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ENERGY CONSULTING & PROJECT MANAGEMENT
إستشارة و إدارة مشاريع الطاقة

Drilling for tight gas in New Mexico. Photo courtesy of BP. See comment on p2

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UAE: **Office No.606, 6/F, Sama Tower, Sheikh Zayed Road**
P.O. Box: 192089, Dubai, United Arab Emirates
Tel: +971-4-3266300, Fax: +971-4-3266363

Iraq: **Hai Al Tashreefat, International Zone, Baghdad**
Tel: +964-780-738-5724

E-mail: admin@manaarco.com

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MENA region moving ahead on shale gas

By Roa Ibrahim

In the past, the MENA countries were prioritising oil developments as opposed to enhancing the gas sector. Nowadays, with the rapid increase in domestic and global gas demand, especially due to power generation, countries are shifting their focus to gas production. Moreover, amid competition from the US shale gas boom and its thriving gas industry, MENA countries are realizing the importance of investing in unconventional gas projects to benefit from exporting gas in the booming industry rather than having to depend on imports. This article aims to outline the major shale and tight gas projects in the MENA region.

North Africa's shale gas resources have been assessed much more thoroughly than those of the Middle East. The North African countries with shale gas, in order of abundance, are thought to be Libya (290 Tcf), Algeria (231 Tcf), Tunisia (18 Tcf), Morocco (11 Tcf) and Western Sahara (7 Tcf). Altogether North Africa is estimated to hold 557 Tcf of technically recoverable shale gas reserves compared to 639 Tcf in Europe, 862 Tcf in the US and 1,389 Tcf in Asia (EIA, 2011).

The shale gas potential in energy-short Egypt was not assessed by EIA and was discounted by Petrenel (2010). However, recent activity, as described below, shows shale and tight gas to be significant.

The 2011 EIA report did not include the Middle East in the study because of its plentiful conventional natural gas reserves. However, this assessment missed the major shift in the region's supply-demand dynamics. The Middle East is currently facing the challenge of gas shortages, and so several countries are looking at alternatives for boosting gas production, one of which is the exploration and development of unconventional reserves.

The MENA countries currently developing shale and tight gas reserves are Algeria, Oman, Saudi Arabia, Kuwait and Jordan. Estimates of unconventional gas

resources in these countries are not available due to confidentiality restrictions from the NOCs, though Kuwait, Abu Dhabi and Saudi Arabia have all carried out studies. Algeria, Oman and Saudi Arabia account for more than 70% of the region's current hydraulic fracturing capacity.

Unconventional gas development is gathering pace. In Libya, the chairman of the NOC, Nuri Berruien, announced that the country is planning to boost its production of natural gas and is aiming to produce at its full capacity of 3 billion cubic feet per day by 2013. Libya is planning to increase its domestic gas production for electricity generation and to replace oil with gas in the power sector and thus free up oil for export.

In order to boost gas production, Libya is considering exploring unconventional gas reserves specifically in the two major shale gas basins in Libya: the Ghadames and Sirte basins. Libya is focusing its efforts on exploring its shale gas reserves as opposed to tight gas, which has not yet been discovered in the country. However, to date, Libya has not yet instigated hydraulic fracturing.

According to the 2011 EIA shale gas report, Algeria's shale gas resources of 231 Tcf are larger than its current proven conventional gas reserves of 159.1 Tcf. Furthermore, Sonatrach, the National Oil Company (NOC) in Algeria, estimates 600 Tcf of shale gas resources in the country, up to four times larger than its proven conventional reserves.

Algeria has finally decided to step up its shale gas development programme since its domestic gas consumption is surging while its oil and gas fields are maturing. BP has forecasted that by 2019, domestic consumption would eat up the country's production on current trends. In addition to rising domestic demand, 90% of Algeria's exports are its hydrocarbons, and it is the world's fourth largest gas exporter, so making successful development of its shale gas is very important for the country and for its customers in Europe.

The major unconventional basins in the country are the Ahnet and Berkine (Ghadames) basins. Sonatrach is encouraging shale and tight gas projects in the country by altering its petroleum law to make it more attractive to International Oil Companies (IOCs), for example, offering tax breaks and 10-25% rates of return. These amendments were made effective as of January 2013.

Following the 2011 civil unrest in Algeria, Sonatrach signed agreements with Shell, Total, Eni, ExxonMobil and Talisman to develop shale and tight gas in the country. Total is evaluating tight gas in the Timimoun and Ahnet formations whereas Shell, Eni, Talisman and ExxonMobil are focusing on shale gas. IOCs are deploying hydraulic fracturing for the drilling of shale gas and tight gas wells. Algeria deploys one of the region's largest

hydraulic fracturing capacities, with Schlumberger being the largest pumper in the country. It is one of the big three users of proppant in the region.

The Egyptian government is looking at substituting coal and petroleum with natural gas in household, businesses and the industrial sector. Struggling to meet demand and balance its finances, EGPC is keen on developing shale and tight gas fields to keep up with domestic demand as well as satisfy export commitments through the Arab Gas Pipeline to Jordan and its two LNG plants, running well below capacity.

Egypt is the second largest fraccer in North Africa after Algeria, with Halliburton being the largest pumper in the country. There is shale gas potential, but most current activity is focused on tight gas fields in the Western Desert. The major unconventional basin in the country is the Abu Gharadig basin.

Bapetco, a JV between the Egyptian NOC, Egypt General Petroleum Company (EGPC), and Shell, is operating the Obaiyed field, a tight gas/condensate field. In 2012, Bapetco performed the first foam frac in Egypt to uncover significant volumes of natural gas trapped in the Apollonia reservoir. Another major tight gas fraccer in the country is Apache (and local affiliate Qarun Oil Company) which has fracced in the Abu Gharadig basin.

Oman and Saudi Arabia are the largest fraccers in the Gulf region. Oman is in need of large volumes of gas due to increasing domestic needs; new industrial cities; maintaining LNG exports with long term contracts; maturing gas fields; and the need of gas for steam generation and miscible injection for EOR in its oil-fields.

Oman's major unconventional developments are in Block 6 which has both shale and tight gas and is operated by Petroleum Development Oman (PDO), the NOC in Oman (a joint venture of the government, Shell, Total and Partex); Block 61 which has tight gas and is operated by BP; and Block 60, Abu Butabul, which contains tight gas and is operated by Oman Oil Company Exploration & Production LLC (OOCEP).

In 2011, PDO announced that it will drill 30 tight gas wells by 2015. BP is planning 60 wells to start commercial production at its Khazzan-Makarem field in Block 61, then 20 wells every year for the next 10 years. To date, BP has drilled approximately 12 wells, the majority of which are horizontal hydraulically-fractured wells with up to 5 frac stages. The goal for BP is to start production in 2016 and build up to 1 Bcf/d of gas for 15. The BP project is one of the largest GCC contracts for 2013 and the company is expected to invest over $15 billion in 10 years.

Oman is consequently forecast to triple its hydraulic horsepower by the end of 2013. Oman is one of the three biggest users of proppants in the MENA region, with PDO and BP demanding the highest volumes of ceramic based proppants for their

operations. Schlumberger is the country's main pumper.

Saudi Arabia is prioritizing unconventional plays to increase gas production in the country because of increasing power demands, new industrial cities such as the Jubail Industrial City II and Yanbu II, excessive use of oil for power generation, and low, regulated gas prices which encourage rapid demand growth and restrain supply.

The priority for Aramco, the NOC in Saudi Arabia, is the evaluation of reservoir potential for shale and tight gas. The Kingdom has already began its efforts to search for unconventional hydrocarbons in the country including shale gas in the north-west targeted at the Silurian (Qusaiba) shale, tight gas in southern Saudi Arabia in the Rub' Al Khali (Empty Quarter) and south Ghawar field with tight sand and carbonate potential. Hydraulic fracturing has greatly improved gas production rates and recovery rates from moderate to tight reservoirs.

In the north-west, Aramco has already begun drilling shale gas wells; however, to date, only one of the shale gas wells have been fracced. Aramco is planning on adding 30 more rigs in 2013 to be deployed in the Tabuk basin and the Midyan basin in the Red Sea. Tight gas is the targeted resource play in Rub' Al Khali.

In the Rub Al Khali, 27 wells have been drilled in the first exploration phase, but with few positive results. The difficult terrain and little-known geology in the Rub' Al Khali area prompted 3 joint ventures between IOCs and Aramco: South Rub' Al Khali (Shell and Aramco), Sino-Saudi Gas (Sinopec and Aramco), Luksar (Lukoil and Aramco). One main challenge for the JV partners is profitability due to the low (regulated) price of gas.

To date, only one shale gas well has been fracced, but more than 14 tight gas wells have been acid or proppant fractured and flowed back. Acid fracturing is used in carbonate formations while proppant fracturing is used in sandstones.

Other countries which are fracturing for unconventional resources are Tunisia, Jordan and Kuwait. In Tunisia, Chinook Energy and Cygam Energy are drilling for tight oil whereas BP in Jordan is developing shale gas reserves in the Risha field in the east.

Kuwait has tight gas and shale gas reserves. Kuwait Oil Company (KOC), the NOC of Kuwait, signed a contract with Shell in 2010 to give technical assistance with its Jurassic gas fields. These newly discovered deep, tight, sour oil, gas and condensate fields in the north have led KOC to set a gas production target of 4 bcf/d by 2030.

The UAE is also expected to start exploring and developing its shale and tight gas reserves in the next few years. In 2008, ADNOC signed an agreement with Royal Dutch Shell to explore offshore Abu

Dhabi for deep gas reserves. Though this agreement has not progressed further, it shows the attention being given to Khuff/pre-Khuff gas exploration.

An experimental mini-frac test (acid injection test) was conducted in the Diyab (Hanifa) Formation where an exploration well (well X) was drilled in 2011. The test showed that the Diyab Formation holds significant unconventional hydrocarbon reserves. However, there are no current sand fracturing operations in the UAE and no frac fleets in the country.

Oman and Saudi are forecasted to be the key growth markets in hydraulic horsepower, as they are most likely to step up their drilling of shale and tight gas wells by 2017. North Africa's frac market is expected to show slow growth due to political instability. Schlumberger and Halliburton are the main pumpers dominating the frac market in the MENA region with Baker Hughes catching up. Countries such as Bahrain and Iraq use frac fleets primarily for acid fracturing and matrix acidizing operations respectively.

MENA could soon become a key market for E&P companies with unconventional skills; pressure pumpers; proppant suppliers; and others. Although in their early stages, tight and shale gas are thus emerging as a potentially key component of the region's gas balance – to meet domestic demand and sustain exports. But to succeed, MENA countries need to reform their gas pricing and commercial models, and successfully adapt the suite of shale gas technologies.

Turkey needs to look to relations with neighbours to meet its energy needs

by Robin Mills

The giant stone heads scattered around Mount Nemrut in south-eastern Turkey combine several cultures. Raised in 62 BC, these statues of Greek, Armenian and Iranian gods have Hellenic faces but wear Persian hats, testament to their builder, King Antiochus.

Today, as the sun sets behind the Atatürk dam to the south, their blind eyes look out over a key pipeline - part of Turkey's energy policy, which also must balance East and West.

Turkey receives less energy attention than it should. The European Union tends to consider it primarily as a transit country for oil and gas from the Caspian and Middle East. But Turkey is the fourth-largest gas market in Europe (outside the former Soviet Union), and the only one that is growing strongly - more than 11 per cent a year over the past decade. By 2020, it could well be the continent's largest gas consumer.

With Europe mired in recession, Turkey grew 8.5 per cent in 2011, even if a slowdown last year raised concerns. Inflation has been mostly brought under control, its young population is the

second-largest in Europe (just behind Germany) and public debt is modest.

With little domestic petroleum, the country relies heavily on gas imports. Expensive energy purchases comprise two thirds of a worryingly high current account deficit. More than half of Turkey's gas comes from Russia, known to use energy as a geopolitical tool; a further 18 per cent from Iran, often cut off in winter. Iranian supplies are coming under pressure from United States-inspired sanctions and restrictions. Ankara-Tehran relations have suffered further over the conflict in Syria. Increased use of coal, nuclear and renewable energy can slow, but not reverse the growth in gas requirements.

In principle, Turkey's geography presents it with ideal solutions. The EU long sought to encourage it to become the "fourth corridor" of gas imports (the other three running from Russia, North Africa and Norway), via the Nabucco Pipeline. But Turkey's own energy needs are more important for its policy than any desire to assist the EU - especially after being cold-shouldered for membership.

To the east, Turkish policymakers look out over the gas-rich Caspian - Azerbaijan and Turkmenistan - speaking languages closely related to Turkish. To the south-east, Iraq and its Kurdish region, Ottoman provinces less than a century ago. To the south-west, massive new gas finds in the deep waters of the eastern Mediterranean.

But all of these regions are politically problematic. The Caspian is the most straightforward - Turkey already buys Azeri gas. The new Trans-Anatolian pipeline will expand imports, and run westwards to connect to EU markets - either Italy or, via a scaled-down version of Nabucco, into central Europe.

But eccentric, isolationist Turkmenistan has not reached agreement with Azerbaijan on laying a pipeline under the Caspian Sea, where the two countries dispute a border - nor is there much reason for the Azeris to facilitate a rival.

Baghdad seems in no hurry to expedite its own gas exports, and relations with Ankara are poor - over Syria, where the two capitals back opposite sides, and over Turkish support for oil exports from the Kurdish region of Iraq. But it would be a dramatic move for the Turks to permit an independent gas pipeline from the Kurdish region- condoning effective Kurdish independence and breaking relations with Baghdad.

And in the Mediterranean, Turkish relations with Israel are cold, Syria is in chaos, and the continuing dispute over the divided island of Cyprus blocks pipeline routes.

Ankara's policy of "zero problems with neighbours" has rapidly transformed into "many problems". To meet its needs, Turkey needs to emulate King Antiochus and rebuild constructive relations with at least some of its energy-rich neighbours.

Key MENA Energy Issues Scorecard

Gulf gas price reform	🟠	⇔	BP negotiating increased price for Khazzan tight gas development
MENA unconventional gas	🟠	⇔	Frac fleets expanding in Saudi Arabia, Oman; pricing/commercial reform still required; Kuwait shale oil study underway
MENA renewable energy	🟢	↑	Abu Dhabi's Shams-1 CSP plant set to start operations; positive momentum from 1st Solar Middle East Exhibition (Dubai); Saudi K.A.CARE white paper released
MENA nuclear power	🟡	⇔	UAE programme on track; Japan offers assistance to Saudi Arabia
Energy infrastructure security	🟠	⇔	Further pipeline attacks in Yemen; fuel oil pipeline attacked in northern Iraq; no further incidents in North Africa
OPEC production	🟡	↓	1-year low in January; cuts in Saudi Arabia and Iran
East Mediterranean gas commercialisation	🟢	↑	Total awarded Cyprus blocks 10 & 11; promising seismic off northern Lebanon; rumours on Israeli pipeline to Turkey and exports to Jordan; Gazprom agrees to buy Tamar LNG
Kuwait energy projects progress	🟠	⇔	No progress on Dorra gas; some minor drilling and pipeline contract awards; shale oil study underway; Clean Fuels EPC to be awarded 2Q 2013
Abu Dhabi concessions renewal	🟠	↓	Reports ADCO may be extended for 1 year while negotiations on new structure continue
Baghdad-Erbil oil agreement	🔴	⇔	Gazprom awarded new Kurdistan block, Halabja; Iraqi budget stuck over payments to KRG; Iraq oil minister claims Turkey refuses independent Kurdish exports
Iraq oil production build-up	🟡	⇔	Exports up in January for first time since October; production down on sabotage, bad weather, halt to Kurdish exports; protests at South Oil Company
Egypt subsidy reform	🔴	⇔	Fuel rationing system to start in July; funds for diesel imports exhausted, causing shortages
Iran oil sanctions	🔴	⇔	New sanctions imposed on use of Iran oil revenues; President Ahmadinejad proposing new budget to deal with impact of sanctions; nuclear talks conclude in Kazakhstan

Source: Manaar research

🟢	Very positive	↑	Improvement in last month
🟡	Positive	⇔	No change
🟠	Negative	↓	Deterioration in last month
🔴	Very negative		

Current studies

Hydraulic fracturing

Manaar has recently completed a study of the market for hydraulic fracturing in the MENA region, with PacWest Consulting. The report is available in MENA-only (29 pages) and worldwide versions (45 pages including the MENA section). The report addresses historical and forecasted frac demand, supply, utilization, constraints and trends. Market coverage also includes current hydraulic fracturing projects, unconventional potential assessments and detailed basin and play maps. The majority of the information gathered in the reports relies on primary intelligence: in-depth surveys and conversations with industry leading experts and technical specialists.

Dimension	Score	Description
Geology		▪ Excellent geology that underlies the most prolific petroleum system in the world; Rub' Al Khali results disappointing thus far
Pricing regime		▪ State-set at very low $0.70 per mcf; unlikely to change soon; very problematic for foreign operators seeking JVs; less of an issue for Aramco, which wants to displace oil
E&P diversity		▪ Aramco dominates; JVs with three IOCs in the Rub' Al Khali have been disappointing; fiscal terms are difficult
OFS capacity		▪ SLB and HAL already serve the country, and BHI and others should enter the market in the next few years
Regulatory landscape		▪ Aramco is able to operate with little government interference, but challenges exist for foreign operators, if allowed to operate in unconventional development at all
Infrastructure		▪ Very well-developed infrastructure from existing petroleum output in Ghawar and northwest, but Rub' Al Khali is isolated
Development constraints		▪ Public very supportive of increased output
Weighted Score	2.6	

Figure 1. Country attractiveness matrix for Saudi Arabia

Please contact Roa Ibrahim r.ibrahim@manaarco.com, +971 4-3266-300 for further information and purchases.

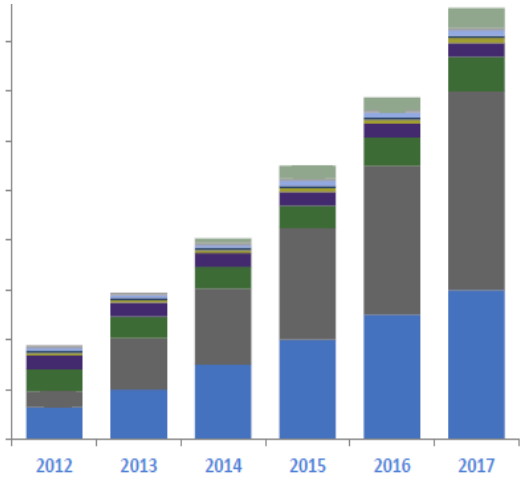


Figure 2. Forecast frac capacity, per MENA country

Recent & Forthcoming Events

Robin Mills spoke on a panel at the Solar Middle East exhibition. Key messages were:

- Solar PV is now an economic part of the generation mix in the Middle East
- Key challenges are outdated perceptions, adapting utility business models, establishing project finance, introducing appropriate regulation for small-scale solar power, and ensuring solar power creates wider economic advantages

Robin Mills will speak at the Argus Mideast Gulf and Indian Ocean Oil Conference, Emirates Towers, Dubai on 13-14th March, on the impacts of gas developments and shale on oil product demand in the Middle East.

Robin Mills will also speak at the 2nd Annual EOR & Heavy Oil Conference on 27th March in Dubai and the Brookings Doha Energy Forum on 1st-2nd April, whose theme is *Power Struggle: Implications of the Changing Global Gas Market for the Middle East and Asia*. For further information on the conference please visit:

Jaafar Altaie and Robin Mills will attend the Doha Forum in Qatar, 20-22nd May.

Environmental policy needs to aim not at static sustainability, but dynamic resilience

by Robin Mills

"*There is not the slightest indication that nuclear energy will ever be obtainable*." An unfortunate comment from 1932, no doubt from someone without expertise in the topic? In fact, the speaker was Albert Einstein.

Failed predictions like this should remind us of the limits of our knowledge. The world's complexities overwhelm the cognitive abilities of any one person. The future is inherently both uncomputable and unknowable.

Just the last five years have seen a once-in-a-century financial crisis; Japan's nuclear power disaster; deadly storms, droughts and wildfires in the United States and Australia; popular revolution in the Arab world; the shale oil and gas breakthrough; the emergence of 3D printing; and the spread of wireless connections between nine-tenths of humanity. That is why, in place of the common notion of "sustainability", we need a new concept. Sustainability is too static a word for our dynamic age - it misses the ability both to respond to crises and to seize opportunities. It looks back to a world in which humanity lived in balance with nature - a world that never existed.

Sometimes sustainability is taken to mean that economies should not grow, or that we should not use resources today but leave them for our descendants. But a truly sustainable economy and society are not fossils, frozen in time like Brezhnev's

USSR from 1964 to 1982. They are creative and adaptable.

Some utopians in developed countries seek zero growth economies. In today's hyper-connected world, this demands that, like Japan during its 200-year Sakoku seclusion, they wall themselves off from fast-expanding and transforming societies in Latin America, the Middle East, the Indian subcontinent and east Asia.

The concept of sustainability is often applied narrowly, to the environment only or, even more specifically, to tackling human-caused climate change. Environmental sustainability, however, cannot be divorced from the fight against poverty, from efforts to ensure social justice and reasonable levels of equality, from open and inclusive political systems, from exploring scientific and cultural frontiers.

At least a billion of the world's people need not static sustainability, but transformation. Without modern energy, they walk to work over long distances, spend hours every day carrying water from kilometres away, cook with wood or dung in smoky homes, and have to stop work when the sun goes down.

"No plan survives contact with the enemy," as the great Prussian general, Helmuth von Moltke, observed. That is why a new concept is gaining popularity: "resilience", the capacity to survive shocks. Japan cleaned up the Fukushima reactor site and instituted a sweeping energy conservation programme. China injected massive financial stimulus to revive demand during the global economic meltdown.

If we speak of climate change, resilience is in direct contrast to the detailed but fragile plans of those who pin all their hopes on renewable energy, on nuclear power, on UN treaties, on reducing population or some other magic bullet.

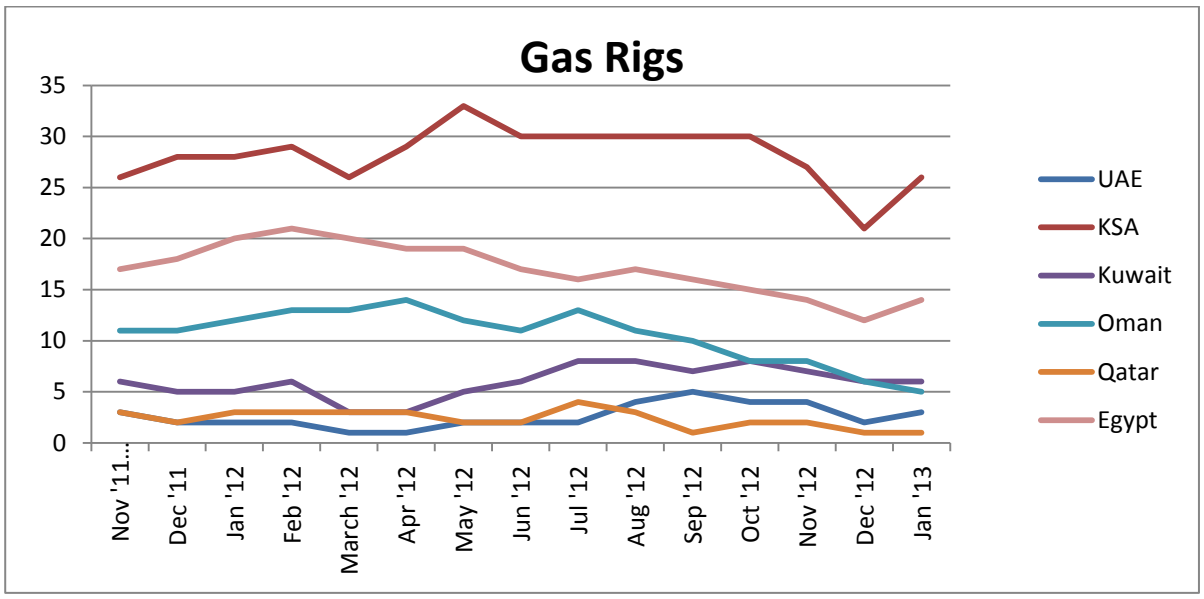
Resilience, though, is often falsely equated with adaptation - that is, seeking to reduce the impact of a changing climate, for example with sea defences and drought-resistant crops. Adaptation is vital, but resilience definitely does not involve - as some deniers of the climate threat might wish - sweeping the problem under the carpet, then cleaning up later.

Resilience also has to acknowledge the ability to create and exploit positive situations - scientific discoveries, booming economies, progressive social movements. Command-and-control mandates and directives are very much second-best to nourishing open, intellectually curious societies. The aim is not to balance economic and environmental imperatives, but to make them the same thing.

As von Moltke put it, "Strategy is a system of expedients". To survive and flourish in the unpredictable future, we need a system, but we also need expedients.

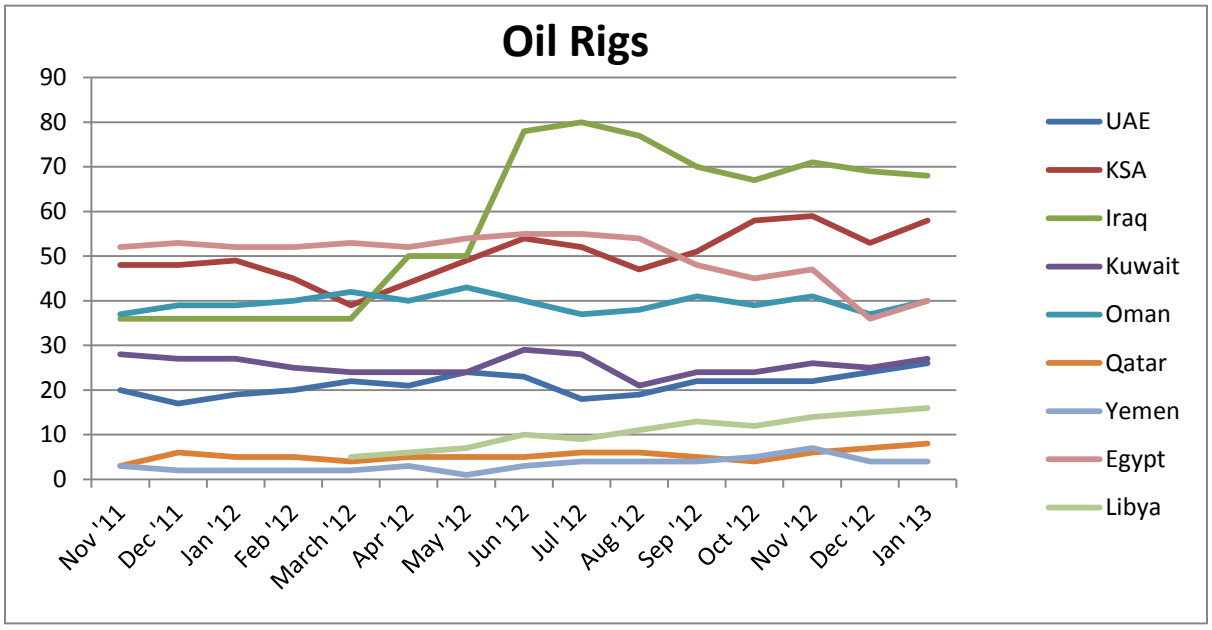
Versions of these articles appeared in The National newspaper on 29th January and 12th February 2013.

Regional Energy Statistics



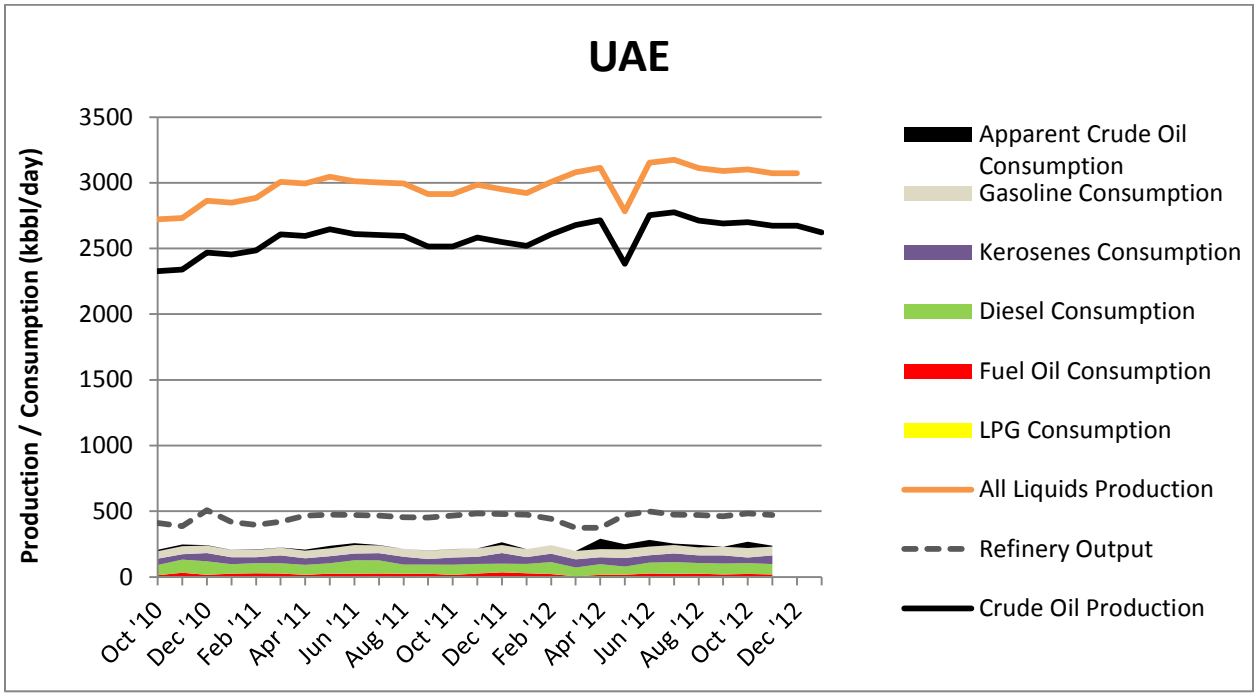
Source: Baker Hughes

- Saudi Arabia's gas rigs rebounded from the low level in December
- Egypt's gas rig count picked up slightly after a long decline over payment and political problems

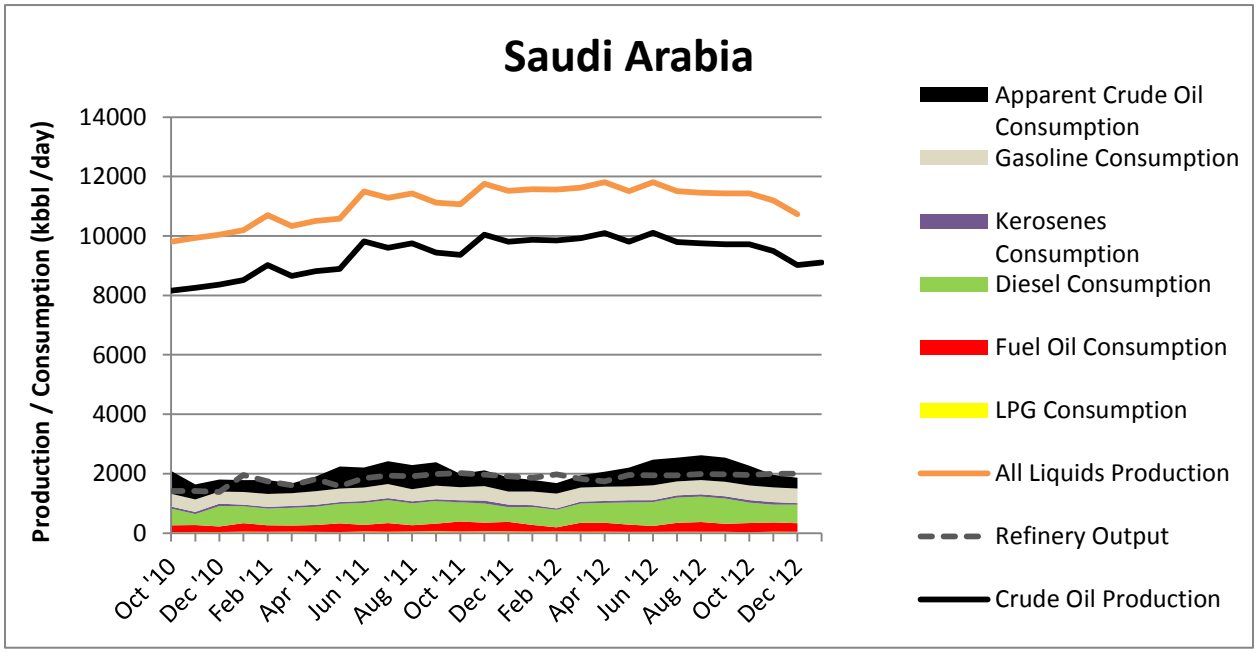


Source: Baker Hughes, Iraq: Baker Hughes and OPEC Monthly Oil Market Report

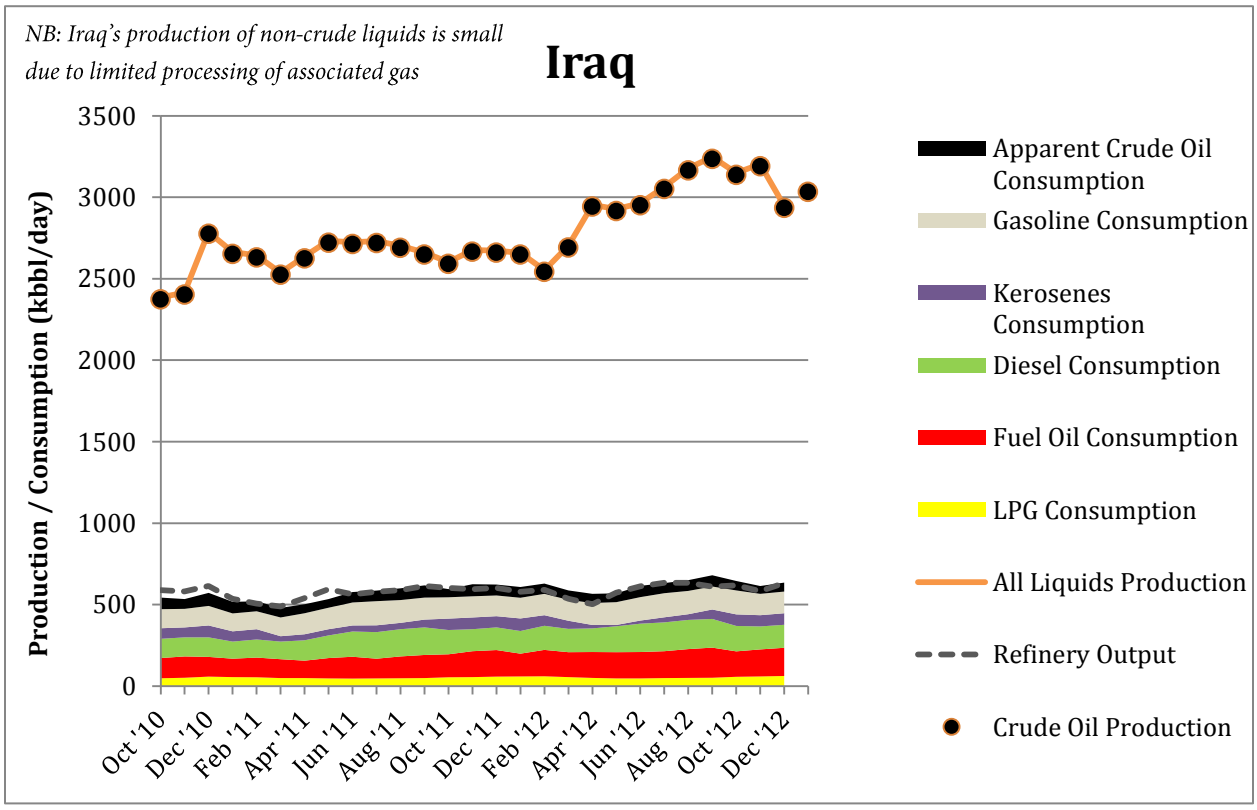
- Saudi Arabia remains close to a record rig-count, and picked up 5 rigs in January ahead of signs that its pre-emptive production cut in December had achieved its aims
- Egypt drilling recovered slightly in January
- Iraq rig count is volatile and still settling down given that data collection was only resumed in June 2012
- Libya rig count continued to rise steadily and is now back to pre-revolution levels

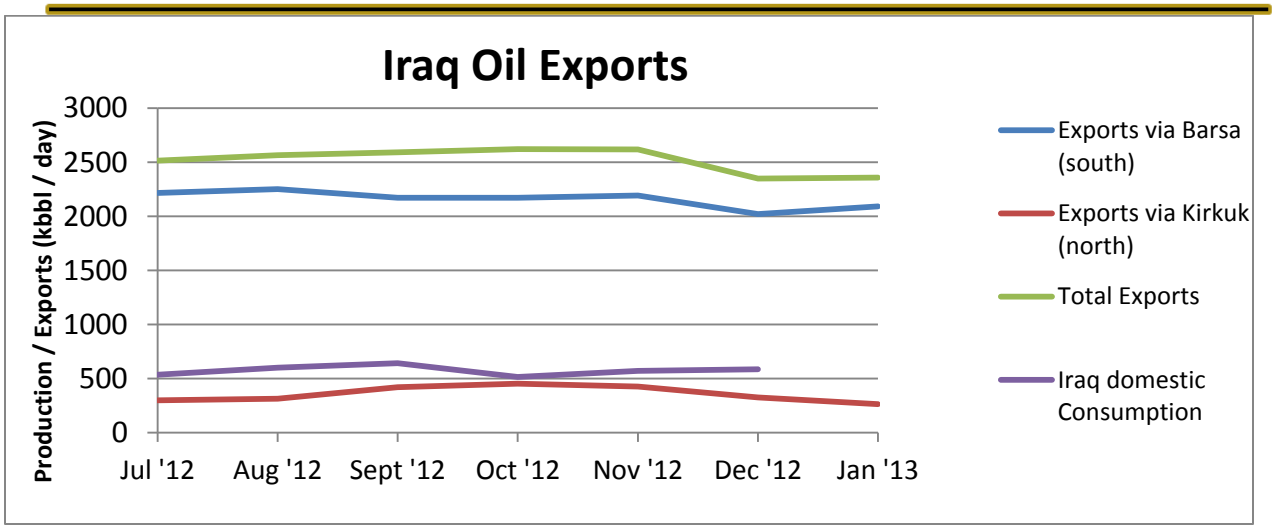


- UAE crude production continued to fall in January, in alignment with Saudi Arabia's production cuts



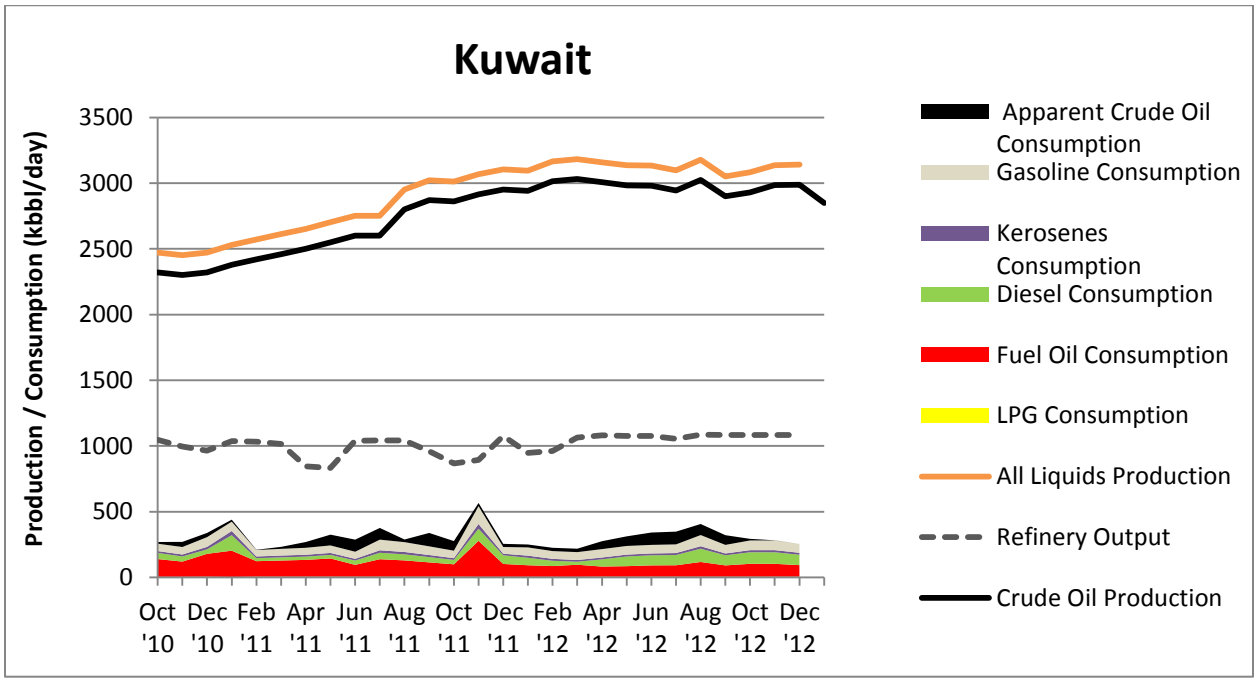
- Saudi crude production was up slightly at 9.105 Mbpd in January as against 9.181 Mbpd in December, the December cut having achieved its aim of preventing inventory build
- Total December consumption was down 0.1 Mbpd from November

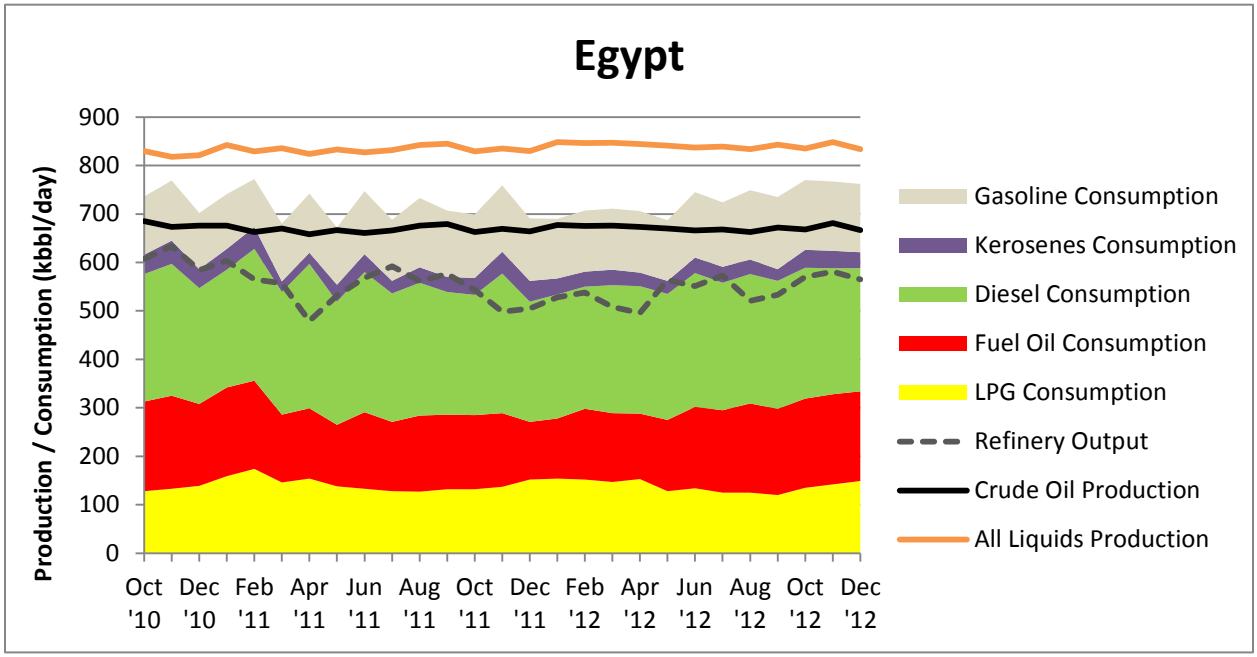




Source: Iraq Oil Ministry

- Iraqi production fell in December and was flat in January due to attacks on the pipeline via Turkey, and the end of the temporary deal for Kurdish exports
- Southern exports recovered from December but are still at their lowest since June 2012; they were affected by bad weather and maintenance at Rumaila





Source: JODI, OPEC, Middle East Economic Survey & EIA

NOTE: All crude oil consumption values are apparent due to unreported / misreported stock change values and refining gains/losses.

Recent & Forthcoming MENA Licensing Rounds

Country	Round	Launch Date	Blocks on Offer	km² offered	Blocks Awarded	Closing Date
Egypt	EGAS	Jun – 12	15	57,300	-	Feb – 13
Egypt	EGPC	Sep – 11	15	18,000	11	Mar – 12
Egypt	Ganope	Dec – 11	20	125,577	-	May - 13
Iraq	4th Licensing Round	Apr – 11	12	80,700	3	May – 12
Iraq	5th Licensing Round	NA	>60	NA	-	NA
Lebanon	1st Licensing Round	Feb - 13	nk	22,730	-	May -13
Syria	Offshore	May – 11	3	9,038	0	Oct – 11
Oman	MOG	Jan – 12	4	26,837	2	Aug – 12
Oman	MOG	Nov – 12	7	103,422	-	Jan – 13
Yemen	6th Licensing Round	Sep – 12	5	20,132	-	NA

Source: Deloitte

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