The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Tech Talk - Current Oil Production and the Future of Ghawar

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Topic: Supply/Production
Tags: crude oil price, crude oil production, eia, ghawar, haradh, momr, opec, saudi arabia, uthmaniyah [list all tags]

There is a growing impression being given in the discussion of oil and natural gas supplies that the world is moving into a period where there will soon be such a plentiful sufficiency of crude that the US may consider exporting some of its production (h/t Leanan). But if one looks behind the headlines, and particularly at the current status of the largest oilfield contributing toward this rosy picture - the Ghawar field in Saudi Arabia - that optimism becomes more evidently built on a very transient set of data that, as this series of posts seeks to show, will not be sustainable for any significant period into the future.

The three major oil producers (i.e. those producing more than 5 mbd each) are currently seeing surges in production as the world moves to an overall production of 90 mbd. The OPEC June Monthly Oil Market Report (MOMR) notes that this has brought Russia to 10.33 mbd in May, some 100 kbd over the same period in 2011; and Saudi Arabia is reported to have averaged 9.917 mbd in May, up 40 kbd over April. The United States is running at 6.236 Mbd of crude (from the EIA TWIP), while importing 9.117 mbd. The MOMR reports US oil supply at 9.66 mbd on average, but counts more than just crude in this value. The gain over the past year is around 600 kbd. It is interesting to note, in regard to OPEC production the continued difference between the volumes that OPEC reports from direct contact with the suppliers, and that when the numbers are obtained from "secondary sources."

	2010	2011	3Q11	4Q11	1Q12	Mar 12	Apr 12	May 12	May/Apr
Algeria	1,184	1,173	1,164	1,180	1,215	1,213	1,220	1,206	-14.0
Angola	1,691	1,618	1,646	1,685	1,734	1,754	1,769	1,762	-7.0
Ecuador	475	500	494	503	502	499	500	498	-2.6
Iran, I.R.	3,544	3,576	3,574	3,609	3,742	3,755	3,758	3,760	2.0
Iraq	2,358	2,653	2,684	2,638	2,628	2,691	2,942	2,915	-27.0
Kuwait	2,312	2,660	2,755	2,909	2,995	3,031	3,007	3,000	-6.7
Libya	1,487	462	75	697	1,296	1,403	1,504	1,552	48.2
Nigeria	1,968	1,896	1,889	1,836	1,880	1,822	1,882	..	..
Qatar	733	734	731	733	745	743	733	732	-1.4
Saudi Arabia	8,166	9,311	9,601	9,736	9,883	9,923	10,102	9,807	-295.1
UAE	2,324	2,565	2,573	2,549	2,602	2,679	2,716	2,383	-333.1
Venezuela	2,779	2,795	2,775	2,809	2,792	2,819	2,831	2,826	-5.3
Total OPEC	**29,020**	**29,942**	**29,961**	**30,883**	**32,015**	**32,333**	**32,964**	..	..
OPEC excl. Iraq	**26,662**	**27,290**	**27,277**	**28,245**	**29,387**	**29,642**	**30,022**	..	..

Totals may not add up due to independent rounding.

Figure 1. OPEC production from its members, with values provided by them (OPEC June MOMR)

	2010	2011	3Q11	4Q11	1Q12	Mar 12	Apr 12	May 12	May/Apr
Algeria	1,250	1,240	1,241	1,228	1,233	1,222	1,217	1,197	-20.0
Angola	1,783	1,664	1,680	1,763	1,757	1,722	1,769	1,730	-39.2
Ecuador	475	490	486	493	491	489	489	499	9.7
Iran, I.R.	3,706	3,621	3,607	3,563	3,383	3,313	3,210	3,138	-71.7
Iraq	2,401	2,666	2,679	2,666	2,705	2,807	2,994	2,952	-42.0
Kuwait	2,297	2,538	2,597	2,695	2,765	2,785	2,789	2,858	69.2
Libya	1,559	462	47	562	1,204	1,340	1,394	1,452	57.5
Nigeria	2,061	2,111	2,184	2,027	2,076	2,085	2,175	2,126	-48.5
Qatar	791	794	793	796	792	789	778	757	-20.8
Saudi Arabia	8,271	9,268	9,629	9,641	9,783	9,832	9,877	9,917	39.7
UAE	2,304	2,517	2,551	2,557	2,564	2,578	2,587	2,578	-8.3
Venezuela	2,338	2,380	2,391	2,371	2,371	2,368	2,362	2,378	16.7
Total OPEC	**29,236**	**29,751**	**29,885**	**30,363**	**31,124**	**31,329**	**31,640**	**31,582**	**-57.8**
OPEC excl. Iraq	**26,835**	**27,085**	**27,206**	**27,696**	**28,419**	**28,523**	**28,646**	**28,630**	**-15.8**

Totals may not add up due to independent rounding.

Figure 2. OPEC production from information provided by secondary sources (OPEC June MOMR).

This surge from the majors has in part led the EIA to project that oil prices will remain relatively stable for the remainder of the year.

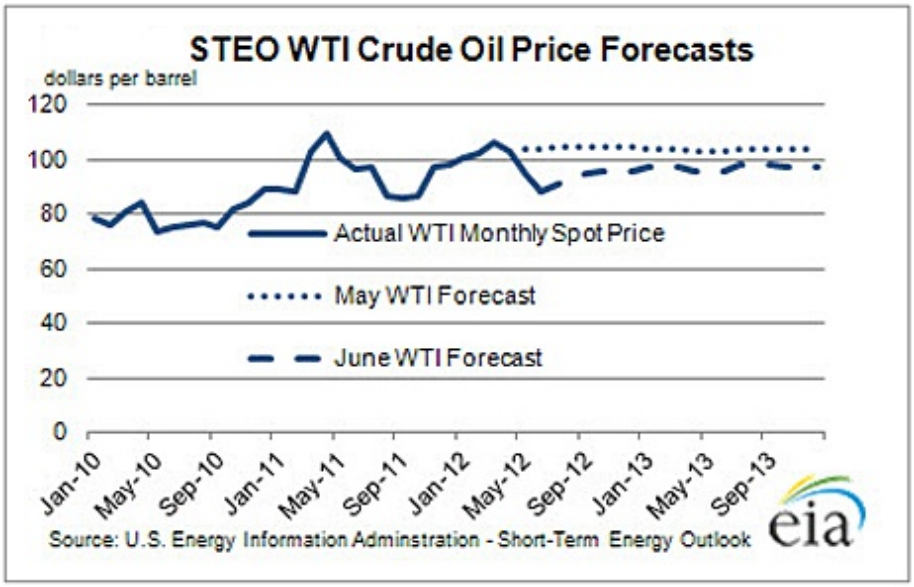

Figure 3. EIA estimate of crude oil prices going forward over the next eighteen months (EIA TWIP)

In the short term, and leading into a national election, there is no significant event (short of a hurricane or two) that obviously threatens this projection, though the Iranian situation and the questionable stability of nations in the Middle East and North Africa (MENA) has to remain a concern. Sadly, the continued ill health of the global economy, with no evident savior or realistic plan for growth now visible, means that the demand OPEC projects - 1.17 mbd y-o-y on average this year - may continue to be met.

However, I have given my reasons in previous posts for anticipating that the surge in both

Russian production and in the United States are at near peak, and will soon decline. Saudi Arabia's fall will be less dramatic and a little later, but the combination does not bode well for the international supply in the next presidential term.

The big question with Saudi Arabian production to date has been more focused on the production from Ghawar, which at 5 mbd has been the rock on which the overall production builds. But that rock is continuously eroding under the long production periods that its different regions have seen.

The final major new effort to bring new production on line in the overall field was the effort at Haradh, down in the South tip of the field.

JoulesBurn has written comprehensively on this region, beginning with the first well that came into production. In 1979, as the late Matt Simmons pointed out in "Twilight in the Desert", the three northern segments of Ghawar, Ain Dar, Shedgum and North Uthmaniyah were producing 4.2 mbd of the 5.3 mbd total Ghawar output, with South Uthmaniyah producing another 400 kbd. By 2006 North Uthmaniyah was running at a 46% water cut.

Joules has taken the historic record for that region of the field and made a short movie presentation included in a post that shows how Uthmaniyah was developed over the years.

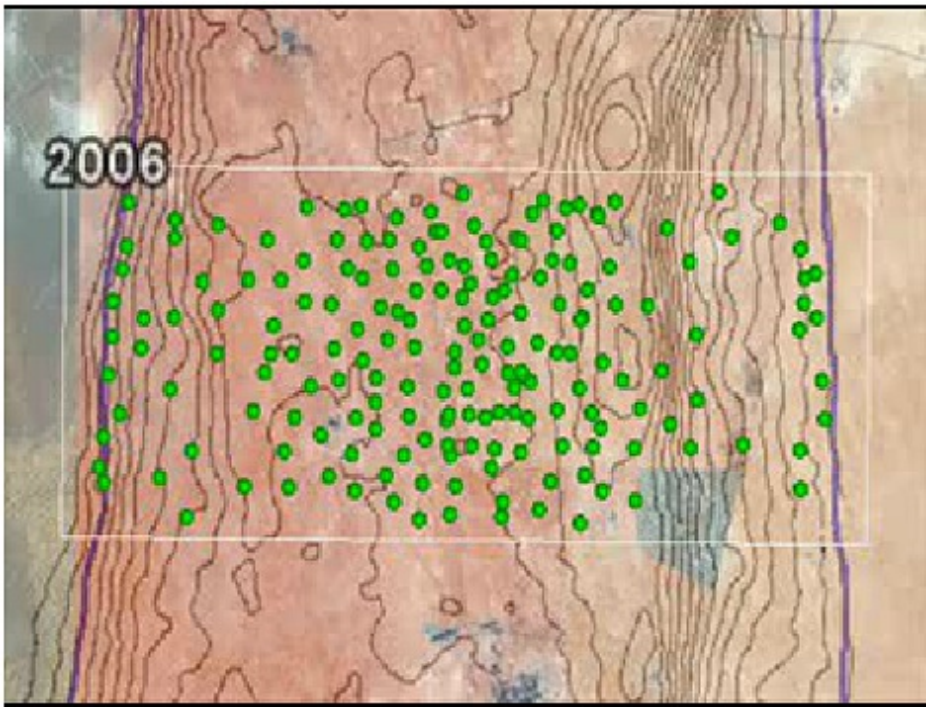

Figure 4. Single frame from the movie on drill site development in Uthmaniyah, over time (JoulesBurn)

The sequence of wells shows how the wells had to move inexorably to the crest of the field as the underlying reservoir became more depleted in oil. Uthmaniyah is the region where the test program to inject carbon dioxide to enhance EOR is under construction, as mentioned earlier, and scheduled for completion in the fourth quarter of 2013. It is worth noting that Aramco is also planning to use more steam injection for enhanced oil recovery (EOR), and that plans have just been signed to increase steam production at the Ju'aymah, Shedgum and Uthmaniyah plants, with completion dates in 2014 and 2015.

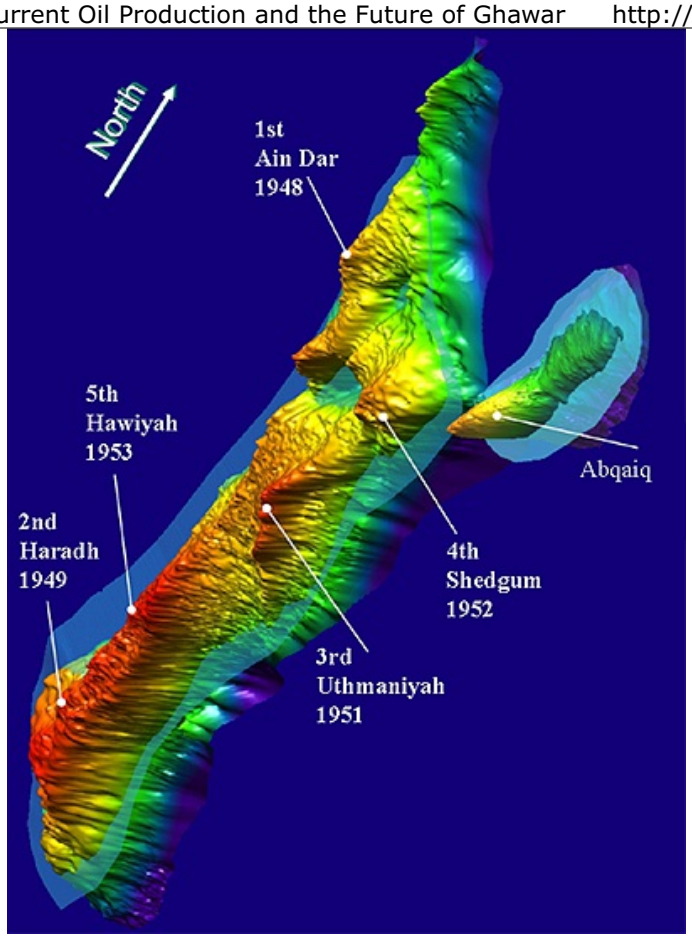

Figure 5. Sectors of Ghawar with the date of discovery (Afifi)

As one moves south, the quality of the reservoir changes, and becomes more difficult to produce. However, as Greg Croft has noted, the two lower segments of the field Hawiyah and Haradh were developed with horizontal wells rather than the vertical wells further north in Ghawar. This has overcome some of the geological constraints and the fact that the productivity index drops from around 140 barrels of oil per day/psi to 45 BOPD/psi at Hawiyah, and 31 at Haradh. In 2008, the Hawiyah NGL recovery plant was commissioned, to yield 310 kbd of ethane and NGL.

The further development of the lowest segment of Ghawar, down at Haradh, was one of the major projects that Aramco listed as contributing to their ability to produce up to 12.5 mbd. The latest development built on earlier development, and because the use of horizontal wells had transitioned into maximum reservoir contact (MRC) designs by the time of Haradh III reduced the anticipated number of wells from 280 verticals to 32 MRC wells.

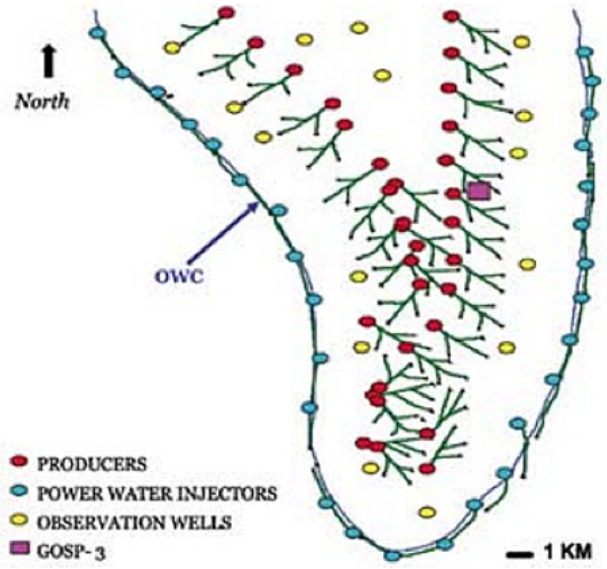

Figure 6. Planned well layout in Haradh III (from Aramco via JoulesBurn)

In his initial review of how that developed, JoulesBurn showed how the wells were developed and laid out and explained how he was able to use satellite images to determine the different components of the production equipment.

It is relevant to note that Joules updated his view of the region in 2010 when he noted that after looking at the satellite images of the region, he was able to show that instead of the production coming from the original 32 wells, there were actually some 52 production wells connected up, which – as he noted – raises a few questions as to the actual performance of the wells over the original projections.

However, Aramco reported(pdf) using Real-Time Reserve Management, that it had been more successful than anticipated by the summer of 2009.

Some of the additional wells drilled were to allow cross-hole tomography (pdf) to monitor the location of the oil:water front, which as production evolved, did not follow the anticipated path. This was particularly important to establish given the 1 km spacing between wells and the more complex geology relative to that further north in Ghawar.

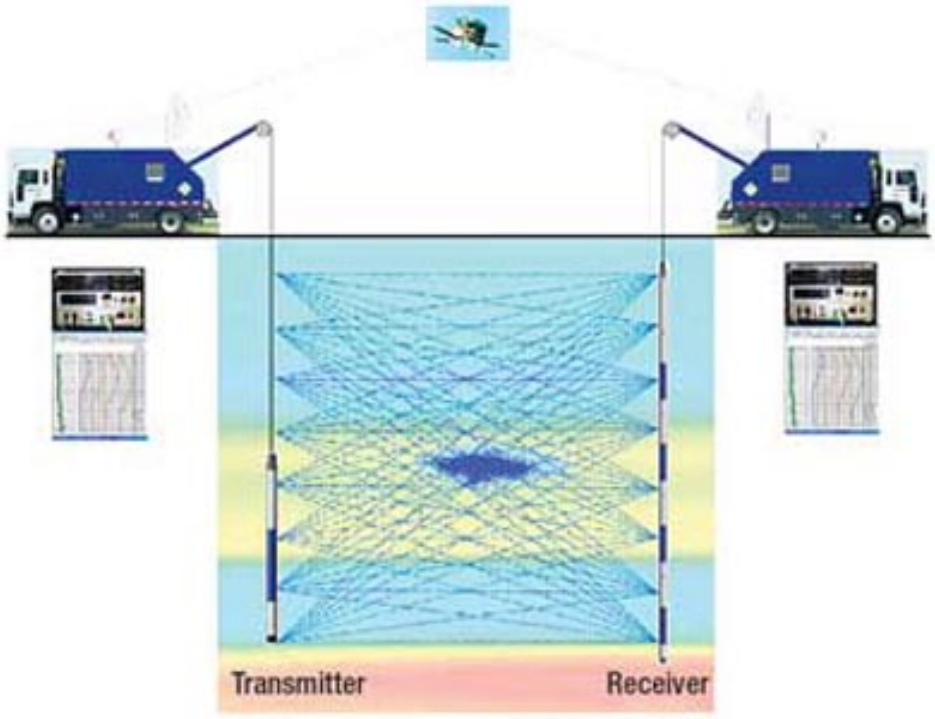

Figure 7. Schematic showing how cross-hole tomography is carried out (Stephen Prenskey)

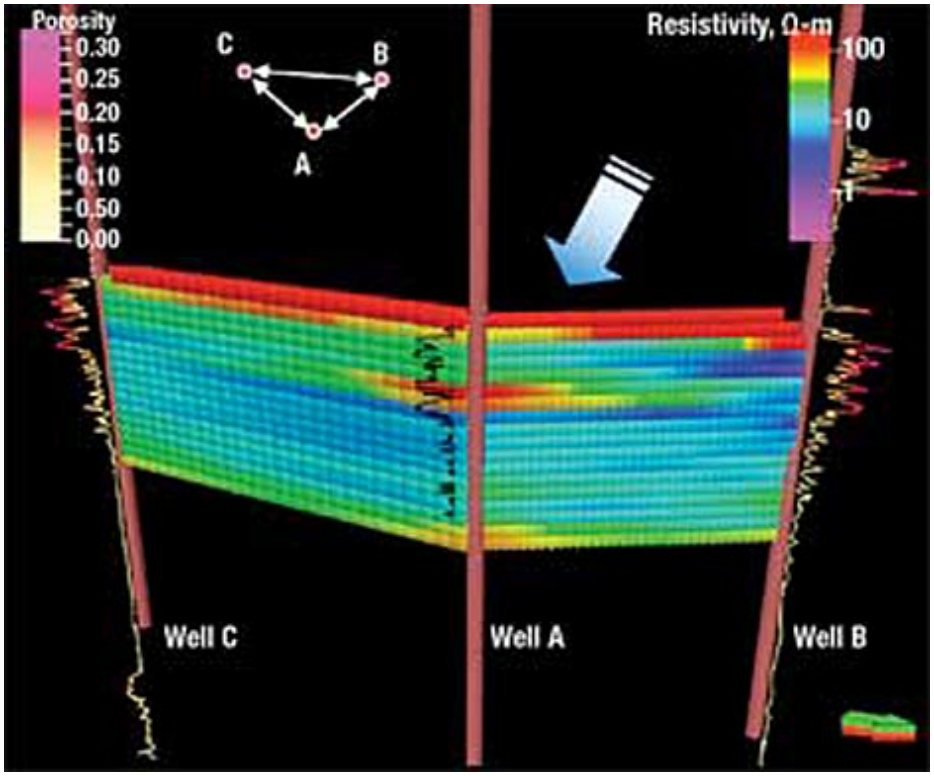

Figure 8. Image from Crosshole tomography at Haradh (out (Stephen Prenskey)

What is also clear, however, from looking at the different regions of Ghawar, is that there are no places left for new programs to restore production as wells become exhausted. If KSA is to sustain its production it must look beyond the King of Oil Fields, which now lies stricken in years.