The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Saudi Arabia's Crude Oil Production Peaked in 2005

Posted by ace on March 3, 2009 - 10:24am
Topic: Supply/Production
Tags: ali al-naimi, aramco, jack zagar, jean laherrère, matthew simmons, opec, original, peak oil, saudi arabia [list all tags]

Saudi Arabia's historical crude oil production indicates a peak of 9.6 million barrels/day in 2005. In 2008, crude production was 9.3 mbd. In 2009 it is forecast to be 8.1 mbd followed by an increase in 2010 to 8.5 mbd. Unfortunately, after 2010 a steady decline is forecast.

The forecast production profile assumes that Saudi Arabia's ultimate recoverable crude oil reserves (URR) are 185 billion barrels (Gb). However, it is possible that Saudi Arabia could have an additional 25 Gb from discovered undeveloped fields and future discoveries. A higher URR of 210 Gb implies that the additional production increment could decrease the total decline rate from about 2015 as shown by the dashed line in the chart below.

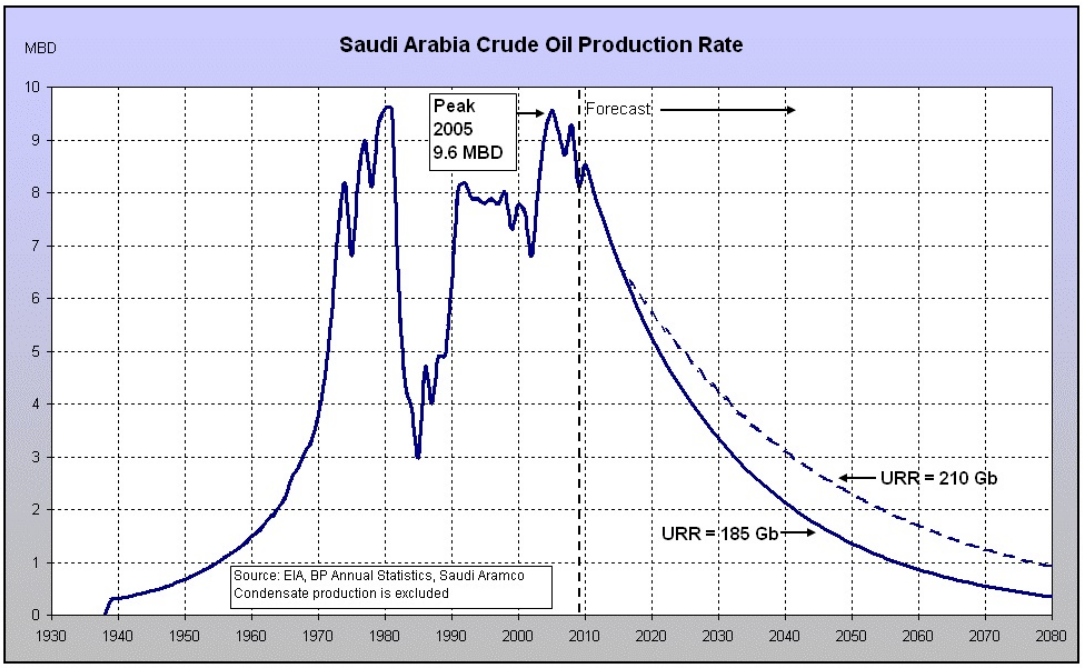

Figure 1 -Saudi Arabia Crude Oil Production to 2080 *- click to enlarge*

The URR estimates in the chart above are made by using secondary data sources. In this time of economic crisis, it would appear appropriate for Saudi Arabia's oil fields to be publicly audited. The full disclosure of total remaining reserves, by field, would enable more effective future oil production and consumption planning in this post peak oil age.

Saudi Arabia's Crude Oil Production Forecast

Production from the Kingdom of Saudi Arabia (KSA) between February and April 2009 is forecast to be just less than its target of 8 mbd as other OPEC members are unlikely to fully comply with announced OPEC production cuts. This source says that KSA produced 7.95 mbd last month and also that OPEC-11 has complied with 81% of announced production cuts of 4.2 mbd from September 2008. I am also forecasting that oil prices will increase this year, assuming that demand does not fall further. Consequently, it is assumed that OPEC will slowly increase production to take advantage of higher prices and that KSA will increase production starting from July 2009 until early 2010 (Fig 2).

The recent KSA production falls are probably a combination of field decline and voluntary cuts. The green line in the chart below shows the annualised depletion rate of remaining oil reserves, sometimes referred to as the extraction rate. In July 2008, the depletion rate was above 5%/year implying that KSA's 9.7 million barrels/day (mbd) production in July 2008 was probably at its maximum capacity. Depletion rates should be less than 5% for good reservoir management of large fields.

KSA's capacity could be treated as a function of its remaining reserves. If it's assumed that KSA has 65 billion barrels (Gb) remaining crude oil in 2009, then a reasonable production capacity for 2009 would be an annual depletion rate of 5% applied to 65 Gb giving 8.9 mbd. This implies that current KSA spare production capacity is about 1 mbd while keeping the depletion rate below 5%/year. As KSA produces oil, its remaining reserves decrease which causes capacity to decrease.

The depletion rate of remaining reserves is forecast to be an average of 4.4% from January 2009 to July 2009, shown by the dashed green line. This depletion rate is the same as the average from January 2005 to December 2007. As the current depletion rate is less than 5%, this indicates that KSA has the ability to increase production back up to 8.75 mbd early next year. It is assumed that KSA's depletion rate returns to 5% in early 2010 which indicates no surplus production capacity.

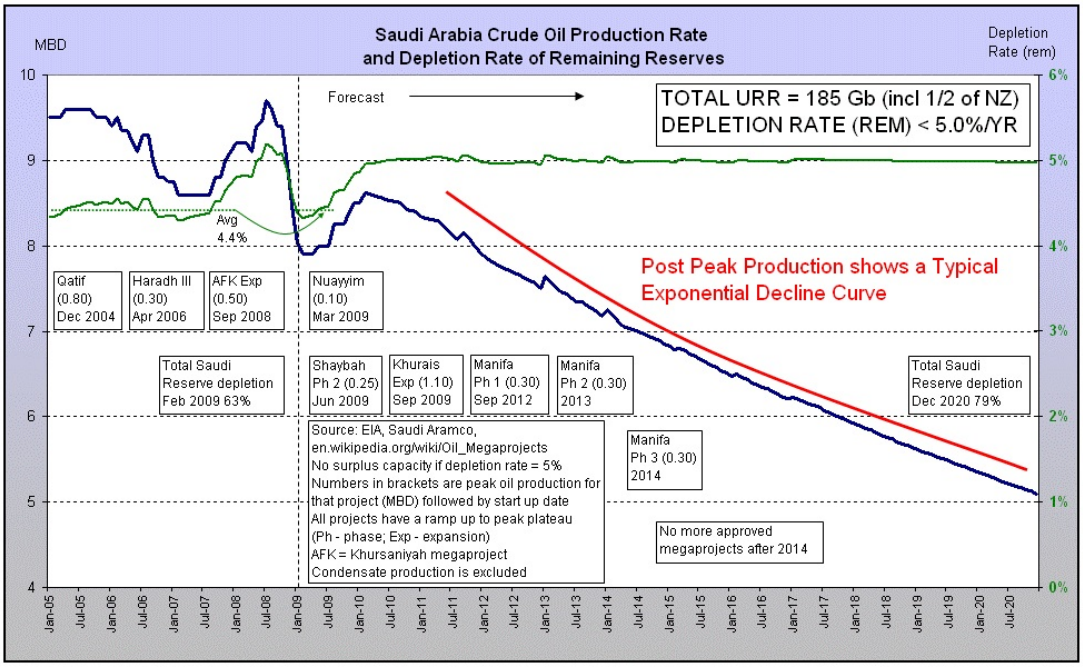

Figure 2 -Saudi Arabia Crude Oil Production to 2020 *- click to enlarge*

The long term KSA forecast is shown below. KSA, including half of the Neutral Zone, produced 9.6 mbd in 2005. In 2008, crude production was 9.3 mbd. In 2009 it is forecast to be 8.1 mbd

followed by an increase in 2010 to 8.5 mbd. Assuming KSA ultimate recoverable oil reserves (URR) of 185 Gb for forecasting purposes, this implies that the dark blue line is the production profile to 2080. Additional recoverable oil reserves from discovered undeveloped fields, future discoveries and technology advances should help to decrease the decline rate but the 2005 peak would remain.

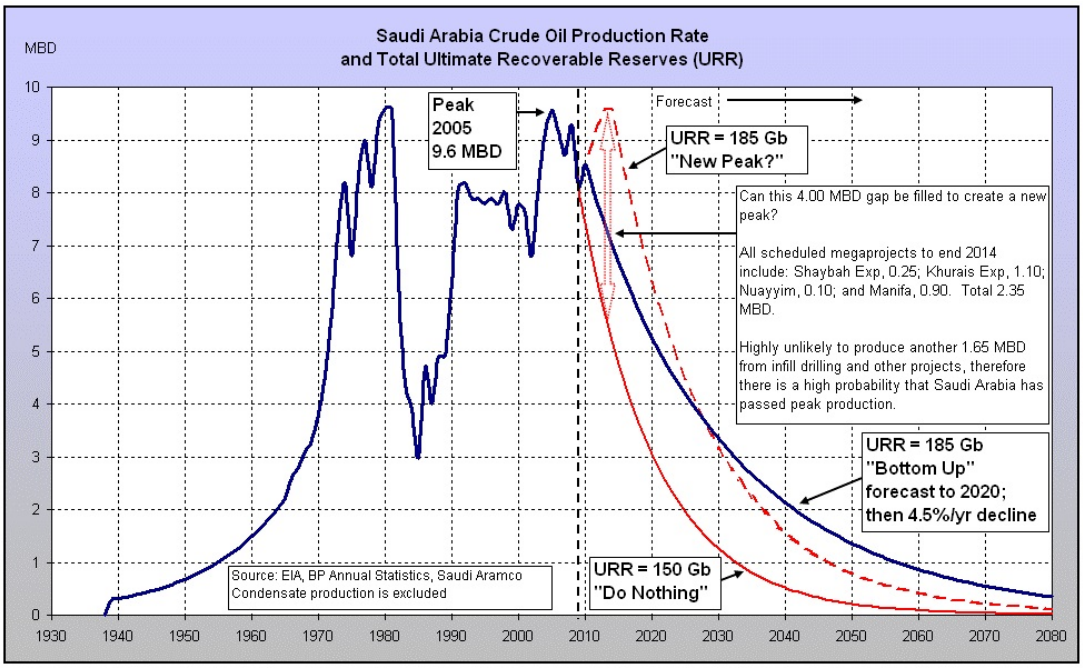

Figure 3 -Saudi Arabia Crude Oil Production Scenarios to 2080 *- click to enlarge*

The declining production forecast scenario after 2010 is much less than the forecasts made by the International Energy Agency, US Energy Information Administration, and Cambridge Energy Research Associates. The main reason for this difference is that these three energy organizations accept Saudi Aramco's unaudited oil reserves numbers. Matt Simmons has been deeply concerned about the true reserves and production capacity of KSA for years, giving many presentations. In this 2005 presentation, he said: "Once Saudi Arabia reaches peak oil, so will the world". Matt Simmons is right as the KSA 2005 peak for crude oil production probably occurred in the same year as the peak of world crude oil production.

Saudi Arabia's Oil Reserves

A critical forecasting assumption is that the ultimate recoverable crude reserves (URR) for KSA, including half of the Neutral Zone, are 185 billion barrels (Gb) relating to producing fields. KSA may have an additional 25 Gb reserves from future discoveries and from the 65 static (discovered undeveloped) fields in the chart below giving a higher URR of 210 Gb. As oil production from these additional reserves would not start until at least 2015, the decline rate should decrease but the 2005 peak would not be exceeded. The production from these additional 25 Gb of reserves would have only a very small impact on future world crude production. This discussion of KSA URR provides support for the higher URR of 210 Gb. More detail about Saudi Arabia's URR split by field is in last year's forecast.

All of KSA's new projects of Nuayyim, Khurais, Manifa, Shaybah and Khursaniyah are either workovers or expansions of fields which have already been producing. The chart below shows the

producing fields by red vertical bars. The OIIP of these producing fields was just less than 500 Gb in 2005. One method of assessing the reasonableness of the URR 185 Gb is to assume that if this URR relates only to producing fields, then the recovery factor would be an average 37% for these producing fields (185 Gb/500 Gb). This is well above the world average of 30% based on 9000 fields from the IHS database. Given that some of KSA's fields would have high recovery factors, the higher KSA average recovery factor of 37% appears acceptable implying that the URR of 185 Gb is reasonable.

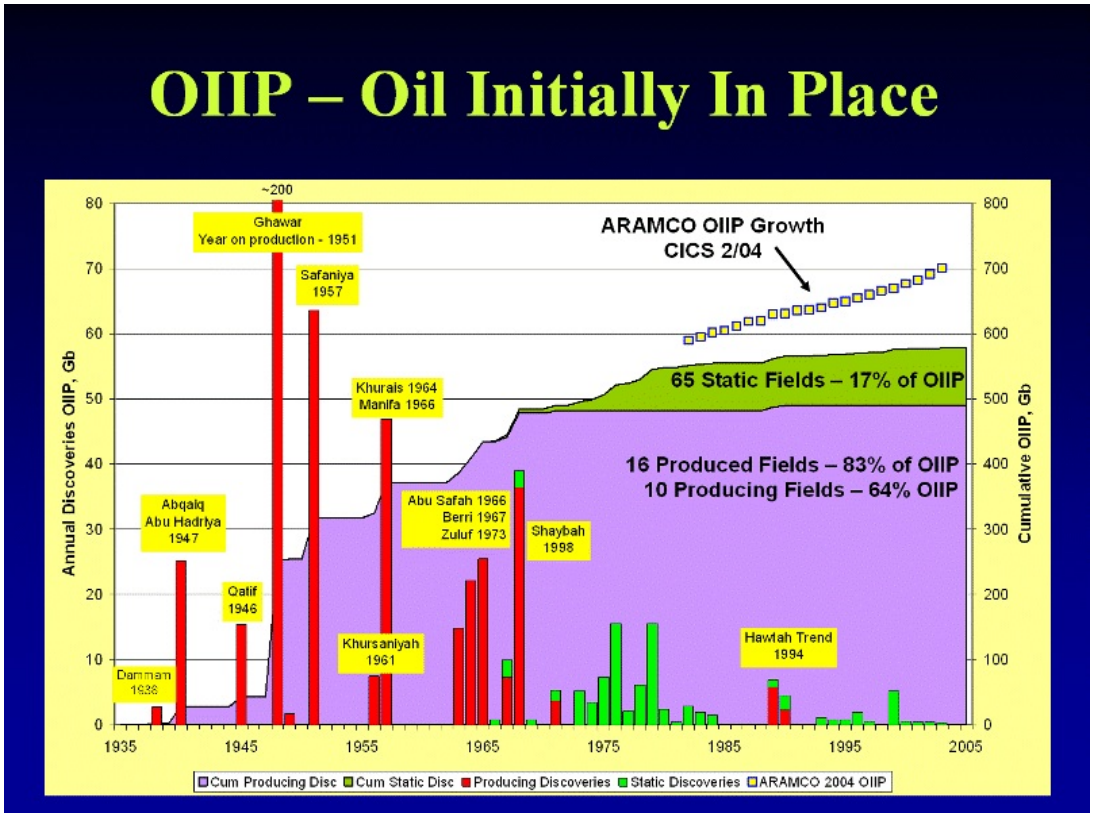

Figure 4 - Saudi Arabia Initial Oil in Place *- click to enlarge*

The chart above is from Jack Zagar's 2005 ASPO presentation which states the following about the higher Aramco estimates for OIIP trending up to 700 Gb in 2004:

> These same ARAMCO contacts hint that the OIIP growth is perhaps a P3 or Probability P10 type estimate; statistically, this means that the higher OIIP number has perhaps a 10% chance of occurrence.
>
> With the most likely OIIP estimate still in the 600 Gb range. Only time will tell if this additional OIIP will translate into additional oil in the tank.

The chart below is an annual crude Hubbert Linearization (HL) plot showing a sudden increase from 2002 to 2005. If this sudden increase is due to additional oil reserves, then the HL URR would be about 185 Gb relating to producing fields. However, I believe there is a strong possibility that this sudden increase is only temporary. In this case, the data points for 2009 and 2010 could fall back to the HL URR 160 Gb trend line. This sudden increase could be the result of using high technology horizontal oil wells, enabling higher extraction rates, rather than additional oil

reserves. The oil is extracted faster and the temporarily high production rates would falsely overestimate the HL URR prediction. This would imply that the HL URR for existing producing fields is 160 Gb. Adding another 25 Gb for discovered undeveloped fields and future new discoveries gives 185 Gb.

For comparison, Jean Laherrere also estimated the URR using an HL plot and arrived at a similar number of 180 Gb from his 2005 ASPO presentation. Laherrere's 2008 estimate was URR 250 Gb which includes discovered undeveloped fields and said this about Saudi Arabia oil data: "There are many uncertainties in liquids forecasts mainly because of the poor quality of the data. Saudi Arabia should improve the quality of these data in order to manage the coming crisis".

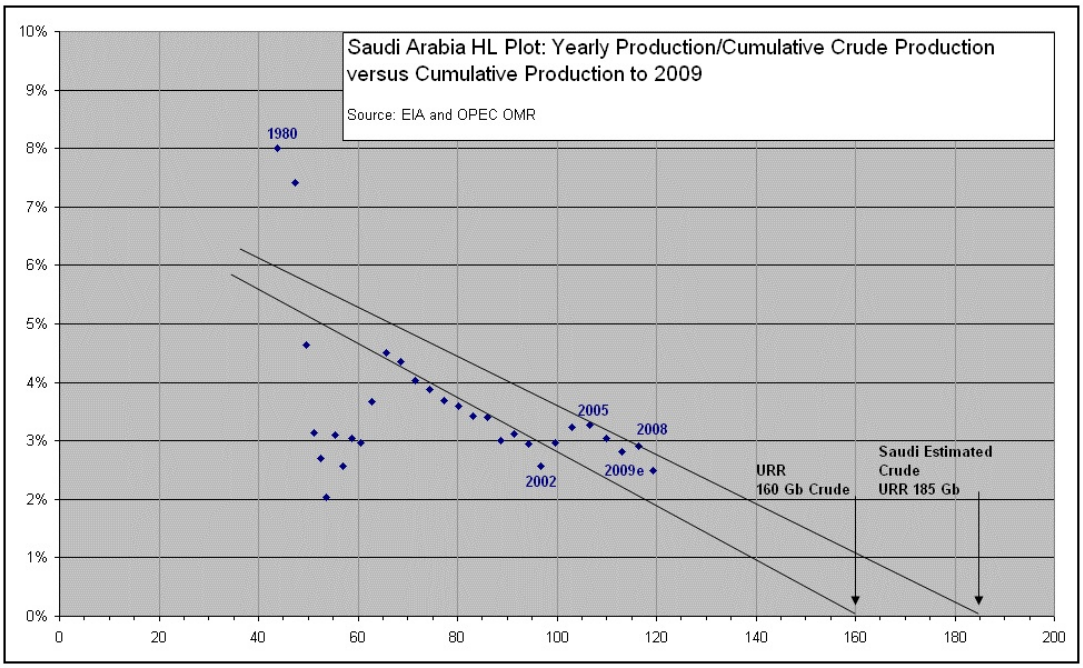

Figure 5 -Saudi Arabia Annual Hubbert Linearization *- click to enlarge*

I carefully selected monthly data points which indicated realistic production rates for KSA's fields which were close to capacity. For example, the April 2003 data point was used because it represented a high production rate, with little surplus capacity, during the invasion of Iraq. Also note that the monthly HL line goes through the months of June 2004 to August 2006, a time period for which many analysts believed that KSA had little spare capacity. A URR of 185 Gb, relating to producing fields, is predicted by the HL method shown below. The HL method only gives a rough approximation, but until KSA allows its fields to be publicly audited there remains uncertainty over KSA's true reserves.

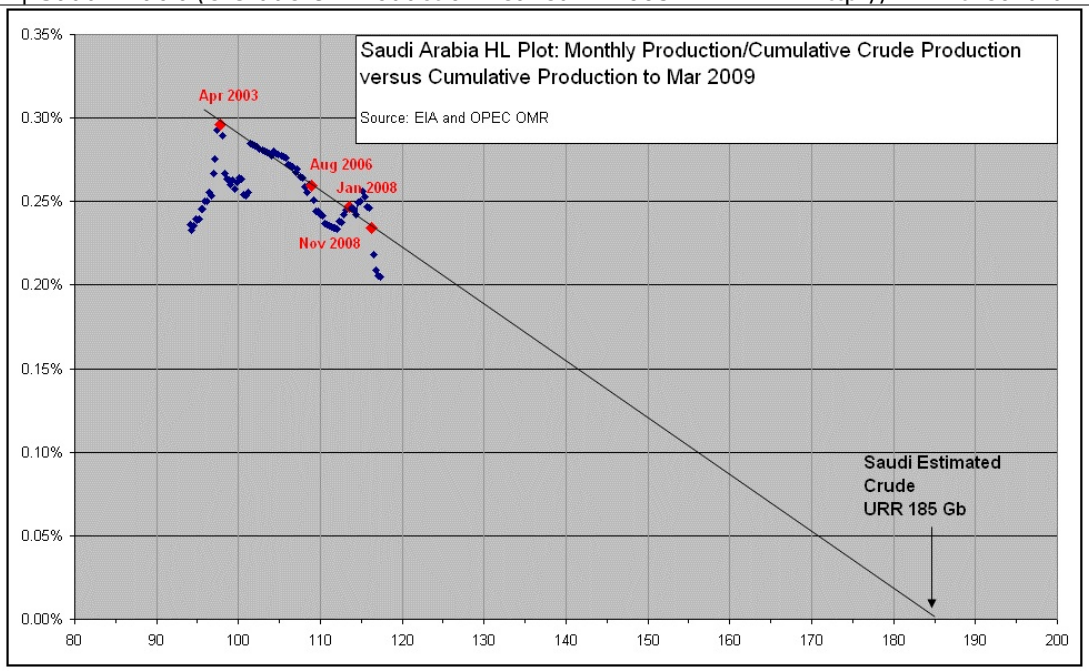

Figure 6 -Saudi Arabia Monthly Hubbert Linearization *- click to enlarge*

Many readers will question the validity of my URR estimates, shown in Figure 1, thinking that the true KSA URR must be higher. A perceived high URR is in the national interest of KSA because it needs its customers to continue their demand for oil leading to sustainable high oil prices for KSA. If customers thought that KSA had less than 100 Gb of oil left then conservation and switching to alternatives would increase. KSA has been creating this perception of overabundant oil reserves for at least sixteen years because it believes that this will maximize the price of its remaining oil.

Mr. Naimi, pictured below, has said on many occasions that the KSA can add another 200 Gb of reserves. In December 2004, Naimi said that reserves could be bolstered by another 200 Gb. In an April 2008 speech, Naimi was still talking about adding the same 200 Gb to increase remaining recoverable reserves to 464 Gb. In April 2008, cumulative crude oil production of KSA was 114 Gb which means that the his total potential crude URR is about 578 Gb which represents an impossible recovery factor of 96% based on Zagar's estimate of oil initially in place of 600 Gb (Fig 4).

It is time for Mr. Naimi to tell the truth about remaining KSA reserves. As the true remaining reserves are probably much lower than Naimi's claimed 260 Gb, a full disclosure of KSA reserves, by field, would not only allow more effective future oil production and consumption planning but might also help increase short term oil prices which would be favourable to all OPEC members.

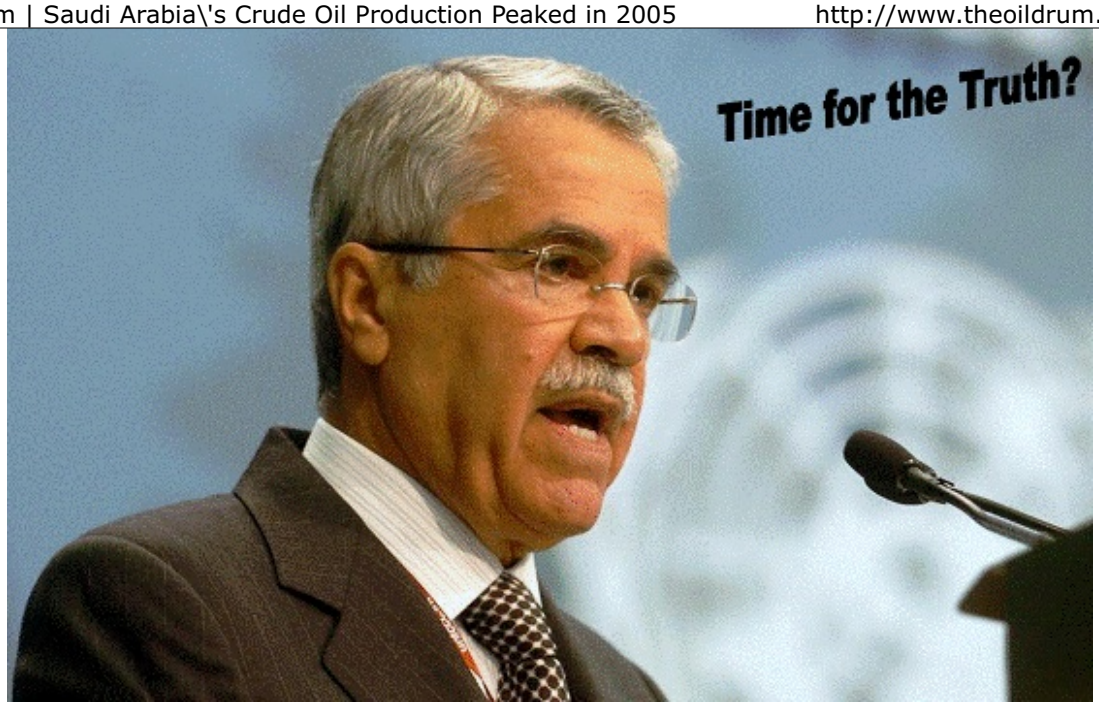

Figure 7 – H. E. Ali I. Al-Naimi, Minister of Petroleum & Mineral Resources, The Kingdom of Saudi Arabia and Chairman of the Board of Directors, Saudi Aramco - *click to enlarge*