The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Of Oil Supply trains and a thought on Ain Dar

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One of the critical factors in making sure that there is enough of an energy supply to meet the growing international demand lies in the logistics of the supply train that is going to have to provide it. When CERA and others point to the totality of the available resource, as Nate is pointing out in his series, they neglect the realities of that chain, and the parts that all have to work if the electric light is to go on the next time that you flip the switch on the wall.

Thus, if for example, Saudi Aramco tells Asian refiners that it is cutting supplies by 9% that does not mean that when a Japanese driver pulls into the gas station tomorrow that he will face a large EMPTY sign. Rather, in March Aramco tells the refiners that it will cut supply in later months, and thus the impact is not immediately evident. :

> Saudi Aramco will cut exports of Arab heavy crude by as much as 20 percent to Japan, 9 percent to South Korea and 15 percent to China, refinery officials said. A Taiwanese refiner will receive a 10 percent cut in Arab heavy supply.

The gas that is in the pump came out of the oil well some time ago, and has had to pass though pipelines, storage, tanker shipment, refineries and additional storage before it actually leaves the pump nozzle to flow into the car gas tank. This takes away some of the immediate impact of the OPEC cut back in supply, and if this is, concurrently, occurring when the refineries normally reduce demand because of maintenance, then the impact can be further concealed.

> Refineries in Asia typically close from April to June for repairs. Japan will see a peak of 26 percent of its capacity closed in May and South Korea will have 19 percent shut, mainly during the second half of June and the first half of July.

Unfortunately that “not-quite-just-in time-production” nature of the supply train also has a downside at the other side of this situation. When production increases again, if it does, then there will be an equivalent lag-time before our Japanese retailer can take down his EMPTY sign because the gas is back in town.

One way that individuals, companies and nations can protect themselves from the violent price fluctuations that usually occur during shortages it to provide themselves with a strategic reserve. Now I don’t call it that when I buy 4 cords of wood in the fall, so that I don’t have to struggle through the blizzard to the store for my daily wood supply, but I could. There was discussion on fluctuations in coal production a week or so ago, and part of that was because of the more common

national strikes that used to occur in struggles between management and unions. With strikes lasting up to a year power stations would build stocks of coal ahead of time so that they could continue work during the strike, but this exacerbated the fluctuation. And power stations must now, because of the variable timing of coal by rail, have an operating reserve just to ensure stable operation over a month. And as a passing comment, driving down the Delta after Katrina I was surprised to see how little damage the coal stockpiles had suffered.

Nations and corporations normally have operational stockpiles for oil (and the relative state of these get posted and commented on fairly regularly). And beyond these short-term reserves the US has a Strategic Petroleum Reserve (SPR) which we are in process of enlarging. It proved useful after the Hurricanes of 2005, and China has built and filled some, but is, interestingly renting out space to Sinopec at the Zhenhai SPR. This does not seem consistent with plans discussed last year for China to build a reserve of 800 million barrels. If they are still waiting for the price to come down, they may have a long wait. India is also moving ahead with the creation of underground space.

It is the more normal stocks, however, that are first run down, should supply become inadequate, but since current U.S. stocks are at typical levels, around 22 days supply, this is still more of a conjectural scenario. However it is a point of vulnerability and is one place to see the impact of a prolonged OPEC reduction. OPEC, for example, see the size of these inventories as a sign of oversupply.

Moving further back along the supply train, and skipping the refining process itself, and recognizing that it takes several weeks to ship oil from Ras Tanura to Houston, or other distant destinations, one arrives back at Saudi Arabia, and two more points that I would like to interject into the debate on Aramco production. And they are more intended to be helpful to those who don't know some of the language and technologies.

The first relates to the debate between Stuart and Euan on the decline in Saudi production. Foregoing, for now the intent of the Saudi Government (see reference above) and the sudden chilling we seem to be seeing in the U.S. relationship with them, the need for time in changing oil production should be recognized.

When Aramco decide to increase production from a field, or to add another field to their supply network, they cannot just drill another well, hook it into the line and see their exports increase. Because of the nature of the fluid that actually comes out of the hole, it has to be run, first through a GOSP , or gas oil separation plant. Here the oil, formation water and gas that come out of the well together are separated, so that they can be piped to the different treatment plants. (And as a side point readers might want to look at some of the articles on oil production from Saudi Aramco World since they are written more for a family audience than a technical one.) These plants are generally rather large, the one in the article treats 450,000 bd of oil, and they take considerable time to build, install and connect up. Thus when new production is planned one has to wait for the plant to be in operation before the wells themselves can be productive. The new addition that is planned for Khurais , for example, must also have a new central processing plant constructed, and when Haradh Stage 3 began, it had, first to have the new GOSP in place and running, which is was by the second quarter of 2006. Thus the production increments in the country are controlled by the rate at which these can be brought on line. In addition the older ones are being upgraded. (Side comment, though the KSA centralize their GOSPs they don't have to be that big we have had an individual well unit hauled through our yard behind an SUV).

The final point that I wanted to slip in was to extend the "back of the envelope" type of calculation that I had originally done for Abqaiq (continued here and here) to do the same thing for Northern

Ain Dar, since this was the subject of the one of the papers that Stuart quoted the other day.

As you may gather from that post Ain Dar has been producing for some 50 years, and for the last 30 of these water has been injected around the edges of the field to gradually push the remaining oil up towards the crest of the anticline (fold) that caused the oil to be trapped there. And while the pictures that Stuart posted tell some of the story, it may also help to look at some numbers. If we begin by seeing how much oil that there can be in this part of the field, we can do this by calculating the total volume of the reservoir, and then seeing how much of this is not rock (the porosity).

This part of the field is roughly 7 miles wide, and some 20 miles long (from Greg Croft and is some 200 ft thick. This gives a volume of rock of some 836,000,000,000 cu ft. If this has a porosity of 25% then the volume of space that can be filled with oil is 209,000,000,000 cu. Ft. If it were all oil, then at 7.48 gal/cu ft this would be 37,237,000,000 barrels, or 37 billion barrels give or take. And I should, here, point out that this is only Northern Ain Dar, and that when larger figures are quoted I believe that they refer to the whole field, which extends about another 25 miles further South, and which is often combined with the adjacent Shedgum which, in 2001, for e.g. was producing about 2 mbd, to the roughly 0.5 mbd coming from North Ain Dar.

Now this is, at maximum, the total volume of oil. However there is, at Ain Dar, apparently a certain amount of water already in the formation with the oil, so this will reduce the total volume that can be recovered. At the same time, even with water flood only a certain fraction of the oil in the rock will be recovered. So that if we say. For example, that the oil filled about 80% of the space, then the total would drop to around 30 billion barrels. And of this one might, at best, anticipate recovering about half of it. So that the ultimate resource recovery might be about 50%, which would mean a total of 15 billion barrels. The reality is, however, of that ultimate potential resource we are only likely to produce a certain fraction. It is the value of that fraction that is often the subject of debate, since by increasing the number, without doing anything else, we can, apparently, increase the amount of oil that is available in a reserve.

Well let us say, just for the sake of creating an example, that the amount we can recover is 70%. (I am going to include in this the oil formation volume factor that plucky underdog explained.Then this drops the available oil down to around 10 billion barrels. Now of this, over the past 50 years they appear to have produced around 7 billion barrels (adding up the columns in the first graph of the paper Stuart used). Which would give them about 3 billion barrels left. If they are producing about 200 mb a year, then this would give the field a remaining life of around 15 years – which is the length of time that they say that the field can continue to produce in the paper. But then, of course, it will be all gone. And, considering the condition of the rest of Ain Dar and Shedgum, as Stuart pointed out, and the condition of Abqaiq, one may presume that they also, by that time will be out of oil also.

The other interesting thing, that I thought to note in the paper was that while they had drilled some horizontal wells in this field, they had only started to implement their use in water control in 2005, and the first MRC well had only been completed at the time of the paper and was not yet on stream. They will be used to produce relatively dry oil from the upper layers of the field, and to mix it with the oil and water coming from the rest of the field through the conventional vertical/inclined wells that go into the area that the water has already reached to maintain the overall water cut at around 42%.