves-oil-production-show-increases-for-2014.html.

[50] Ali Aissaoui, "The Threat of a Possible Crisis," and "Shale gas: Results of First Pilot Drilling 'Promising,'" *Algeria Press Service*, 28 December 2014, http://www.aps.dz/en/economy/5468-shale-gas-results-of-first-pilot-drilling-promising.

Table 1: Algeria's shale basins and technically recoverable oil and gas resources[51]

Basin - formation	Depth of shale gas reservoirs (ft)	Risked, technically recoverable shale gas resources[52] (tcf)	Risked, technically recoverable shale oil resources (bn barrels)	Organic-rich average net thickness for shale reservoirs (ft)
Ghadames - Silurian Tannezuft	10000-16000	176	0.5	104
Ghadames - Devonian Frasnian	8000-16000	106	3.9	248
Ghadames, *total*		*282*	*4.4*	
Illizi - Devonian Frasnian	3300-8000	56	0.5	162
Timimoun - Silurian Tannezuft	5000-15000	59	/	90
Timimoun - Devonian Frasnian	3300-9000	93	/	180
Timimoun, *total*		*152*	/	
Ahnet - Silurian Tannezuft	6000-10500	51	/	297
Ahnet - Devonian Frasnian	3300-9500	9	0.2	54 (dry gas) – 248 (wet gas/ condensate)
Ahnet, *total*		*60*	*0.2*	
Mouydir - Silurian Tannezuft	5000-10000	10	/	54
Reganne - Silurian Tannezuft	5000-16000	105	0.3	117 (wet gas/ condensate) –207 (dry gas)
Reganne - Devonian Frasnian	5500-16000	16	0.2	234 (dry gas) – 297 (wet gas/ condensate)
Reganne, *total*		*121*	*0.5*	
Tindouf - Silurian Tannezuft (uncertainty due to limited well penetrations)	6600-14000	26	0.1	54
Algeria, *total*		**707**	**5.7**	

Source: EIA, "Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States," U.S. Department of Energy, June 2013, http://www.eia.gov/analysis/studies/worldshalegas/pdf/fullreport.pdf.

[51] All data drawn from: EIA, "Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States."

[52] The technically recoverable resources are referred to as "risked, (technically) recoverable resources" in the EIA report and are calculated by multiplying the risked in-place oil or natural gas by a recovery factor composed of a formation success probability factor (which takes into account results from current shale gas and oil activity, indicating how much is known or unknown about the formation) and a prospective area success factor (which, taking into account factors such as geological complexity and lack of access, indicates the portions of the prospective area which could be limited from development). See: EIA, "Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States," p. 15-17.

comparison, the typical depth of shale gas formations in the United States is somewhat shallower, ranging from 2,600 to 8,500 feet.[53] The Marcellus shale, for instance, accounting for more than 36 percent of U.S. shale gas production, reaches maximum depths of approximately 8,000 feet, and starts at 1,000 feet, while producing wells generally lie between 2,000 and 6,000 feet.[54] Geographically, the unconventional resources overlap to a reasonable degree with the location of the known conventional resources (ensuring transport infrastructure is in place, or at least in relative proximity), with the exceptions of the Mouydir basin and the Tindouf basin in the far west.

As is the case with much of the country's conventional resources, most of the shale acreages described above are remote with limited local population. While field remoteness poses potential difficulties in terms of accessibility to sites and lack of infrastructure, the low population density and the lack of large urban centers would seem to reduce the likelihood of social resistance. However, the remoteness of this location is no guarantee of local quiescence, as proven in the demonstrations following Sonatrach's first pilot wells near In Salah, in the Ahnet basin.

ESTABLISHED GAS INDUSTRY

It is no surprise Algeria has a solid foundation of available infrastructure and service industries, given its decades of hydrocarbon production. Sonatrach has substantial in-house knowledge and experience, as well as long-standing international business relations. That can help, in particular when it comes to unconventional gas extraction. Therefore, we think it is reasonable to differentiate between IOCs and service companies active in Algeria for a longer period of time, on the one hand, and "new" companies on the other. The former have acclimated to working in the country, understand the political complexities in play, and are accustomed to the geophysical climate in the Sahara desert. One of their chief concerns is red tape and lack of competition, discussed in greater depth later. At the same time, the Algerian authorities have struggled to make the country's hydrocarbon sector attractive for new investors. This fundamental issue hinders Algeria from taking full advantage of its existing infrastructure, pipelines and LNG liquefaction terminals to serve international markets.

SOCIAL UNREST

Algeria's first exploration wells for shale gas garnered significant media attention—not for their promising results, but rather for the local protests they triggered. While small-scale protests are ubiquitous in Algeria (as mentioned earlier), in this case, the protests swelled and gathered international media attention.

In January 2015, demonstrations broke out in the main square of In Salah, a Saharan town of some 35,000 inhabitants roughly 650 miles south of Algiers in Tamanrasset province, and spread in a three month burst to other towns in the area, including Tamanrasset, Adrar, and Ouargla. The protesters' concerns were environmental and health-related, with worries about the impact of shale gas exploration on the depletion of aquifers that sustain the traditional oasis and nomadic agriculture in the area and about possible contamination by fracking fluids and wastewater. As expressed by a protest leader, Sonatrach engineer Bouhafs, protesters also demanded increased

[53] Meagan Mauter, Pedro J. J. Alvarez, Allen Burton, Diego C. Cafaro, Wei Chen, Kelvin B. Gregory, Guibin Jiang, Qilin Li, Jamie Pittock, Danny Reible, and Jerald L. Schnoor, "Regional Variation in Water-Related Impacts of Shale Gas Development and Implications for Emerging International Plays," *Environmental Science and Technology*, vol. 48, no. 15, March 2014.

[54] Olga Popova, Evan Frye, and Elizabeth Panarelli, "Updated Geologic Maps Provide Greater Detail for Marcellus Formation," *Today in Energy*, EIA, 1 April 2015, http://www.eia.gov/todayinenergy/detail.cfm?id=20612.

transparency from their government and a national dialogue on the exploration of unconventional resources.[55] At time of writing, shale gas exploitation had become an openly debated and fiercely contested topic all over the country, with misunderstandings and misinterpretations on both sides of the aisle (as is generally the case).

As the movement swelled, Energy Minister Yousfi travelled to In Salah, evoking national solidarity in times of falling oil prices.[56] The army also entered into negotiations with the protesters, and President Bouteflika attempted to calm the crowd by stating that "[a]ll energy sources, whether conventional or not, are a gift from God and it is our duty to use them for the development of the country, whilst strictly respecting the environment and taking all necessary health precautions."[57] The protests continued to spread however, ultimately leading to clashes between security forces and protesters, and multiple citizens and policemen were wounded. From April 2015 on, the demonstrations began to lose strength, though they did continue at a much smaller scale through Ramadan.

These protests took place in the context of broad discontent in the south of Algeria, with widespread feelings of marginalization among the local population. Rather revealingly, Prime Minister Abdelamalek Sellal directly linked the In Salah demonstrations to prior—and non-shale gas-related—protests in other Southern regions, declaring that after failing in Ghardaïa, Ouargla, and Djanet, certain regionalist groupings now sought to undermine national unity in In Salah.[58]

Regional imbalances in Algeria are indeed substantial, with the underpopulated and underdeveloped south drawing the short stick. Just 9 percent of the population is located in the Southern territories that make up nearly 87 percent of Algerian territory,[59] and economic and social infrastructure is sorely lacking.[60] Conflicts and uprisings in the region are rooted in religious, ethnic, and social grievances. Protesters decry the government's misadministration of and contempt towards the region and its citizens.[61] They frequently demand, among others, better housing and greater employment opportunities, especially

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[55] Quoted in Djamila Ould Khettab, "Q&A: 'We Want to Avoid an Ecological Disaster,'" *Al Jazeera*, 11 March 2015, http://www.aljazeera.com/news/middleeast/2015/03/qa-avoid-ecological-disaster-150311072044323.html.

[56] The maximum number of protesters at any point in time remains disputed, with reports ranging up to 15,000 (e.g. "Demonstrators protest against shale gas development," Intelligence Unit, *The Economist*, 19 January 2015, http://country.eiu.com/article.aspx?articleid=992677083&Country=Algeria&topic=Economy&subtopic=Forecast&subsubtopic=Policy+trends&u=1&pid=742690658&oid=742690658&uid=1.

[57] Borzou Daragahi, "Environmental Movement Blocks Fracking in Algeria's Remote South," *Financial Times*, 9 March 2015, http://www.ft.com/intl/cms/s/0/db622d4c-c0f6-11e4-88ca-00144feab7de.html#axzz3f5ucT3fm.

[58] "Le Premier Ministre Appelle à Préserver L'unité et la Souveraineté Nationales [Prime Minister Calls for the Preservation of National Unity and Sovereignty]," Republique Algerienne Democratique Et Populaire, Portail du Premier Ministre, last modified 24 February 2015, http://www.premier-ministre.gov.dz/index.php?option=com_content&task=view&id=3798&Itemid=245; Ghardaïa, at the northern fringe of the Sahara and some 400 miles north of In Salah, has been the stage of small-scale but recurrent conflicts since 2013. Ethnic struggles between Sunni Arabs and the Mozabite Berber population, followers of Ibadi Islam, have escalated, leading to around ten deaths (the exact number varies by source) in 2014. In July of 2014, the government responded to the tense situation in Ghardaïa with a 2.5 billion dinar investment plan for economic development and rebuilding after the violence. However, tensions once again flared in the summer of 2015, leaving over twenty dead. See: Mokrane Ait Ouarabi, "Le nouveau plan du gouvernemnt dévoilé [New Government Plan Revealed]," *El Watan*, 23 July 2014, http://www.elwatan.com/archives/article.php?id_sans_version=265548 and "Situation à Ghardaïa: réunion d'urgence à Alger, Sellal se déplace sur place [Situation in Ghardaïa : Emergency Meeting in Algiers, Sellal Visits the Area]," *Algérie Presse Service*, 9 July 2015, http://www.aps.dz/algerie/25715-situation-%C3%A0-gharda%C3%AFa-r%C3%A9union-d-urgence-%C3%A0-alger,-sellal-se-d%C3%A9place-sur-place.

[59] Including the wilayas of Adrar, Tamanrasset, Illizi, Tindouf, Ghardaïa, Ouargla, Béchar, El Bayadh, El Oued, and Laghoat (based on 2008 census information).

[60] African Development Bank Group, *People's Democratic Republic of Algeria Dialogue Note 2011-2012*, May 2011, http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Algeria-%20Dialogue%20Note%20%202011-2012%20(01%20juin%202011)%20Revised%20English%20final.pdf.

[61] Ali Aissaoui, "The threat of a possible crisis."

for the youth. Note, in this sense, that the age category of 15 to 24 year olds makes up almost a quarter of the population (20 to 24 percent) in the southernmost wilayas (districts), while those under 15 make up 29 to 37 percent of the total in the South. Meanwhile, youth unemployment in the country currently stands at over 25 percent.

Government responses to the social uprisings in the South have generally included classic, stabilizing measures of ad hoc social and economic investment, and the In Salah protests were no exception. For example, on April 9, 2015, Prime Minister Sellal visited Ouargla, provincial capital to the oil and gas-rich Hassi Messaoud area and one of the focal points of the Southern protests: On the official visit, he tellingly toured and highlighted housing, hospital, water, education, and tourism projects.[62]

For now, protests in In Salah have tempered, but given unpromising long-term socio-economic perspectives such as declining hydrocarbon rents, ongoing energy subsidies coupled with increasing domestic energy demand, and most importantly, very limited local economic opportunities, political stability remains uncertain. The government's reaction to these protests—classic appeasement through one-off distributions of hydrocarbon rents—may prove to be only a temporary fix. It seems that officials chalked the demonstrations up to miscommunication on hydraulic fracturing, yet given the structural challenges the country and the shale-rich South confront, it is doubtful whether the government's ad hoc responses will suffice to placate the population.

WATER CONCERNS

Beyond the deeper background of social unrest, In Salah demonstrators cited water-related issues as their major reservations regarding the first exploration wells. At the global level, concern over water use, treatment, and pollution in hydraulic fracking operations is not new, and in an arid country like Algeria, water is of vital importance. According to the World Resources Institute (WRI) Aqueduct Water Risk Atlas, the country's baseline water stress level is "arid and low water use," and with more than 95 percent of Algeria's shale plays lying in the Algerian desert, fully 96 percent of their area is arid, featuring extremely low levels of available surface water.[63] Moreover, renewable internal freshwater resources stand at 295 cubic meters per capita, placing Algeria among the bottom 15 percent of countries worldwide in terms of availability of these resources.[64] In addition, almost two thirds of the territory (mainly the South, home to the unconventional resources) faces extremely high physical risks regarding water quantity (e.g. floods and droughts), which may impact short or long-term availability.[65]

[62] "Actualités," Republique Algerienne Democratique Et Populaire, Portail du Premier Ministre, http://www.premier-ministre.gov.dz/index.php.
[63] Paul Reig, Tianyi Luo, and Jonathan N. Proctor, *Global Shale Gas Development: Water Availability and Business Risks,* World Resources Institute, Washington, D.C., 2014, p. 39, http://www.wri.org/sites/default/files/wri14_report_shalegas.pdf.
[64] Based on data from the World Bank, 2013, http://data.worldbank.org/indicator/ER.H2O.INTR.PC. Percentage calculated based on the 177 countries for which data is available.
[65] World Resources Institute, "Aqueduct Water Risk Atlas," October 2013, accessed 10 June 2015, http://www.wri.org/resources/maps/aqueduct-water-risk-atlas.

Even though surface water is scarce and variable, Algeria in fact sits atop very large groundwater reserves, in the shape of the North West Sahara aquifer system (NWSAS), which stretches for a million square kilometers under Algeria, Libya, and Tunisia and has been estimated to hold some 60,000 billion cubic meters of groundwater.[66] Given the lack of surface water in Algeria's south, these deep, mostly non-renewable reserves of groundwater make up approximately 96 percent of total water use in the region.[67] However, concerns are rising regarding decreases in both the quantity and the quality of the aquifer, due to factors such as increasing extractions—which, at an estimated 2.5 billion cubic meters per year in 2007, exceed annual renewal (1 billion cubic meters per year)—and seawater intrusion.[68]

Though groundwater is currently abundant, the water-intensive technology of hydraulic fracturing (typically requiring some 10 to 20 million liters of water per well) would further contribute to the decline of water stocks in the aquifer, given its non-renewable nature.[69] As such, the application of new technologies in water use—including using brackish groundwater or other alternatives in place of freshwater, or water reuse[70]—could possibly make hydraulic fracturing more socially feasible in Algeria.[71]

Nevertheless, given that environmental concerns are rarely the sole driver behind management decisions, economics will also prove critical in the water management strategies employed in Algeria. Cost calculations will include, inter alia, the costs and availability of source water, the type of water transport available, the types of disposal available,[72] the overall water management strategy, and the available water treatment methods. Produced water reuse strategies, for example, have been found to cut overall water management costs by 30 to 80 percent, while also reducing total trucking miles.[73] However, water reuse would require significant capital investments in storage and treatment facilities—an investment that many companies in early development phases elect to defer in favor of water disposal. The question therefore remains whether the industry will implement these measures in possible future hydraulic fracturing in Algeria, and government incentives, such as water regulation or pricing, could be critical in this sense.

Using alternative water sources would be an important step towards reducing the upheaval caused by freshwater extraction. However, contamination remains an important risk: Given that this single aquifer is almost the only source to meet the water needs of the South, pollution

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[66] "North Western Sahara Aquifer System (NWSAS) M&E Rapid Assessment Report," Center For Environment & Development For The Arab Region & Europe (CEDARE), Monitoring & Evaluation for Water In North Africa (MEWINA) Project, Water Resources Management Program, March 2014, http://namcow.cedare.int/namcow/attachments/article/218/North%20Western%20Sahara%20Aquifer%20System%20NWSAS%20Monitoring%20and%20Evaluation%20Rapid%20A~.pdf. Note that estimated volumes vary according to source.

[67] Food and Agriculture Organization of the United Nations (FAO), *Groundwater Management in Algeria: Draft Synthesis Report,* United Nations, Rome, Italy, 2009, http://www.groundwatergovernance.org/fileadmin/user_upload/groundwatergovernance/docs/Country_studies/Algeria_Synthesis_Report_Final_GroundwaterManagement.pdf.

[68] MEDA Database on Transboundary Aquifers (ESCWA-UNESCO-UNECA-UNECE), "Questionnaire on Transboundary Aquifers in the MEDA Region," 7 July 2007, http://www.inweb.gr/html_reports/North%20Western%20Sahara%20Aquifer%20System%20(NWSAS).html.

[69] Meagan Mauter, et al., "Regional Variation in Water-Related Impacts of Shale Gas Development and Implications for Emerging International Plays."

[70] There are several parts in the United States, such as the Permian basin in Texas, where high water prices incentivized the development and application of new technologies, and industry in some places now uses predominantly saline water for its operations, rather than freshwater.

[71] Rowlan Greaves, Roy Hartstein, Dianne Lincicome, Jenifer E. Wehner, Pat Beck, Julianne E. Lamb, and Karen Elaine Olson (Southwestern Energy), "The Fresh Water Neutral Challenge: The Need for Protection, Reduction, Innovation and Conservation," Society of Petroleum Engineers, Hydraulic Fracturing Technology Conference, Texas, 3-5 February 2015.

[72] The lack of disposal wells in the Marcellus shale, for example, is a key driver of its high rate of reused produced water.

[73] James Slutz, Jeffrey A. Anderson, Richard Broderick, and Patrick Harold Horner, "Key Shale Gas Water Management Strategies: An Economic Assessment Tool," Society of Petroleum Engineers (SPE), SPE/APPEA International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Perth, Australia, 11-13 September 2012.

would be disastrous. A recent draft Environmental Protection Agency (EPA) study on the effects of hydraulic fracturing on drinking water found that drilling can by and large be done safely, and in the United States, it has not had widespread, systemic impacts on drinking water resources.[74] Implementing best practices will be vital to mitigate this risk, for instance regarding the design and construction of cement well casings.

OVERALL SECURITY, IN AMENAS, AND THE WAY FORWARD

Both the country's history and its regional setting have made security a consistent concern in Algeria since its independence, and the aftermath of the Arab Spring has intensified this focus. The priority of security on the Algerian agenda is evidenced by the country's sixth position worldwide in terms of military expenditure as a share of GDP (which stood at 5.4 percent in 2014), with this share more than doubling since 2006.[75]

Many of the shale plays identified for potential extraction lie in the vast and empty Algerian Sahara, and some of them—the Ghadames/Berkine and Illizi basins, for instance—lie close to or along Algeria's extensive borders with Libya, where a power vacuum essentially reigns. Furthermore, in the Sahel desert, jihadi groups and smuggling networks mingle and collude, with little to no respect for national borders, posing security risks for hydrocarbon extraction—as the January 2013 terrorist attack on the Tiguentourine gas processing plant near In Amenas revealed.[76]

Following the Arab Spring uprisings in 2011, the army reinforced its border protection in the southeast.[77] Nevertheless, it was from across the Libyan border that the militants of "Signatories in Blood," an al-Qaeda in the Islamic Maghreb (AQIM) splinter faction led by veteran Islamist Mokhtar Belmokhtar, stormed the Tiguentourine complex. Following the attack—which, after a four-day hostage stand-off and intervention by Algerian special forces, left 69 dead (39 foreign hostages, one Algerian guard, and 29 terrorists)[78]—the Algerian army reacted by further beefing up its presence on the country's southern and eastern borders.[79] In fact, reports hold that 78 percent of Algerian military units are currently stationed in the south.[80]

With the broad exceptions of AQIM and Jund al-Khilafa in the northeast, most of Algeria's extremist jihadis now operate in the virtually borderless Sahel, which—after the Arab Spring—features not only the jihadi triangle of Algeria-Mali-Mauritania but also a new Algeria-Tunisia-Libya axis.[81]

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[74] Coral Davenport, "Fracking Has Not Had Big Effect on Water Supply, E.P.A. Says While Noting Risks," *The New York Times*, 4 June 2015, http://www.nytimes.com/2015/06/05/us/epa-hydraulic-fracking-water-supply-contamination.html?_r=0.

[75] "The SIPRI Military Expenditure Database," Stockholm International Peace Research Institute, accessed 14 July 2015, http://milexdata.sipri.org.

[76] Isabelle Werenfels, "The Risks of Playing for Time in Algeria: Internal Strife over Key Choices after the Presidential Election," Stiftung Wissenschaft und Politik, German Institute for International and Security Affairs, May 2014, http://www.swp-berlin.org/fileadmin/contents/products/comments/2014C23_wrf.pdf.

[77] Laurence Aïda Ammour, "Bulletin de Documentation N°7 Evolution de la Politique de Défense Algérienne [Documentation Bulletin N°7 Developments in Algeria's Defence Policy]," Cf2R: Centre Français de Recherche sur le Renseignement, August 2013, http://www.cf2r.org/images/stories/bulletin_documentation/bulletin-documentation-7.pdf.

[78] HM Coroner, *In Amenas Inquests,* accessed 22 September 2015, http://www.inamenasinquest.org.uk/index.html. See also: HM Coroner for West Sussex and His Honour Judge Nicholas Hilliard QC, *Factual Findings, The In Amenas Inquests*, 26 February 2015, http://www.inamenasinquest.org.uk/docs/In%20Amenas%20Factual%20Findings.pdf.

[79] Following the In Amenas attack, Algiers in fact reformed the territorial structure for defense in the region, creating a seventh military region with headquarters in the city of Illizi, some 60 miles from the Libyan border. See: Ammour, "Bulletin de Documentation N°7."

[80] Bouhania Goui, "Is the Algerian Military Mightier than the Law?" Arab Reform Initiative, July 2015, http://www.arab-reform.net/sites/default/files/Is%20the%20Algerian%20Military%20mightier%20than%20the%20law%3F.pdf.

[81] Isabelle Werenfels, "Going 'Glocal': Jihadism in Algeria and Tunisia," pp. 51-67.

Of late, the extremist Islamic State (IS) has also entered this complex panorama, with its leader, Abu Bakr al-Baghdadi, proclaiming Algeria one of its wilayat (Wilayat Al-Jazair) in November 2014 after Algerian AQIM breakaway Jund al-Khilafa swore its allegiance to IS.[82] Nevertheless, IS action since has tapered off.[83]

Given Algeria's violent and troublesome regional setting, which plays into the hands of its traditional extremist groups, and with over 4,200 miles of borders to protect, over half of which lie in the Saharan desert, it is clear that the threat of terrorist actions is nearly impossible to exclude in full. Moreover, regardless of its strong capacity to act against violent extremists at home, the Algerian army is loath to intervene at the regional level despite calls for further leadership to this end, which some argue would be critical to counterterrorism action in the region.[84]

However, Algeria's intelligence and special operations capacities are the strongest in the region, and the state remains supremely committed to domestic security.[85] In addition, both the United States and France have provided significant counterterrorism funding and training since the attacks of September 11, 2001.[86] For energy companies accustomed to operating in complex security environments, therefore, Algeria is not a considerable exception. During the course of our interviews, several companies indicated that security did not rank particularly high on their agenda of concerns about investing in Algeria, though arguably the security calculus may have changed for individual companies after 2013. We also noted that, were shale gas extraction to take off in the future, this in turn may change that security calculus again, as it would mean that the number of wells being drilled in remote areas would likely increase substantially, with workers travelling rather than operating in a man camp that is relatively easy to secure.

A question which merits attention is whether companies face a greater threat to their operations in conflicts between the regime and Algerian society (particularly in the underdeveloped South). An ominous precedent was set nearly 30 years ago, when the riots of "black October" in 1988 and the ensuing army interventions left hundreds of Algerians dead. Recall that these social uprisings gained traction precisely when the fallout from the 1980s oil price crash blocked the government's customary path to social legitimacy, namely buying this legitimacy with its hydrocarbon funds.[87] Given this past, the stark decline of Algeria's foreign reserves and sovereign wealth fund following the government's Arab Spring appeasement measures and 2014's oil price drop is worrisome.

RED TAPE AND LACK OF COMPETITION

Despite these security concerns, especially since the In Amenas attack, it is worth keeping in mind

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[82] Aaron Y. Zelin, "The Islamic State's Archipelago of Provinces," The Washington Institute, 14 November 2014, http://www.washingtoninstitute.org/policy-analysis/view/the-islamic-states-archipelago-of-provinces.

[83] Also, in December 2014, Jund Al-Khalifa's leader, Abd al-Malik Guri was killed by the Algerian army. See: Aaron Y. Zelin, "The Islamic State's Model," *The Washington Post*, 28 January 2015, http://www.washingtonpost.com/blogs/monkey-cage/wp/2015/01/28/the-islamic-states-model/.

[84] Anouar Boukhars, "The Paranoid Neighbor: Algeria and the Conflict in Mali," Carnegie Endowment for International Peace, 22 October 2012, http://carnegieendowment.org/2012/10/22/paranoid-neighbor-algeria-and-conflict-in-mali.

[85] Ibid.

[86] Alexis Arieff, "Maghreb Facing New Global Challenges: U.S.-Algerian Security Cooperation and Regional Counterterrorism," l'Ifri: Programme Moyen-Orient/Maghreb, July 2011, https://www.ifri.org/sites/default/files/atoms/files/alexisarieff.pdf. See also the following French Senate report on the North African "Sahel" region, citing Algeria as an "indispensable partner" in ensuring the region's security: "Rapport d'information [Information Report]," no. 720, July 2013, pp. 158-161, http://www.senat.fr/rap/r12-720/r12-7201.pdf.

[87] Ray Takeyh, "Islamism in Algeria: A Struggle between Hope and Agony," Council on Foreign Relations, July 2003, http://www.cfr.org/world/islamism-algeria-struggle-between-hope-agony/p7335.

that energy companies are regularly exposed to risk or even outright danger, and make substantial security costs part of their portfolio. In our research, we found that firms operating in the country generally considered bureaucratic red tape more troubling than security concerns to their operations. One such concern was that currently all communications with policymakers in Algeria go through Sonatrach. Miscommunications about the desired course of policy occur, contributing to a policymaking process which is considered to be lengthy and cumbersome. As a result of endless bureaucratic processes, investment decisions are often delayed.

The fairly unsuccessful bidding round in September 2014 is a case in point, providing clear evidence that the energy community at large is not interested in investing under the current conditions. If Algerian policymakers want to attract new foreign direct investment, then investment conditions will have to be evaluated and improved accordingly. This applies to conventional gas production, but even more so to unconventional production. Bringing the costs of drilling down through competition means attracting new companies to the country. This likely means getting rid of Sonatrach's majority share in each and every project, despite the clear resistance to such a step from within the Algerian regime.

Bringing more competition to the Algerian energy sector however is easier said than done, especially given the combative nature of intra-regime political maneuvering. While President Bouteflika has worked to increasingly bring the Algerian state under control of the civilian political clans, political risk and questions of continuity are undoubtedly concerns for potential investors. Perhaps the major question for the near future is who takes charge when President Bouteflika, who is very frail, passes. Despite President Bouteflika's apparent recent sidelining of the DRS, there is always the possibility of the military or intelligence services seeking to take advantage of a potential power vacuum.

The tide in global energy markets is probably also not in Algeria's favor. If commodity prices were high and natural gas scarce, then companies would be willing to take on higher risks in order to access new reserves. However, natural gas is abundant, predominantly due to the U.S. energy revolution combined with disappointing demand for natural gas in Asia and Europe. In due time, the latter will change, but so will the future supply mix. As other reserves are developed around the world—in Russia, East Africa, Australia, Canada, the Eastern Mediterranean, China, Argentina, etc.—Algerian authorities will still have to meet the interests of energy companies around the world if they want them to invest. The clock is ticking.

Algeria's Place in the Global Gas Market

Algerian natural gas trade is characterized in most publications along three simple lines: pressure on domestic production, falling exports, and rapidly rising domestic consumption. These trends, combined with continued and large scale energy subsidies, project an unsustainable path for Algeria going forward. In essence, the current policy "works" when oil and gas prices are high and enough revenues flow into the country; it does not work when commodity prices are down and demand for oil and gas is in decline. In these instances, the Algerian government spends its foreign currency reserves in anticipation of higher prices, when those reserves can be replenished again—as is the case now.

Aissaoui observes that despite the aforementioned trends, the focus of energy policy has almost exclusively been on augmenting supply—not on curbing growing domestic demand.[88] Algeria plans to bring several new natural gas fields online, though delays and financing gaps continue to occur.[89] Table 2 shows the projects that are expected to come online in the next few years.

Most exports of natural gas leave Algeria through pipelines, of which there are currently three in operation:

- TransMed, which runs to Italy through Tunisia and Sicily and has a transport capacity of 30.2 bcm per year;
- The Maghreb-Europe pipeline, which runs from Algeria to Andalusia in Spain, through Morocco, and has a capacity of 12 bcm;
- Medgaz, a subsea pipeline that runs from Algeria straight to Spain, with a maximum discharge of 8 bcm per year.

It is worth noting that plans to construct an additional pipeline to Italy have been on the table for a number of years, though the final investment decision continues to be pushed into the future largely due to uncertainty as to whether additional capacity is truly required to meet demand in Southern Europe. Next to pipeline capacity, Sonatrach operates a number of liquefaction terminals in both Skikda and Arzew, with a total liquefaction capacity of 39 bcm.[90] Not all of the existing capacity is being used, however. According to a BP statistical survey in 2014, Algeria exported 23.5 bcm of natural gas by pipeline, of which 19.5 bcm went to Europe (the other offtake

[88] Ali Aissaoui, "Algeria's Energy Policy: What to Expect?" Linkedin Pulse, 27 July 2015, https://www.linkedin.com/pulse/algerias-energy-policy-what-expect-ali-aissaoui.
[89] For more details, see EIA, "Country Analysis Brief: Algeria," accessed on 14 July 2015, http://www.eia.gov/beta/international/analysis.cfm?iso=DZA.
[90] International Gas Union, *World LNG Report–2014 Edition,* International Gas Union, accessed on 14 July 2015, http://igu.org/sites/default/files/node-page-field_file/IGU%20-%20World%20LNG%20Report%20-%202014%20Edition.pdf.

Table 2: Upcoming natural gas projects in Algeria

	Project Name	Companies	Peak Output (Bcf/y)	Target Start Year
South West Gas Project: Phase 1	Touat	GDF Suez/Sonatrach	160	2017
	Reggane Nord	Repsol/Sonatrach/RWE/ Edison	100	2017
	Timimoun	Total/Sonatrach/Cepsa	55	2017
South West Gas Project: Phase 2	Ahnet	Total/Sonatrach/Partex	140	2018
	Hassi Ba Hamou	BG Group	70-110	
	Hassi Mouina	Statoil/Sonatrach		
	Timimoun Expansion	Total/Sonatrach/Cepsa		
Other Gas Projects	In Salah (expansion)	BP/Sonatrach	200	2016
	Isarene (Ain Tsila)	Petroceltic/Sonatrach	130	2017

Source: "Country Analysis Brief: Algeria," U.S. Energy Information Administration, last updated 24 July 2014, http://www.eia.gov/beta/international/analysis_includes/countries_long/Algeria/algeria.pdf.

was in Morocco and Tunisia). In addition, a total of 17.3 bcm of natural gas was exported in the form of LNG, of which 14.6 bcm went to Europe (including Turkey).[91]

These relatively low utilization rates of existing export capacity are part of a wider trend in the EU, where natural gas has been under significant pressure since 2009 and has lost market share in electricity generation to both competitive coal projects and subsidized renewables. In addition, the economic downturn has affected gas demand negatively for industrial activity, as have increased energy efficiency and occasional mild winters that have reduced demand for heating. In 2014, natural gas demand again fell sharply by an expected 45 bcm, of which 75 percent was weather related.[92] It is expected that demand will recover somewhat in the coming years by an additional 18 bcm by 2020. However, it is worth noting that even in that case, when the EU reaches an aggregate demand figure of around 500 bcm, this is still over 50 bcm below 2008 consumption levels.[93] Annual electricity consumption in the EU in that period will grow on average 0.2 percent. It is worth keeping in mind that in this scenario, modest economic recovery is anticipated, though increased energy efficiency limits the pass-through.

Demand for natural gas naturally is not static, and increasingly difficult to predict. It is important to keep in mind that although natural gas plants for electricity remain largely uncompetitive in Europe, the price differential with coal has narrowed substantially. Were gas prices to fall further, at some point (according to industry sources,

[91] *BP Statistical Review of World Energy June 2015,* British Petroleum (BP), June 2015, http://www.bp.com/content/dam/bp/pdf/Energy-economics/statistical-review-2015/bp-statistical-review-of-world-energy-2015-full-report.pdf.
[92] *Medium-Term Gas Market Report 2015*, International Energy Agency, 2015, http://www.iea.org/bookshop/707-Medium-Term_Gas_Market_Report_2015.
[93] Ibid.

around $5 per million British Thermal Units) fuel switching may occur. Spot market prices of natural gas have tumbled globally over the course of the last year, chiefly due to disappointing demand in Asia. However, even though that trend may be moderately positive news for gas demand in Europe, producers are of course at the other end of the table. With substantial additional new liquefaction capacity entering the market in the next five years, the global gas market is rapidly turning into a buyers' market, where sellers of natural gas will face fierce competition from their rivals, and will have to sell their product at a lower profit.[94] Therefore, in the short term, even though Sonatrach may be able to recover some market share, and may recover some of its domestic production, this does not necessarily imply that its revenues will rise as well.

[94] See also Tim Boersma, Charles K. Ebinger, and Heather L. Greenley, "An Assessment of U.S. Natural Gas Exports," The Brookings Institution, July 2015, http://www.brookings.edu/research/papers/2015/07/us-natural-gas-exports.

Conclusions

This brief analysis leads us to the following conclusions. First and foremost, Algerian shale gas will not be a short-term fix for the EU in its quest for alternative supplies. Shale gas extraction in the country is in an embryonic phase, and it is uncertain whether commercial production of unconventional gas is in the cards even though test drilling results are considered to be promising. Moreover, we observe that those closely involved in shale gas in Algeria have not foreseen the potential for these developments to drive social unrest, as evidenced by the continued protests in the country and the Ministerial shuffle in May 2015.

Our analysis has also demonstrated that Algerian natural gas production in general faces several structural challenges, which, taken together, are reason for concern. In short, natural gas production levels in the country have been stagnant for over a decade, and combined with a lack of investments in new exploration and rapidly increasing and heavily subsidized domestic demand, this increasingly puts pressure on state coffers. The fall in commodity prices further squeezes the state's budget, with almost all export revenues coming from hydrocarbon sales.

In this context, and acknowledging that relatively low commodity prices according to many analysts may well prevail for a number of years, sensible policies would include those aimed at curbing domestic demand and cautiously reforming subsidies so as to have more commodities available for export. However, even though several countries in the MENA region such as Morocco, Egypt, and the United Arab Emirates (UAE) have taken steps in that direction, the Algerian authorities continue to be extremely hesitant to endorse reforms in fear of a social backlash. Instead, the government's strategy seems to be to wait out the current dip in commodity prices until higher oil and gas prices return, along with increased revenue. Given the market outlook, and considering that Algeria will run out of foreign currency reserves by the end of this decade at a burn rate of $40 billion per year, we find this a risky proposition.

The overall lack of reforms prohibits energy policy liberalization along with the development of renewable energy, even though at first glance the conditions for certain technologies seem promising. Reform of the energy sector has been initiated in the past, in particular in 2005 when the legal requirement of the state oil and gas company Sonatrach's majority share in hydrocarbon projects was let go in order to stimulate more competition and attract foreign investment. Unfortunately these reforms have been reversed, likely orchestrated by the powerful military and security apparatus which have major financial and power interests in maintaining the status quo.

Security concerns feature prominently in Algeria. Though historically understandable when

considering the horrific civil war of the 1990s, the obsession with security seems to grip the country in a chokehold. The popular narrative holds that Algeria had its Arab Spring in the 1990s, and that it only takes one look at the situation in neighboring countries like Mali, Libya, and Tunisia for the government to confirm that it should continue to pursue security at all costs—with citizens accepting the resulting economic and political outcomes as preferable to political chaos.

However, if these concerns translate into an attitude of avoiding all change, this will jeopardize the country's economic and social development—and, in the long run, the very security and stability being pursued. For shale gas development, instead of all but ignoring nearby communities at the planning stage and then furiously working to stave off resulting unrest, Algerian authorities would be far better served by sounding out local concerns and working to engage with these communities before the drill bits hit the ground. This may include presenting an economic development plan for the impoverished southern regions, and should clearly lay out steps to address water concerns.

Algeria continues to struggle to diversify its economy and especially its exports, which even for an OPEC country are markedly reliant on hydrocarbon sales. In addition, the authorities struggle to create the right conditions to attract foreign investors, apart from the energy companies who have been in the country for a long time and have grown accustomed to Algeria's specificities. Attracting investments in new exploration activities, albeit conventional or unconventional, continues to be a challenge, as underlined by the very modest interest of the industry in the most recent licensing round in September 2014. The Algerian authorities acknowledge that the conditions have to be changed and are currently working on this. Yet even though the country has long-term experience with hydrocarbon extraction, and therefore a number of important preconditions such as infrastructure and a service industry are in place for successful investments, it remains to be seen whether the country can attract new investors. Market liberalization seems necessary to attract foreign capital, and is currently not on the table.

The long-term prospects of the Algerian regime represent another potential risk. We know that a change of leadership is likely in the coming years, and intuitively expect the military and security apparatus to play a prominent role in the transition period. While this might be sufficient to maintain stability in the country, these forces will be entering a period of uncertainty with markedly fewer resources to paper over any cracks in their rule.

If the United States and EU member states have a vested interest in Algeria's security and stability—whether as an apparent "bulwark against terror" or to prevent another Libya-like scenario on the Southern Mediterranean—then they should move to engage Algerian authorities in pursuing modest initial improvements such as reforming subsidies, stimulating energy efficiency, and liberalizing the country's energy sector. Lessons to be learned from countries elsewhere in the MENA region on subsidy reform that can help construct a measured, gradual approach to this issue. Reforms like these, even in a modest initial form, can help to curb domestic energy demand and attract foreign investment. This would make for a more proactive response to the current economic crisis than reactive measures such as cutting social spending.

Only curbing domestic energy consumption can boost Algerian exports in the near-term. Even with more competition, better investment incentives, and reduced production costs, we will be well into the next decade before Algeria may become a major producer of shale gas.

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