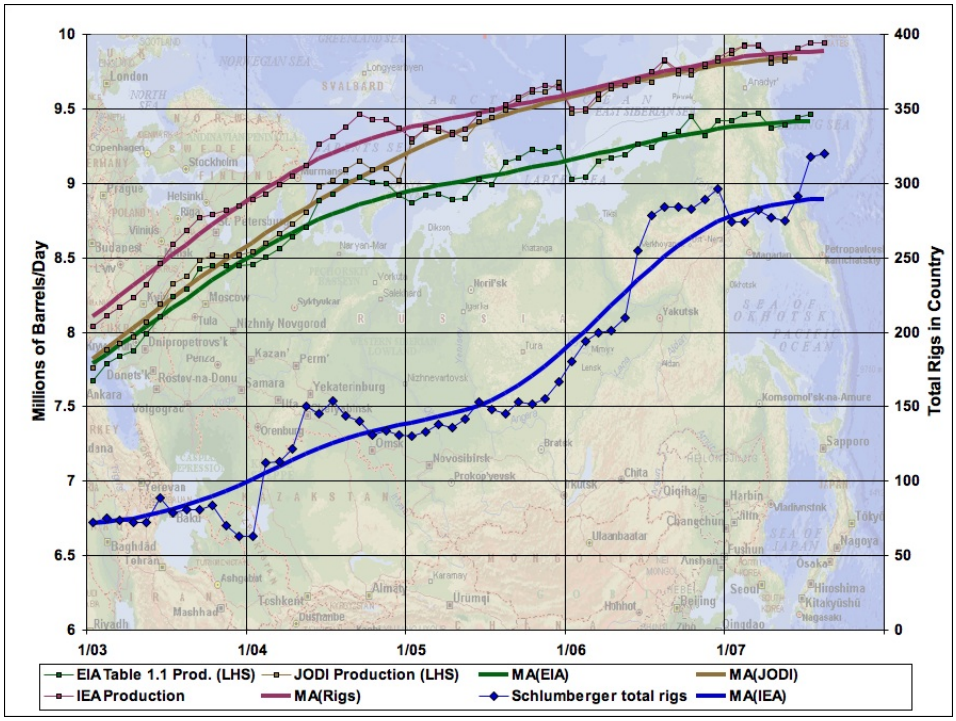
The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Are We Missing Russian Megaprojects?

Posted by Stuart Staniford on December 24, 2007 - 2:00pm
Topic: Supply/Production
Tags: megaprojects, peak oil, russia [list all tags]



Monthly Russian oil production according to three data sources, Jan 2003 - Aug 2007 (left scale), and oil and gas rigs in country (right scale). Sources: EIA Table 1.1c, IEA Table 3, and JODI. Solid smooth lines are 13 month centered moving averages, recursed once (note last 13 months rely on an incomplete window). Production graph is not zero-scaled. Rig data are from Schlumberger data and include both oil and gas rigs.

This piece looks at the question of whether the Russian oil production increases of recent years might have been due in part to projects that should have been listed as megaprojects, but went missing due to lack of transparency on the part of Russian companies (or at least lack of transparency to English speaking readers). The tentative answer to the question is "No."

Instead, it appears that Russian production increases are in large part due to revival of mature Soviet era fields as the Russian economy recovered and as now-private Russian companies applied Western techniques of oil production (and Western contractors) to their fields.

Firstly, let's review the main facts of the situation. A graph of Russian oil production is shown above at the start of this piece. From the beginning of 2003 to now, Russian production increased by about 2mbd. This is the later stages of a longer increase, commonly called the "Russian Revival", that began in the late 1990s. By contrast there are only about 630kbd of currently known Russian megaprojects in 2003-2007. Here they are, tabulated

Field	Company	First oil	Peak date	Peak flow (kbd)
Salym group	Shell/Sibir	6/2003	2009	160
South Priobskoye	Gazprom Neft	2003	2005	220
Sakhalin-I	ExxonMobil	10/2005	3/2006	250
Total				**630**

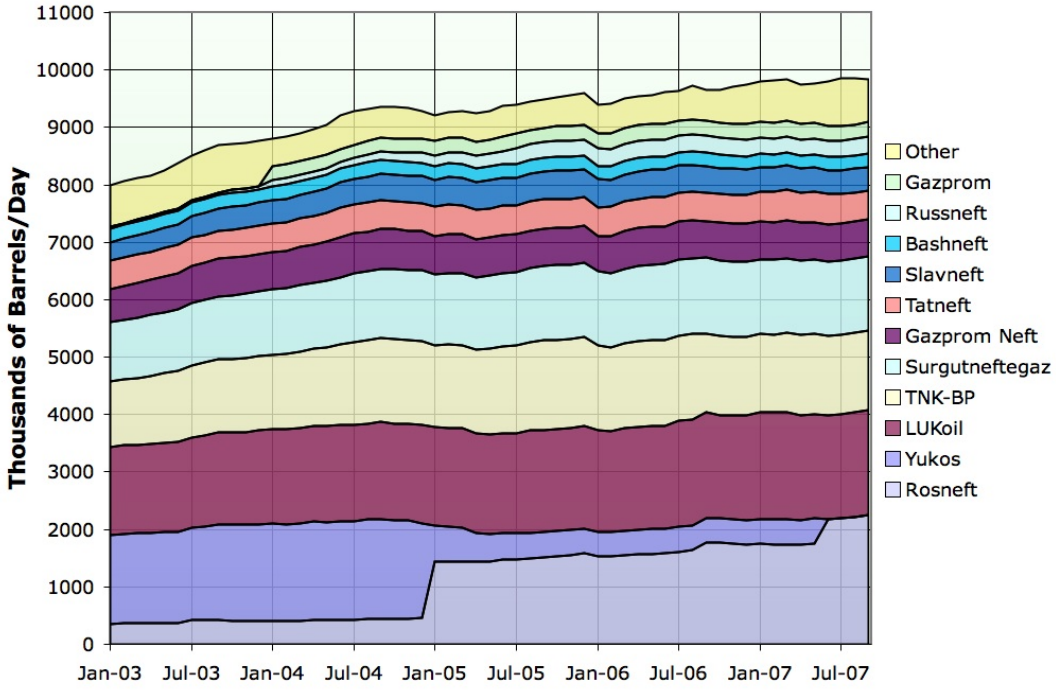
That 630kbd slightly overstates the amount of the new capacity available so far, since at least one of these projects will not hit peak for several more years. If you thought the 8mbd (or so) of Jan 2003 production would have had a base production decline of something like 5% a year, then you'd expect to have lost about 1.5mbd of the 8mbd by now due to declines. That would imply the 630kbd of megaprojects would have been nowhere near enough to hold the country's production steady, let alone increase it by 2mbd.

Two kinds of explanation seem possible:

1. Production at existing fields actually increased, rather than declining
2. Megaprojects have been missed.

In the course of the last couple of weeks, I've been ploughing through annual reports for Russian oil companies (in order to update the Wikipedia megaprojects listing). So far, I've only found a few small future projects that weren't already known, so I believe option 1 is almost certainly most of what is going on.

For context, let's take a look at Russian production by company:

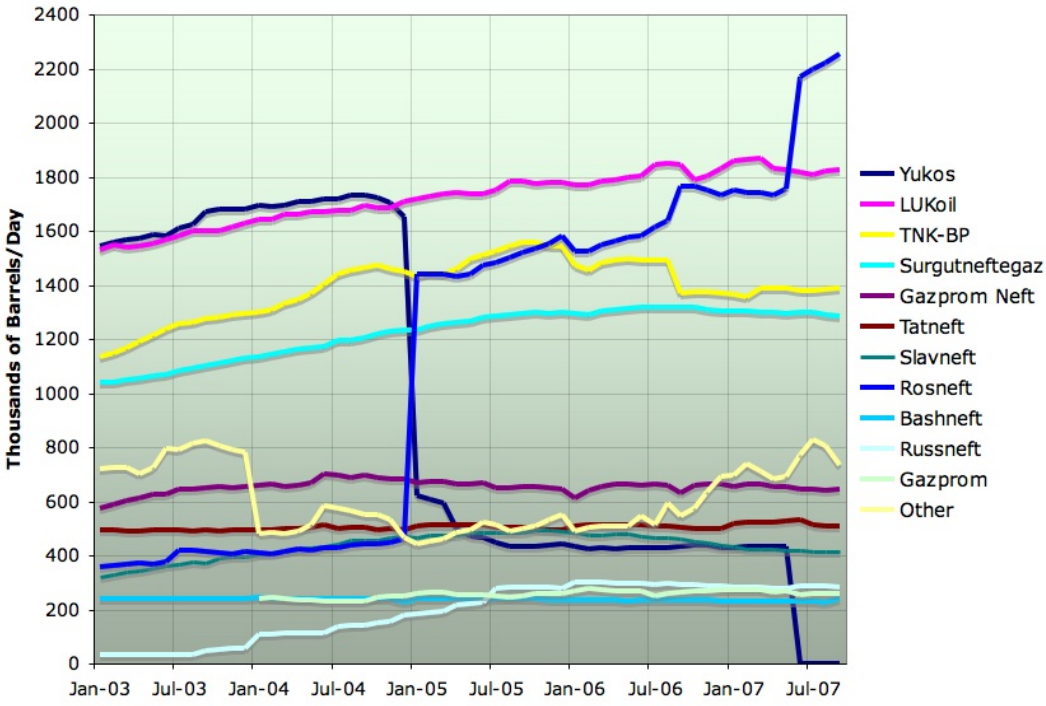


Monthly Russian oil production by company, Jan 2003-Sep 2007. Source: Rembrandt Koppelaar. Click to enlarge.

Note that the assets of Yukos were seized by the Russian government under controversial

circumstances in late 2004, and sold to Rosneft. I've placed the two companies adjacent so their combined production streams can be viewed as the same collection of reserves over time.

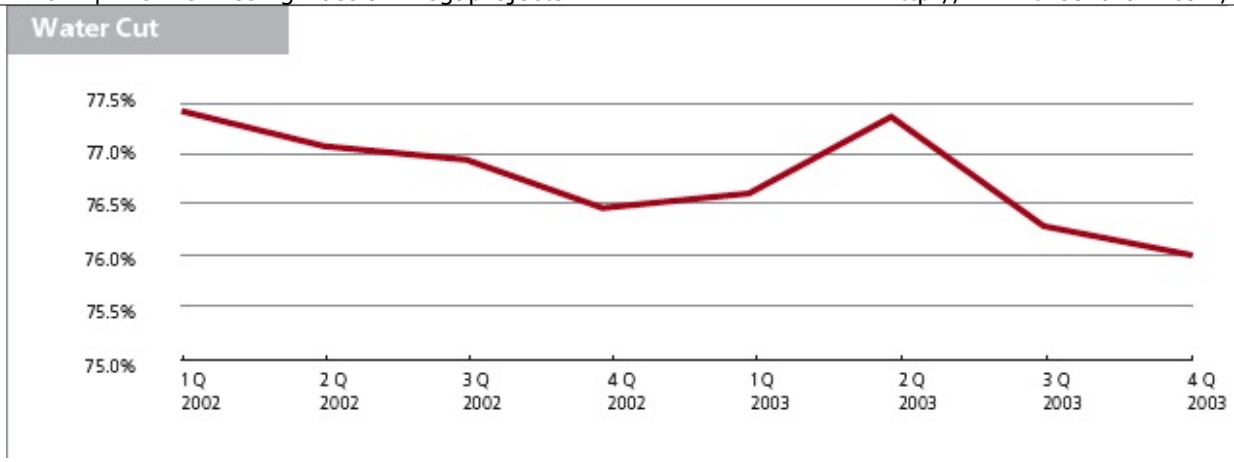
Here's the same data, only not stacked so that it's easier to see the trends in individual companies:



Monthly oil production of top Russian companies, Jan 2003-Sep 2007. Source: Rembrandt Koppelaar. Click to enlarge.

I'm going to focus most of my discussion on Lukoil, which is the second largest Russian company by production. I believe Lukoil is fairly typical and illustrates the general issues well. It is also particularly conveniently documented; it's been a public company during the entire period, so there are annual reports for every year (in English as well as Russian), and they are informative. There have been no documented Lukoil megaprojects during the 2003-2007 period, but nonetheless production has increased by about 250kbd (15%), instead of decreasing (we'll see that there have been new fields bought on by Lukoil, but they are probably all too small to count as megaprojects).

This graph comes from the Lukoil annual report for 2003, and I think serves as a good orientation to the situation:



Lukoil average water cut, Q1 2002-Q4 2003. Source: Lukoil annual report for 2003. Click to enlarge. ***NB:*** *graph is not zero-scaled and involves a very small range of water-cuts.*

The water cut is the fraction of liquid volume coming up out of a well, or collection of wells, that is water, rather than oil. Generally, a new field will produce at 0% water-cut, and very old fields (where almost all the oil has already been produced) will operate at water cuts over 90%. What this graph says is that Lukoil's production has a fairly high water-cut, which is indicative of a mature production base in which much of the producing reservoirs are now filled with water, and smaller amounts of remaining oil are moving. However, Lukoil is improving the water cut slightly from year to year.

It's worth reviewing some history here. In the Soviet era, fields were produced in a fairly brute-force manner with no nuances. To quote John Grace's outstanding book Russian Oil Supply,

> On the basis of [maps from the Ministry of Geology], and the results of tests run on the the delineation wells, the producing association designed the first-round of drilling targetd at the largest reservoir in the field. Crews built drilling pads in the West Siberian swamp. From these higher and dryer locations, several dozen wells were drilled in all directions. Drilling multiple wells directionally from centralized pads minimized the costs and logistic difficulty of operating in a wetland.
>
> The intersection of these wells with the reservoir formed a geometric grid. In the first round of drilling, the grid was fairly loose. Pattern drilling (locally called the 'Siberian box') carried the advantage of easy planning, but did not respect the geologic heterogeneity of reservoirs. Mixed in the grid of producing wells were water injectors. Under Soviet practice, water flood usually commenced at the beginning of field development and continued to the field's abandonment...
>
> Engineers put pumps on every well they could. Nonetheless, they quickly met the limit of improvements that could be won with sucker-rod pumps. Without the option to upgrade to ESPs, sucker-rod pumps would only soften the wells' decline rates. Moreover, installing pumps meant incurring the cost and management requirements of maintaining them...
>
> The second line of attack was infill drilling. As the bump in output from mechanization declined, a second geometric grid of wells was planned for the spaces in between the first grid in a reservoir. In theory, infill wells increase the total volume of oil recovered from a reservoir. When drilled in the West or the USSR, however, most infill drilling is for production rate acceleration - not increased recovery. When drilled on a pattern,

> particularly with the reservoir under water flood, infill drilling can actually reduce the amount of oil ultimately recovered. As meeting the current quarter's planned production goal overhwelmed all other considerations, infill drilling became the brute-force instrument of choice.

So you should picture Lukoil's main assets as a set of large West Siberian fields that were developed in this manner during the Soviet era, and peaked and started to decline while under a poorly designed and monitored waterflood. Here is Lukoil's oil production by region:

Lukoil oil production by region in 2006. Source: Lukoil annual report for 2006. Click to enlarge.

In the early years of the Russian Revival, production increased just by fixing infrastructure that had broken down and not been repaired during the collapse of the Russian economy in the early nineties when oil companies were not getting paid, not making money, and not able to buy parts. Grace again:

> The idle well 'crisis', as it became known, began immediately after the massive 1986-88 recovery campaing wilted. State budgets for field operations dove in every year thereafter, falling by half as of 1992. Well repair took the hardest hit. By 1991, the number of wells going off line exceeded the number of new wells drilled. In 1992, the number of producing wells in the newly independent Russian Federation was lower than during its last year as part of the USSR.
>
> As budgets shrank, producers deferred maintenance; the backlog of wells awaiting repairs quickly and inexorably accumulated. Whereas idle wells ran at around 3,000 during the eighties, by 1993 there were 29,101. This cost the nation 1.6 million b/d of production, or 23 percent of national output. A seemingly incredible number of wells remained offline for want of small repairs or lack of routine attention.

The situation began to turn around in the late 1990s. First Russia defaulted on its debts, and the rouble was devalued, which dramatically increased the profitability of Russian oil companies (since their costs were mainly in roubles, but they could sell oil in dollars). Then oil prices started

to go up.

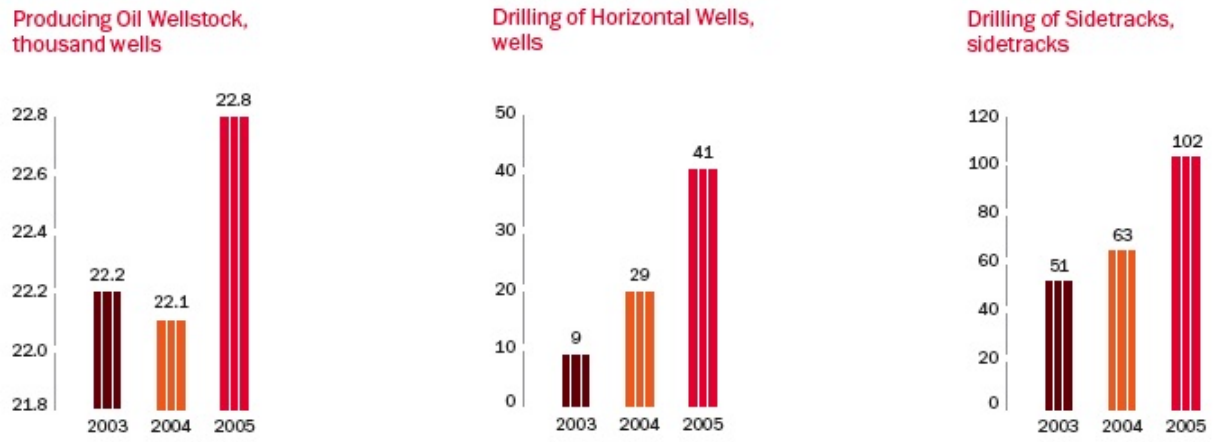
> By the beginning of 2000, the surge in export prices and a significant increase in domestic prices substantially raised the volume of income heading back to producers. They, in turn, began to plough back into the fields much of the net income received at the wellhead (over $9/bbl in 2000). The number of idle wells fell, and for the first time in a decade, the number of new wells rose. Output went up a bracing 6%.
>
> The same trend continued through 2002. The increases not only fueled drilling in general, they supported the initial development of a a **handful** of major new fields.

(Emphasis added). By the time we start tracking megaprojects in 2003, however, most basic "fix the wells" work that was worth doing was done. What has been going on in recent years has a lot more to do with the application of a variety of western technologies to the old Soviet fields. For example, here's Lukoil's 2006 annual report:

> By the end of 2006 a total of 196 fields were included in a multi level system of field development monitoring by use of geological hydrodynamic models. Modelling of 47 fields was carried out in the course of the year. Geological hydrodynamic models are helpful in selecting optimal technical solutions for field development, matching solutions to specific geology and structure of reserves. Modelling raises the oil recovery ratio and lowers field development costs. The Company makes intensive use of models for drilling over fields and for application of enhanced recovery techniques. LUKOIL plans to increase the number of geological hydrodynamic field models to 261 by 2009, so that 75% of Company fields will have such models (compared with 55% of fields at present). Geological hydro dynamic modelling will be extended to all fields in such regions as Western Siberia, Timan Pechora and Kaliningrad Region.

Rather than the oil Soviet system of just drilling a geometric grid into the reservoir, Lukoil is now striving to build actual geophysical models of their reservoirs, so they can optimize the placement of wells into the remaining oil, and study the likely flow of the oil in the face of the various faults, fractures, and variations in reservoir permeability that pervade oil reservoirs.

Other techniques include the application of horizontal wells, and horizontal sidetracks (where a vertical or mostly vertical well which is now producing too much water is redrilled horizontally into the remaining oil layer to lower the water cut and increase oil production.) This next graph shows the trends in these activities:



Lukoil use of horizontal drilling and sidetracks, 2003-2005. Source: Lukoil annual report for 2005. Click to enlarge.

As you can see, there are sharp increases in the use of sidetracks and horizontal wells, so we might imagine that the water-cut has continued to fall from the late 2003 value of 76%.

Another technique of importance is hydrofracturing ("fraccing" - putting the well under enough pressure to cause fractures in the reservoir rock, which can enhance production in certain situations). From the 2004 report:

> A large part of LUKOIL Group's fields are in the last stages of exploitation, marked by increase of the water cut and falling flow rate of oil wells. This deterioration of reserve structure calls for application of scientific and production know-how, which can find, test and implement the most suitable technologies for oil extraction at declining fields.
>
> The Company carried out 4,909 enhanced oil recovery (EOR) operations in 2004. Additional production thanks to EOR was 20.8 million tonnes last year, which is 5% more than in 2003.
>
> Most of the EOR oil (13.2 million tonnes or 63.5% of the total) was extracted using physical EOR, and 92.6% of oil produced by physical EOR was obtained by hydrofracturing techniques.

20.8 million tonnes/year is about 400 kbd.

Finally, a brief discussion of new fields brought on by Lukoil. The only new field during 2003-2006 for which production figures are mentioned is the Kratsovskoye platform in the Baltic sea. This came on in 2004, and

- was mentioned prominently in the initial letter to shareholders in the 2004 annual report
- has merited at least a paragraph and production statistics in every annual report 2003-2006,
- had its picture fill most of the front cover of the 2004 report.

so apparently Lukoil considers it a significant project.

Lukoil annual report cover for 2004, featuring the Kratsovskoye platform in the Baltic sea which started up production in that year. Source: Lukoil annual report for 2004. Click to enlarge.

However, by 2006, production at Kratsovskoye was still only 861,000 tonnes, which is about 17,200 barrels/day. That was a 55% increase over 2005, but is below the current threshold to be considered a megaproject. Lukoil's crown-jewel annual-report-cover offshore project is tiny by global standards. And also tiny compared to the cumulative effect of 4000+ EOR operations on wells in giant old fields.

A variety of other new fields are mentioned by name in the reports, but have no production figures, and Google produces no information about them. They are probably small. For background, Grace reports that 400 small fields have been found in Western Siberia alone, and as of late 2004, only 160 of them were on line (the rest being too small or too far from infrastructure to be worth it. Collectively, the 400 small fields only hold 15% of the basin's remaining reserves. It's likely Lukoil is bringing some such fields on stream. For example, in 2005, of 9 new fields brought on line, the largest, East Sarutayuskoye and Perevoznoye had 3P reserves of 0.624 gb. So probably 2P reserves might be 0.15gb each. Given the slow rate at which Russian projects generally progress, they probably are not of megaproject size.

Similarly, of 11 new fields brought on in Russia in 2006, the only ones large enough to get mention were as follows. First in Western Siberia:

> Major new commissionings included the West Pokamasovskoye and West Kotukhtinskoye fields with proved, probable and possible oil reserves in excess of 280 million barrels.

so that's probably less than 0.1gb each of 2P reserves.

And in the Timan-Pechora region:

> Three fields were commissioned in 2006: West Lekkeyaginskoye (commissioned by Naryanmarneftegaz, the joint venture between LUKOIL and ConocoPhillips), Verkhnegrubeshorskoye and South Sedmesskoye, with overall proved, probable and possible reserves of about 230 million barrels of oil.

Three fields with 3P reserves of 0.23gb between them is very small fish to fry indeed.

So in summary, I don't think we are missing any megaprojects of any great consequence in recent years from Lukoil. Although my research is incomplete, this seems to be the pattern at other companies also. Production increases have been coming from better management of the very large but significantly depleted Soviet-era fields, along with commissioning of very small new fields. Only a handful of megaprojects have occurred.

Other selected Oil Drum pieces on Russia:

- Stuart Staniford, When Will Russia (and the World) Decline?
- Dave Cohen, Uncertainties About Russian Reserves and Future Production