The Oil Drum
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Tech Talk: OGPSS - Some limits to oil fungibility

Posted by Heading Out on December 12, 2010 - 11:05am

This is the second in a series I am just starting on oil production and consumption around the world. While it is going to focus more on individual nations and oil fields, over time, there are some general remarks that I want to use to preface the series and this is one of those. (OGPSS – Oil and Gas Production Sunday Series).

One of the first things that I was told when I started looking into whether there was a coming crisis in oil supply was that oil is fungible. What that meant was that if, for the sake of discussion, the Saudi Arabian government cut off oil supply to the West, then the West could turn around and buy an equivalent amount from somewhere else (it turned out to be the North Slope and the North Sea) and the world could continue on its merry way. In fact if you go to Merriam Webster oil is cited as an example of a fungible commodity.

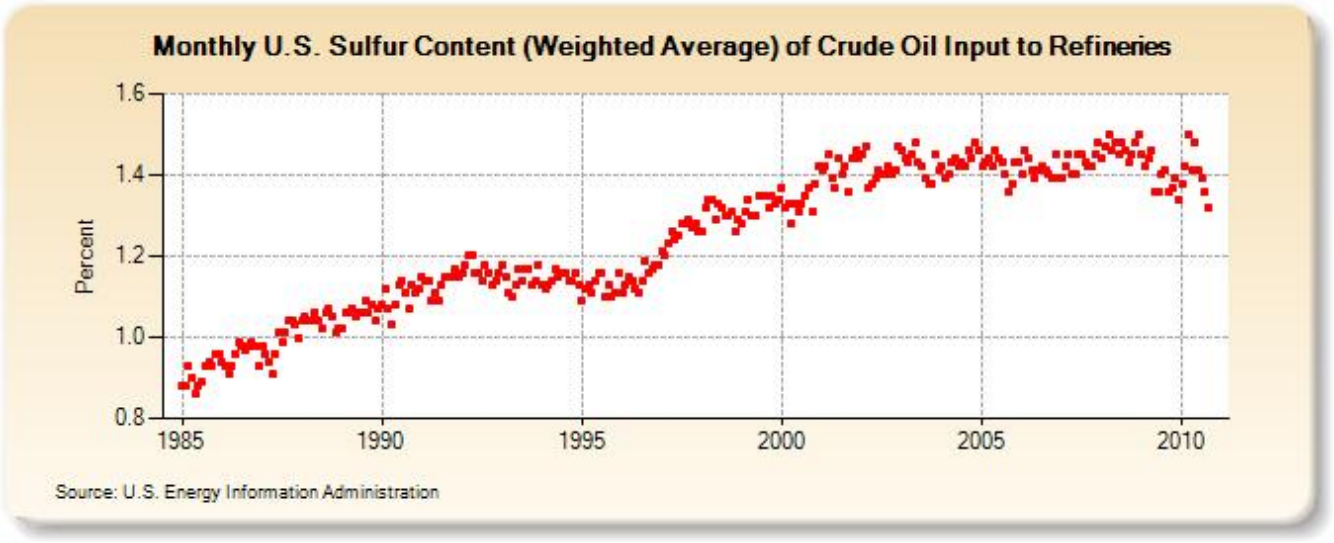
> being of such a nature that one part or quantity may be replaced by another equal part or quantity in the satisfaction of an obligation:- oil, wheat and lumber are fungible commodities.

But that assumption is not totally true, and in the world where matching production to demand is becoming a somewhat more difficult and expensive operation the limits to the fungibility of oil may soon become more evident.

One of the reasons for this is that, with some increasingly rare exceptions, one cannot drive up to an oilwell and fill the tank with the flow out of the ground, and then drive happily off. Crude oil is a mixture of different hydrocarbons. (Morgan Downey explains this is more detail in "Oil 101", and I will refer to that book a number of times as this series progresses, it sits on my desk.) Hydrocarbons are a combination of hydrogen and carbon atoms in different combinations, but with very approximately, twice as many hydrogen atoms as carbon. As the number of carbon atoms increases one moves from the simple light compounds such as methane (CH_4) to the more complex heavier fluids that get down to residual oils (29 to 70 carbons) and bitumens (above 70). Because the different components of the oil have different uses, the different fractions of the oil are separated out for individual use at a refinery. The quality of the crude is generally expressed by the API gravity, of which more in a later post.

Typical crude oil fractions

Because the different oilfields of the world produce oil with different combinations of hydrocarbon compounds, and with varying levels of other contaminants, such as, for example, sulfur, it is not always easy to switch the oil supply coming into a refinery from one field to that from another. The EIA has plotted the increase in sulfur content coming into US refineries. As the crude becomes heavier and contains higher sulfur content, so the refining process becomes more complex and expensive.



For many years, for example, the heavy, high sulfur, crudes produced in Venezuela were shipped to refineries in the United States that were designed to refine the oil to the desired products. Other refineries, geared to refining lighter sweeter (i.e. lower sulfur) crudes cannot accept very much of the Venezuelan oil and blend it into their process streams, since even to get to an

intermediate crude they would need to include a higher quality (and more expensive) lighter crude in the blend. Thus when there was a strike in Venezuela in 2002, and the world lost 3 mbd of oil production, there was only a limited flexibility in the way that the affected refineries in the United States were able to resolve their supply shortfall. (And in those days it was possible to increase Mexican supply to help out).

Venezuela is one of two countries (Canada being the other) with a significant production of synthetic crude from the heavy oil sands in that country. These are a more extreme case of the need for special refineries, since in both the Canadian and Venezuelan case the heavy oil must first be treated at the site to upgrade it to the quality of a conventional crude, before it can be sent to a conventional refinery. (I briefly discusses that refining in an earlier Tech Talk). This established a secondary limit on how much oil can be produced from those deposits at one time. Some time ago I visited the Oil Sand operations in Alberta, and was there on the day that the new Upgrader facility was shut down because of the escape of some of the gases from the process. I could smell a faint odor of “cat pee”, but nothing near the smells from many other processing plants of varying nature that I have visited over the decades. Nevertheless the new section of the plant was shut down for months until the problem was solved, removing over 100,000 bd from the market.

More recently the difference in price between heavy crude and light has reduced, to the point that the Canadians are no longer going to increase the size of the upgraders in the Fort McMurray area, but will instead be shipping the bitumen to eager customers. This does require some additional technology:

> Under the new timeline, which was disclosed yesterday, Syncrude will lift production to 425,000 barrels through debottlenecking, and add a further 115,000 per day of bitumen production. Both expansions are expected by 2020.
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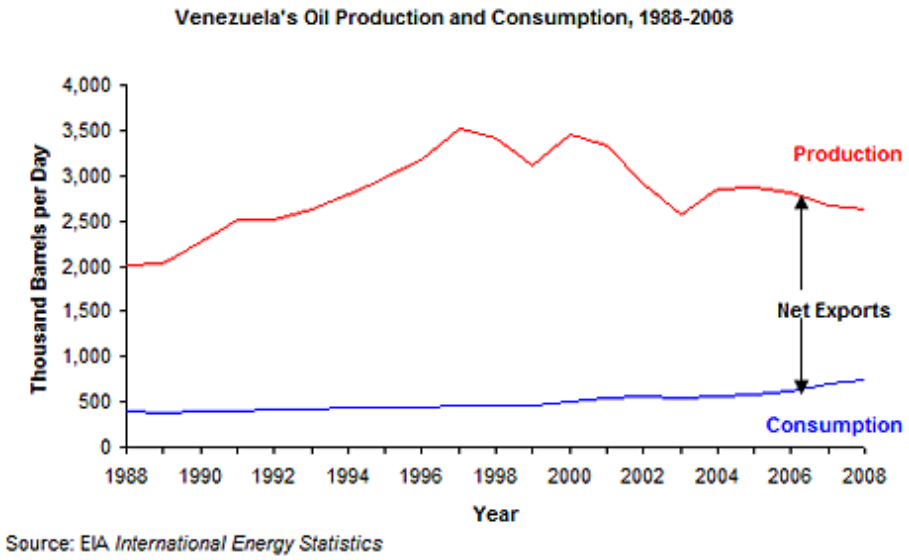
> (With additions to its mining operations, Syncrude actually plans to extract 600,000 barrels a day of bitumen by 2020, but barrels that go through its upgrading process actually shrink in size, resulting in a total output of 540,000.) Bitumen on its own is too thick to flow through a pipeline: at room temperature, it has the consistency of old molasses. But Syncrude plans to employ a new system that uses a solvent to remove what Ms. Fisekci called the "nasty" part of the bitumen. That system, which Syncrude operator Imperial Oil also intends to use at its Kearl oil sands mine, will allow the bitumen to flow without needing to be upgraded.

This will reduce the current bottleneck in production, which lies with the upgrader capacity, since it is only after the crude has passed through them, that it is able to flow easily through the pipelines to the conventional refineries. That change is not yet being considered in Venezuela, where the syncrude is now counted, by the EIA at least, as part of overall production.



The graph from the EIA highlights another consideration as I move to discuss the global trade in oil. That is the rising consumption within the country, a phenomenon that Jeffrey Brown (Westexas) introduced us to as the Export Land Model back in January 2006, since, with declining production it accelerates the reduction in net exports, as the Venezuelan case now illustrates.

I'll close today with one last point on the limits of fungibility. There are certain oilfields where the contamination of the crude is such that special refineries are needed to process the oil. The most outstanding of these is the oilfield at Manifa in Saudi Arabia, a subject I have been writing about for over five years. The problem with that production, which was initially slated to be in production next year comes from the need for special refineries to process the oil (an extreme case of the earlier condition I described). The plan was that two refineries would be built in Saudi Arabia to handle the initially 1 mbd of planned production, which by last March had dropped to 900,000 bd. One of these is being built by Total at Jubail, though it is interesting to note that the refinery is now scheduled – in its 400,000 bd capacity – to also receive oil from the more conventional field at Safaniya. It is now anticipated to open in 2013. A second refinery at Yanbu will also take 400,000 bd. Aramco will then build a new refinery at Jazan, with a capacity of 400,000 bd starting in 2013. But until those refineries come on line, unless the Saudi's and Chinese work out a deal (not beyond the bounds of possibility) that oil will stay in the ground.

The above is intended to show is that there are constraints outside of just having oil in the ground, and a ready customer, that preclude immediate sales and satisfaction. As this series develops I will be highlighting some others.