The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

US Petroleum Supply: Some Overview Graphs

Posted by Gail the Actuary on November 14, 2007 - 11:00am
Topic: Supply/Production
Tags: eia, graphs, oil production, refinery utilization [list all tags]

The US Energy Information Administration (EIA) puts out a lot of data. Even for the United States, the amount of data is overwhelming. To get an overview, I have prepared some graphs showing information I find interesting, and occasionally somewhat alarming. I include links to the underlying data, so those who are good with Excel can find data to make their own graphs.

1. EIA reports show oil production on a "total liquids" basis. What does this include for the United States?

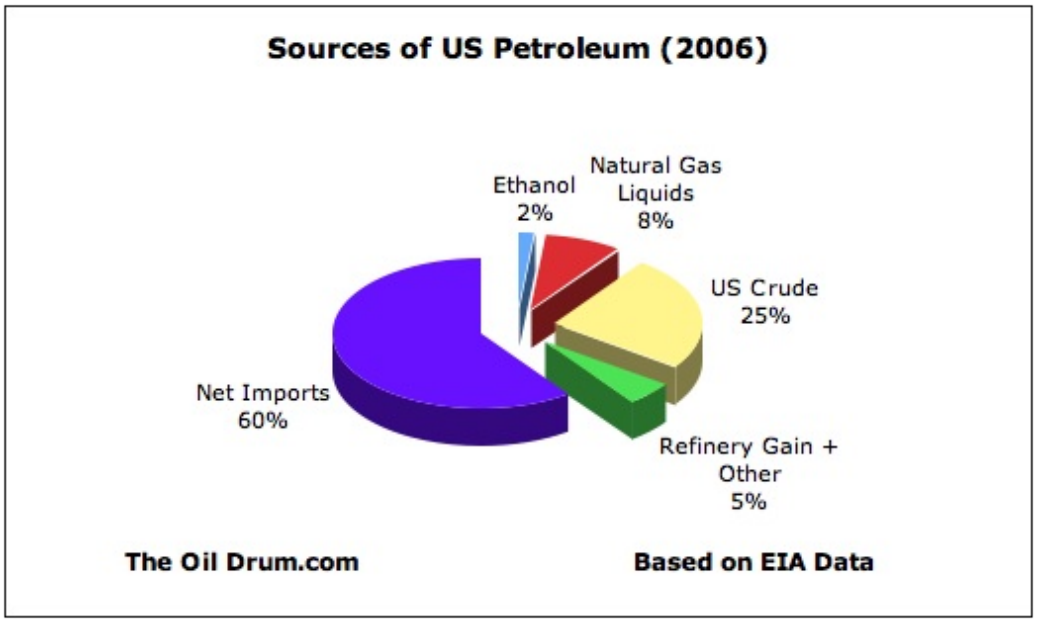

Figure 1

Discussion follows below the fold.

Figure 1 indicates that only 25% of US "total liquids" fuel production comes from US crude oil. Approximately 60% comes from net imports. We actually export a small amount of petroleum products (for example, fuel in airplanes leaving the country), so 60% is the net contribution when exports are considered.

The remaining 15% is from lower BTU contribution items:

• Ethanol - Ethanol accounted for 2% of 2006 "total liquids" oil production. Its BTU contribution is

about 70% of that of gasoline, so the sliver would be even smaller, if it were on a BTU content basis. To produce this tiny sliver of ethanol required 20% of the US corn crop, plus a large amount of fossil fuels and fresh water. This is a link to an article I wrote about corn-based ethanol.

• Natural gas liquids - These are the liquids that separate out when natural gas is produced. Like ethanol, they are of lower BTU content than gasoline. Since the US is a major producer of natural gas, we have quite a bit of these.

• Refinery processing gains - When petroleum is refined, the volume of the finished product is greater than that of the components that entered the refinery. The BTUs are not correspondingly higher, however. In 2006, approximately 70% of the refinery gain related to oil which the US had imported; 30% related to our own production. Oil production accounting gives the US credit for the entire gain, including that relating to the processing of imported oil.

Data for Figure 1 is from here (Table 1.1c or 4.1c for crude; Tables 1.3 or 4.3 for natural gas liquids, and Table 1.4 or 4.4 for "all liquids"); here for ethanol (click on monthly to get 2007 ethanol data); and here for net imports. I used "total product supplied" from here as my base. It differs by a small inventory change amount from what one gets by adding US total liquids to net imports.

2. How does US petroleum break down by product produced?

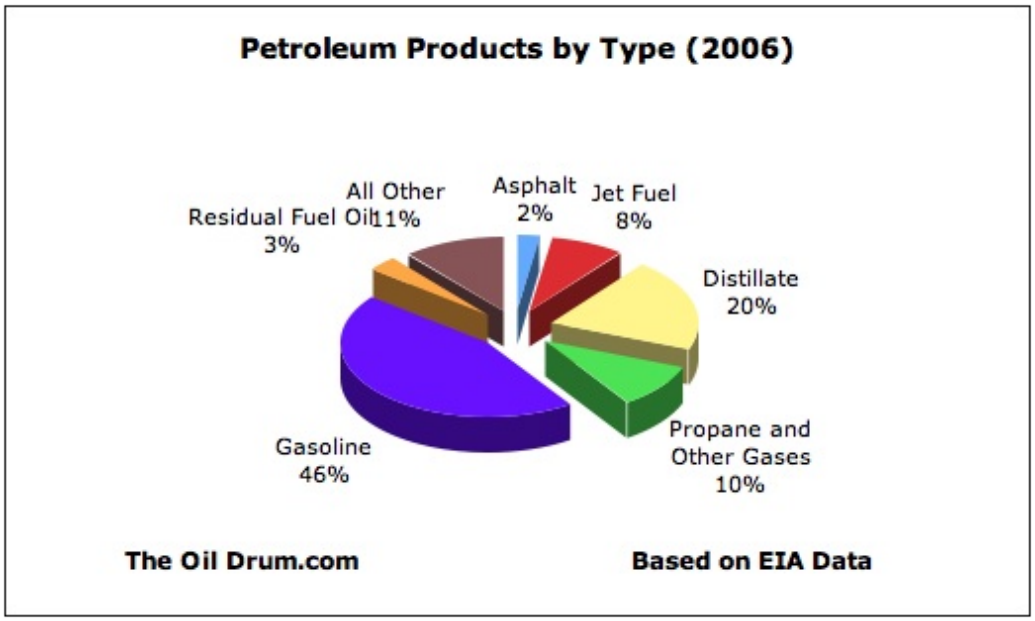

Figure 2

Figure 2 shows that the largest component of petroleum products is gasoline, amounting to 46% of the total. The second-largest component is "distillate." This is really a combination of diesel fuel (the majority of this category) and home heating oil. The sliver designated a "residual fuel oil" is a less-refined piece. It is used as "bunker fuel" in boats, and for various industrial uses.

The All Other category, amounting to 11% of the total, consists mainly of oil used as a raw material for the manufacturing of products such as plastics, textiles, building materials, pharmaceuticals, dyes, and a huge number of other items. Many people are surprised to learn that many manufactured products have oil as a raw material.

In the United States, almost no oil is used for the production of electricity. Instead, coal, nuclear,

natural gas, hydroelectric, and (recently) wind are used for that purpose. Oil can be use to produce electricity, but it tends to be expensive compared to other fuels. Backup generators often are powered by diesel.

It might be noted that it would be virtually impossible to convert to, say, 100% gasoline produced from petroleum. When petroleum is refined, the chemical structure of the output varies, with part of the output being best-suited for gasoline, part best-suited for diesel, and so on. With additional processing it is possible to "tweak" the percentages a bit, but to a significant extent, the output is determined by the petroleum used as input.

The supply percentages shown in Figure 1 reflect a combination of products the US produces by refining petroleum, together with the finished petroleum products the US imports. We are able to import extra gasoline, because Europeans tend to use diesel for their cars, so there is some left-over gasoline from the product mix refined for use in Europe.

Data for Figure 2 is from here.

3. What is the trend is US petroleum production?

To look at trends in US production, I have developed some graphs that are unusual in two respects:

• To give an idea of what kind of production we might expect for 2005 through 2007, I fitted an exponential trend line to data preceding these years, and extrapolated it to 2005 to 2007. The fitted trend line gives us an indication of the annual percentage change in production we would expect based on 2004 and prior data. By comparing how the fitted trend line compares to recent data, we can see how recent production deviates from what we might have expected, based on earlier information.

(For the more technically inclined) The selected data points used for determining the trend line vary somewhat from graph to graph. The latest point for the fitted data is always 2004. Enough points are used prior to 2004 to give what appears to me to be a representative recent trend line. Generally, the entire 1991 to 2004 period is used for the fit; if there appears to be a change in trend, I use a shorter, more recent period - say 1996 to 2004. This is admittedly a bit subjective, but the result is not expected to be exact.

• In the graphs I show annual data. Since I do not yet have an "actual" data point for 2007, I instead show the latest available year to date value (August 2007 YTD, from the November report). Using the August 2007 year to date value gives a general idea of where production is headed in 2007. Since these are average daily production amounts, they are not distorted by the shortened time period in the same way that total production amounts would be. One would generally expect the full year averages to be a little lower, if amounts are trending downward; or a little higher, if amounts are trending upward.

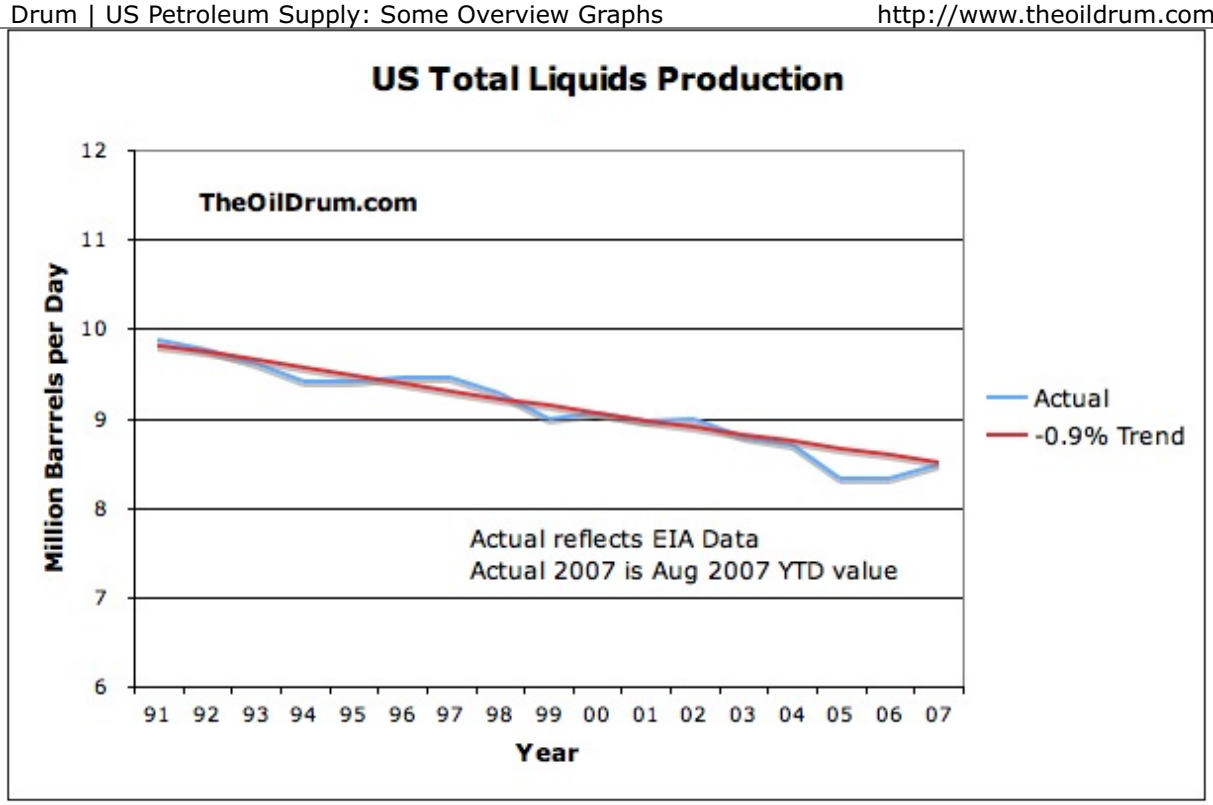

Figure 3

Figure 3 shows that prior to 2005, US "All Liquids" oil production was trending downward at -0.9% per year (slightly under 1% per year decline). There was a dip in production in 2005 and 2006, but by 2007 production seems to be approximately back to where we might have expected, based on the prior trend line. Data for Figure 3 is from here Table 1.4 for recent years; Table 4.4 for older years.

We can't know precisely the cause of the dip in production, be we do know that 2005 was a very bad year for hurricanes in the Gulf of Mexico, including hurricanes Dennis, Katrina, and Rita. The timing of the outages, and the rapid drop in the monthly production amounts at the time of the hurricanes, suggests that hurricane damage played a major role in the production decline.

Total Liquids shown in Figure 3 can be divided into US Crude (Figure 4) and US Other Liquids (Figure 5).

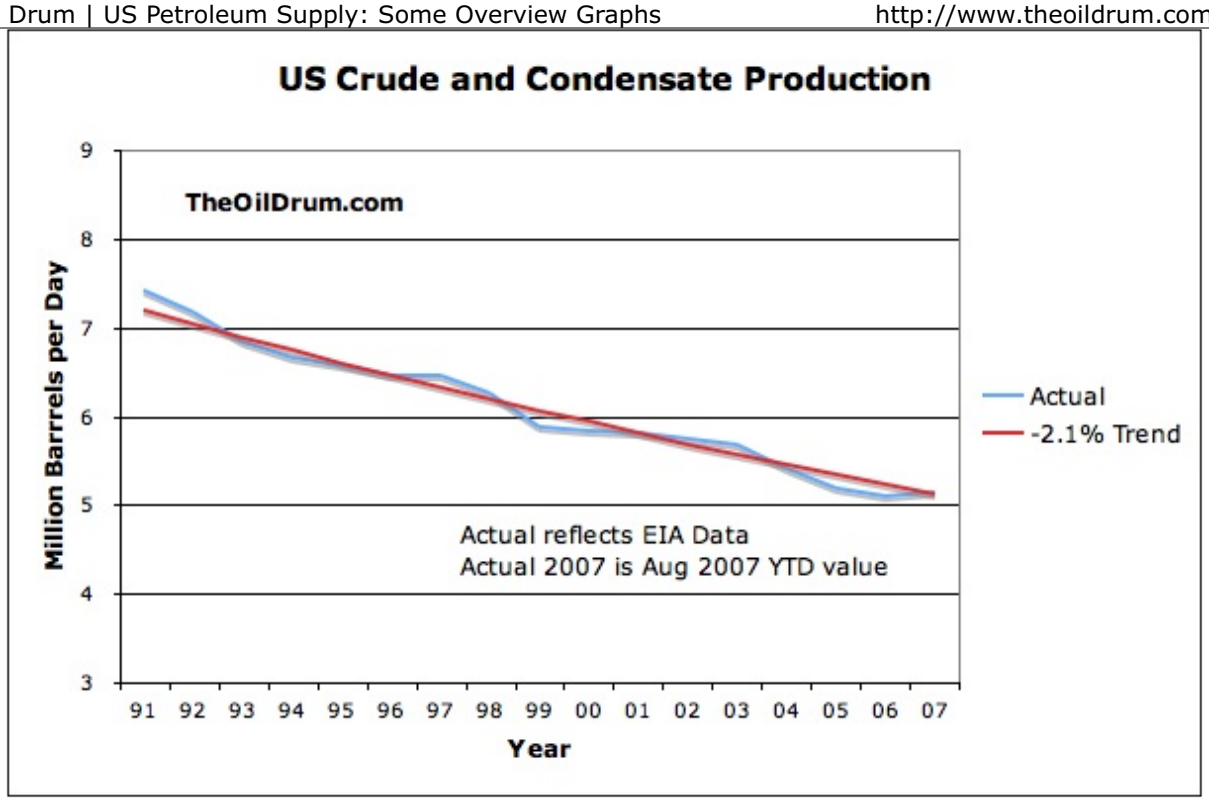

Figure 4

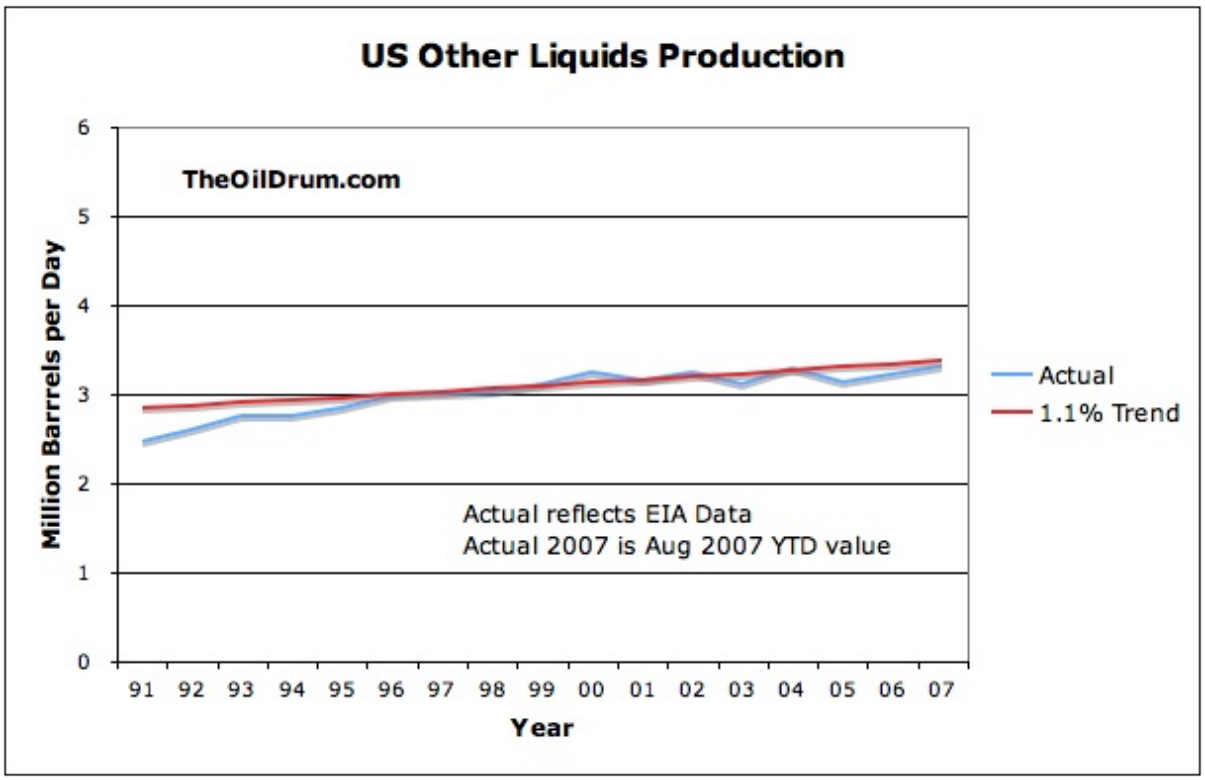

Figure 5

If we look at these separately, we find that US Crude (Figure 4) is trending downward at about -2.1% per year, while Other Liquids (figure 5) is slightly increasing, with an indicated trend of 1.1% per year. Both show dips during the 2005 and 2006 period. These dips are not unexpected, since both crude oil production and natural gas liquids can be disrupted by hurricanes.

The data for Figure 4 is from here (Table 1.1c and 4.1c). "Actual" data for Figure 5 is obtained by

subtracting actual data for Figure 4 from actual data for Figure 3.

Note that ethanol is included as part of "other liquids." Ethanol production is growing rapidly, but is of such small volume that it hardly makes a difference on the graph. Ethanol volumes (from here) amounted to the following amounts for recent years:

2004 0.2 million b/d
2005 0.3 million b/d
2006 0.3 million b/d
2007 0.4 million b/d

4. How about imports? The production trend data we have looked at so for relates to US produced oil.

Figure 6 shows that imports in 2006 and 2007 have dropped below the trend line.

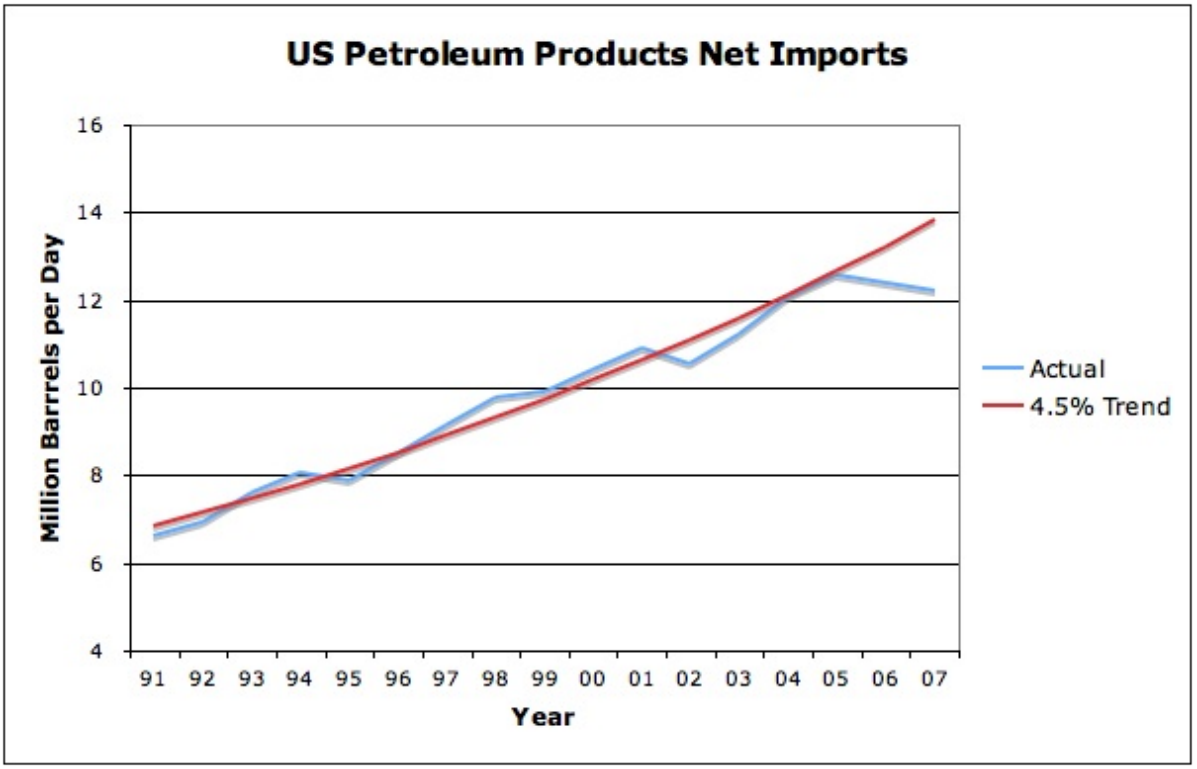

Figure 6

Prior to 2005, imports were increasing by about 4.5% a year. This has recently changed, and imports are actually declining. The shortfall between expected imports and actual imports is 0.9 million barrels per day for 2006 and 1.7 million barrels per day for 2007 (using August YTD data for 2007). If imports continue to decline in 2007, the shortfall could be even greater by the end of the year. Data for Figure 6 is from here.

5. What does the trend in Total Product Supplied look like?

Total product supplied represents the combination of US production and imports, adjusted for inventory changes. It can be thought of as all of the gasoline, diesel, and other fuels shown in Figure 1. The trend in Total Product Supplied was about 1.6% per year prior to 2005, but actual production in 2006 and 2007 has dropped below this trend line.

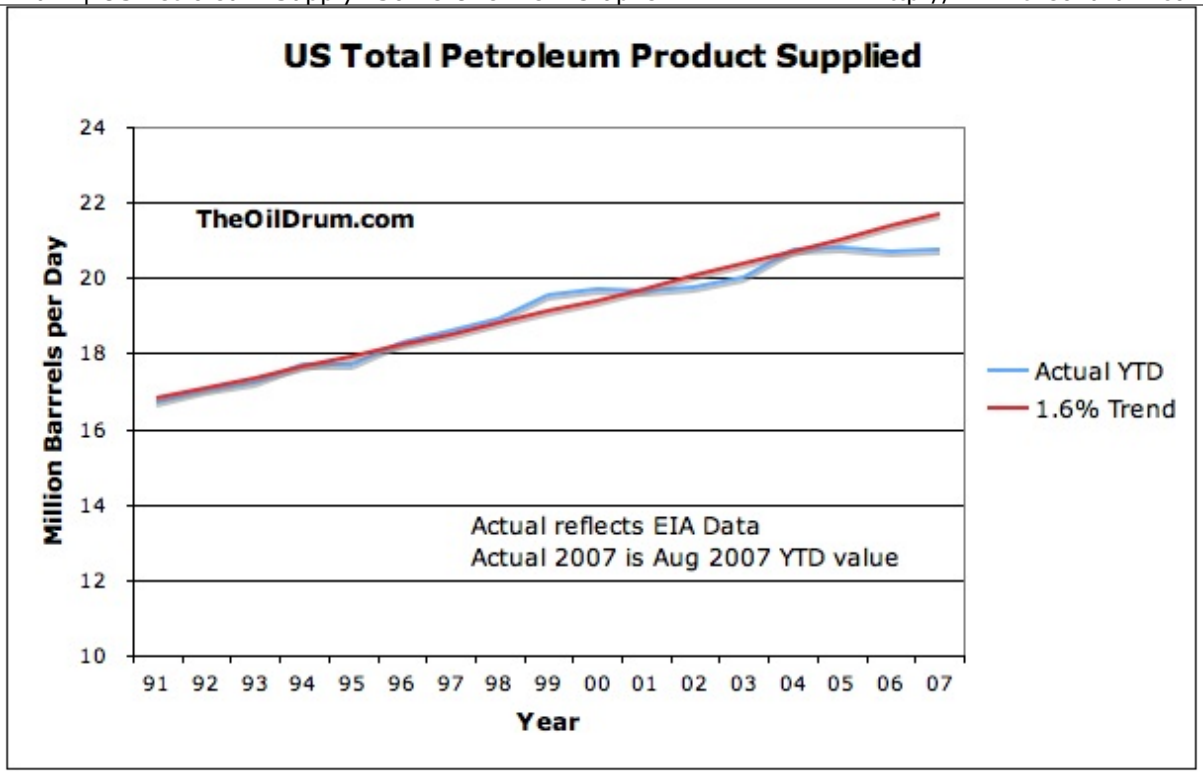

Figure 7

Data for Figure 7 is from here.

6. Gasoline is the biggest component of Total Product Supplied. What does its production trend look like?

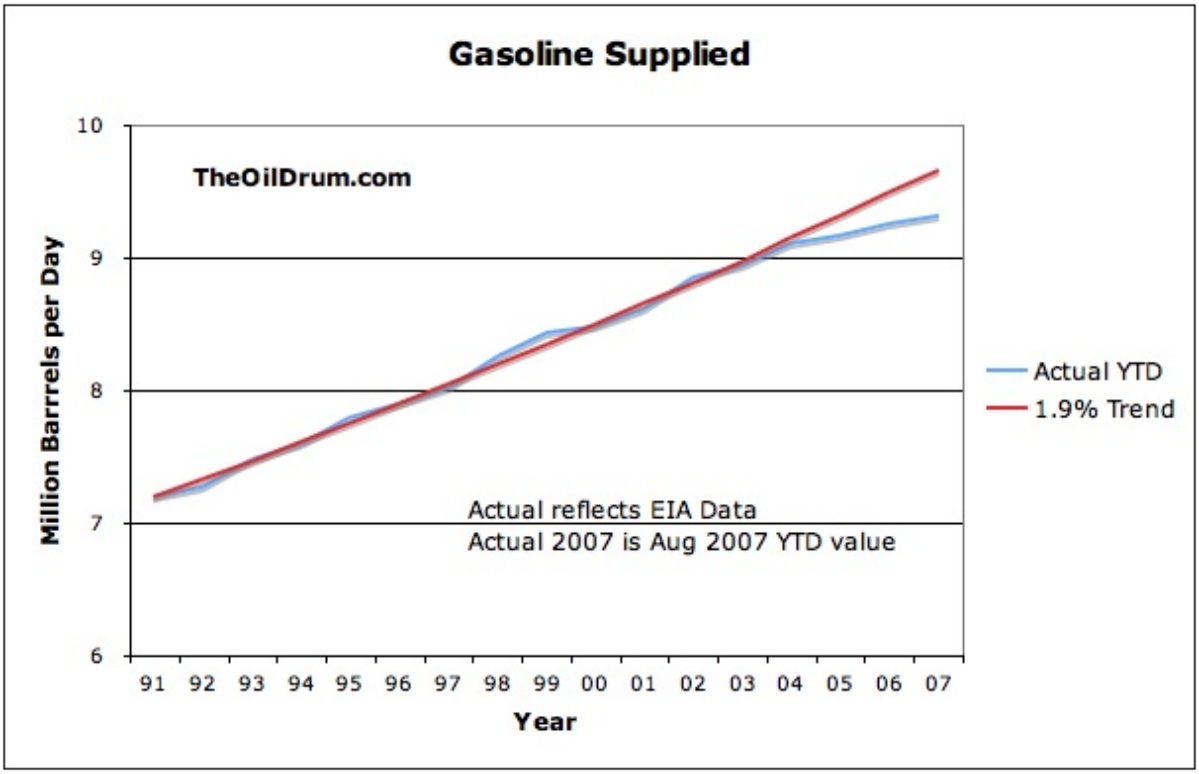

Figure 8

Until recently, gasoline production was increasing at 1.9% per year. This is higher than the

increase of 1.6% per year increase in Total Product Supplied. Gasoline production started dropping below the 1.9% trend line in 2005. The amount of the shortfall between the trend line in the actual is
approximately:

2005 150,000 barrels per day
2006 230,000 barrels per day
2007 (through August) 350,000 barrels per day

Data for Figure 8 is from here.

7. If gasoline has been increasing faster than Total Product Supplied, I would expect that products other than gasoline have been increasing more slowly than Total Product Supplied. Is this the case?

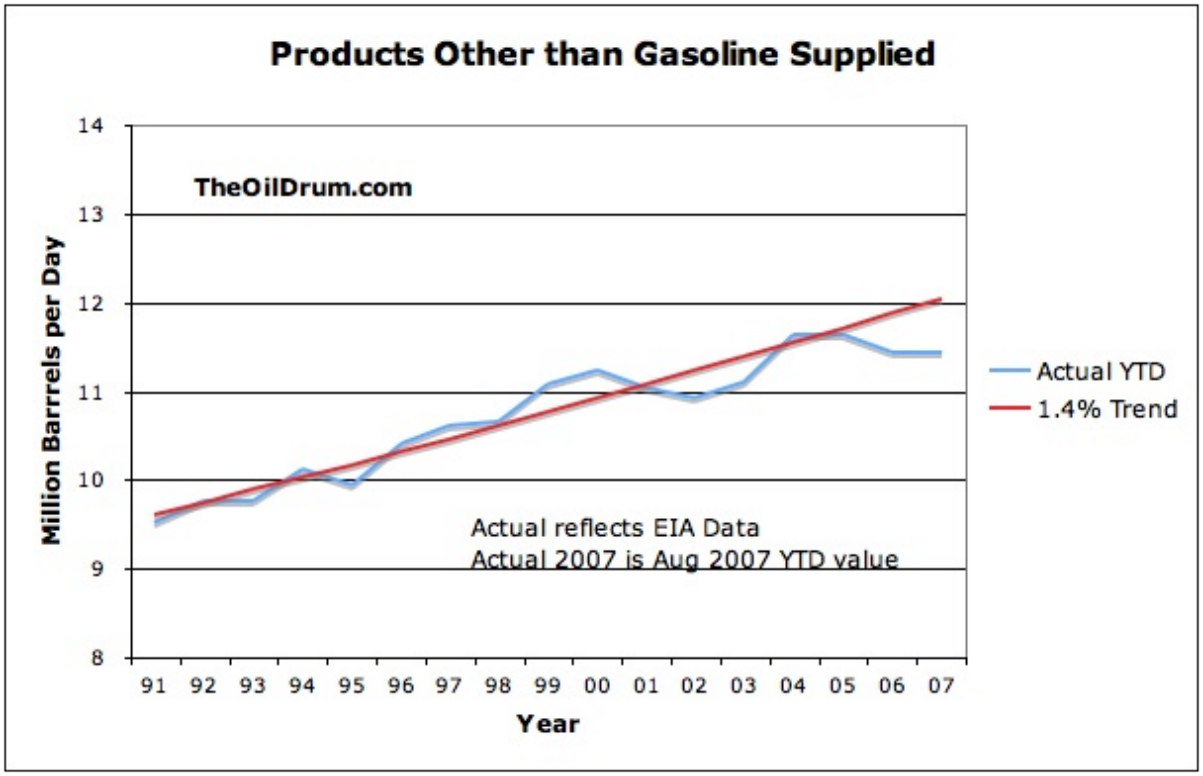

Figure 9

Non-gasoline products supplied have only been growing by about 1.4% per year. The amount supplied in any year seems to be more variable than the gasoline supply. In 2006 and 2007, production of non-gasoline items seems to have dropped off to a greater extent than gasoline production. The amount of the drop below the trend line is 450,000 barrels per day in 2006, and 620,000 barrels per day in 2007 (using year to date data).

Actual data for Figure 9 is obtained by subtracting "actual" data for Figure 8 from "actual" data for Figure 7.

8. How about refinery capacity and use? What kinds of trends do you see there?

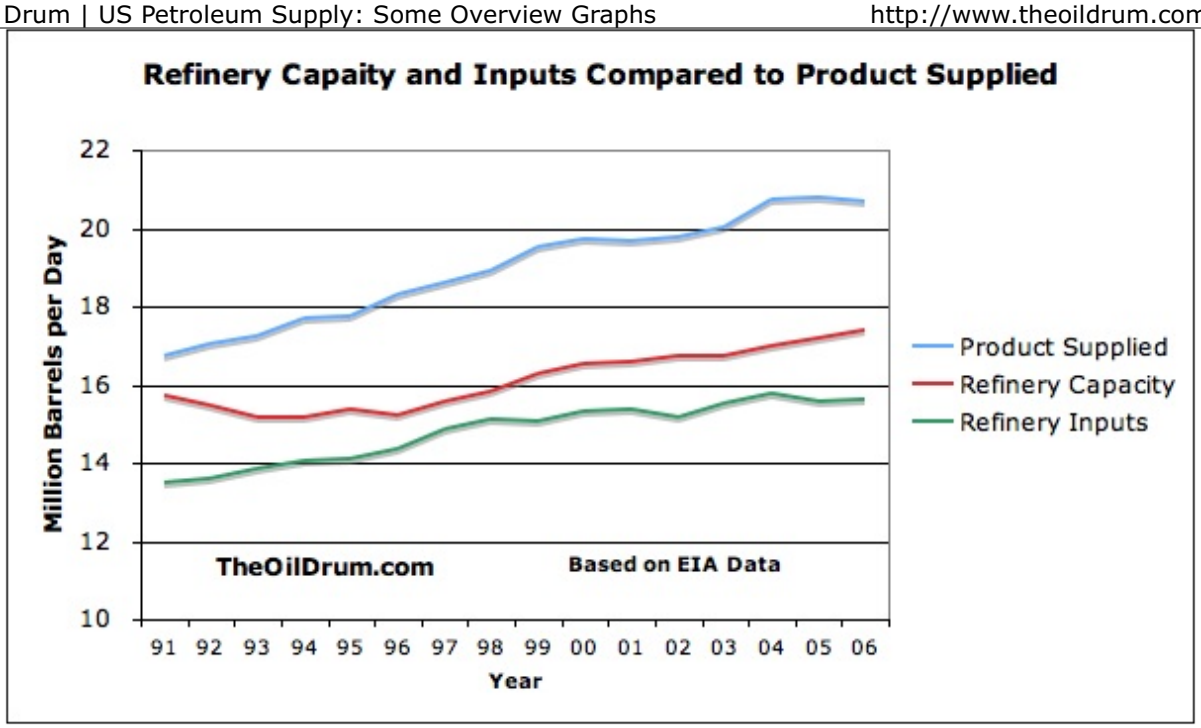

Figure 10

Figure 10 shows that refinery capacity has been growing less rapidly than total product supplied, especially in the early 1990s. Refinery use was very close to capacity in the 1997 and 1998 period, but has been dropping back in recent years. I have not tried to fit trend lines to the data, since I am not certain this type of analysis makes sense. Refinery capacity and use is from here.

9. How about inventories?

It seems to me that far too much emphasis is placed on inventories. Robert Rapier has observed that if a refinery sees a problem with supply, it is likely to cut back production, before it allows inventories to drop too low, because the company cannot stop its refinery quickly if supply proves to be inadequate. Thus, a problem with inadequate supply seems more likely to be apparent through high price, lower refinery use, and lower final product, than through declining inventories.

I sometimes think the emphasis on inventories is a little like the Bush administration's emphasis on terrorism. It keeps analysts busy, thinking about something which is not terribly important (except if the pipelines get so empty that there are actual outages). If analysts were not thinking about inventories, they might look more closely at more important information, like what is happening to imports, and what longer-term trends are like.

10. Where does this analysis suggest that future US petroleum product supply is headed?

If US produced petroleum products continue to decline, as indicated in Figure 3, and imports continue to decline as in Figure 6, it would seem like Total Product Supplied would begin to decline as well.