The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

# Uncertainties About Russian Reserves and Future Production

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There are few subjects regarding peak oil as important as the uncertainties around what Russia's reserves are and the mysteries of what their future production will be. J. Robinson West, chairman of PFC Energy., says in The future of Russian energy

> The world needs every barrel of Russian oil. With growing Chinese and Indian demand and the insatiable appetite of the United States, markets will be tight and even more reliant on the Middle East. Given today's high oil prices, Russian companies and the Russian government believe that they can fund a good part of new developments and even infrastructure projects themselves. Additionally, Chinese and Indian companies, with the strong backing of their governments, are ready to do business with Russian companies and the Russian government. Their investment criteria are more in line with the approach favored by their Russian hosts. Skills as well as money will be crucial, however, and they bring few. If as a result Russia cannot sustain its current oil production level, this will negatively impact world oil markets.
>
> A faltering Russian oil sector would be a disaster for the world economy as well as for Russia itself. President Putin must recognize that he needs a petroleum sector with well-managed and well-capitalized oil, gas and pipelines. He is well within his rights to want the state to dominate it, but it must be managed efficiently. The Yukos affair, as well as infighting in the Kremlin and a lack of transparency and predictability, indicates that he is going in the opposite direction and could hurt Russia's interests as well as the world's if he does not correct his course.

This post takes *no official position* regarding Russian reserves and predictions about their future production. Lately, there has been controvery regarding some statements made by westexas who, using some data modelling being worked up by Khebab, is predicting a rapid decline in Russian production in a pretty short timeframe. Naturally, if this *does* occur, the world could be in for a very rough ride. Here, I will present the best data and estimates I can find outside the world of Hubbert Linearizations to give TOD readers a chance to consider the uncertainties surrounding Russia. I should also mention that HO did a post It would be nice, but... back in October covering some of these issues but not in this kind of detail.

## Estimates of Russian Reserves

There is a large range of estimates of current Russian reserves. I'll take my initial data from an excellent paper Can Russian Oil Growth Be Sustained? by Erik Janssen of Clingendael

International Energy Program and add some additional sources to his. Shortly, I'll add in what ASPO has to say as well. Here are the various reserve estimates in billion barrels (Gb) from that document.

| | |
|---|---|
| Oil & Gas Journal | 60 (proven SPE) |
| John Grace* | 68 (proven SPE) |
| World Oil | 69 (proven SPE) |
| British Petroleum | 72 (proven SPE) |
| 10 largest Russian Oil Companies | 82 (ABC1) |
| E Khartukov (Russian Oil Expert) | 110 (ABC1) |
| United States Geological Survey | 116 (proven SPE) |
| Ray Leonard (MOL) | 119 (ABC1) |
| Wood Mackenzie | 120 (proven SPE) |
| IHS Energy | 120 (ABC1) |
| M. Khodorkovsky (former Yugos) | 150 (he's in jail) |
| Brunswick UBS (consultants) | 180 (proven, P50, P5 SPE) |
| DeGolyer & MacNaughton (audit) | 150 to 200 (proven SPE?) |

* This estimate was given to me by Stuart (personal communication) from Grace's book Russian Oil Supply - Performance and Prospects, which I have not read.

As you can see, there is a *high camp* and a *low camp* which we can arbitrarily split down the middle at about 100 Gb. The Society of Petroleum Engineers (SPE) method of accounting reserves, which is less strict than the SEC definition,

> ...classifies reserves into three categories: proved, probable and possible. For the oil industry, the proven category is the most important and is used to inform investment decisions by producers and investors. The SPE defines proven reserves as those quantities of oil, which by analysis of geological and engineering data, can be estimated with reasonable certainty to be *commercially* recoverable, from a given data forward, from know reservoirs and under current economic conditions, operating methods and government regulations. [ie. there is a 90% certainty that quantities recovered will meet or exceed the estimate]

On the other hand, the bizarre ABCD system of reserves estimation was developed under the old Soviet Union and crucially *does not* take commercial factors into consideration. The Russians consider ABC1 (there is a C2, D1 and D2) to be equivalent to an SPE proven reserves estimate. This is disputed by analysts and is the reason why the Russians are becoming more open to outside audits of their reserve numbers. Importantly, there is disagreement about the C1 category. As Janssen reports, these are geologically evaluated reserves for which engineering data show partial recovery. The Russians want to count 75% of the C1 reserves as proven but even the liberal IEA "argues that only 30% of C1 reserves can be regarded as proven under the SPE system".

What does ASPO have to do say about all this? As you can imagine, they are *low end* people (under 100 Gb) but they have revised their numbers in recent years. In December of 2004, Colin Campbell reported on The Status of Oil and Gas Depletion in Russia in which he presents this overview.

| RUSSIA | | *Regular Oil* |
|---|---|---|
| ***Rates Mb/d*** | | |
| Consumption | 2003 | 2.5 |
| per person b/a | | 6.0 |
| Production | 2003 | 8.26 |
| | Forecast 2010 | 10 |
| | Forecast 2020 | 5.5 |
| Discovery 5-yr average Gb | | 0.5 |
| ***Amounts Gb*** | | |
| Past Production | | 127 |
| Reported *Proved Reserves** | | 60 |
| Future Production - total | | 83 |
| From Known Fields | | 60 |
| From New Fields | | 23 |
| Past and Future Production | | 210 |
| Current Depletion Rate | | 3.5% |
| Depletion Midpoint Date | | 1993 |
| Peak Discovery Date | | 1960 |
| Peak Production Date | | 1987 |

*Oil & Gas Journal

There are many observations to be seen in this table. Note also the production estimate for 2010--but we will talk about daily production numbers below. First, the cumulative production to date (presumably through 2002?) is 127 Gb for Russia. Second, the estimated reserves duplicate the OGJ results but add from future production an additional 23 Gb (excluding Polar oil and NGLS) for a URR total of 210 Gb for Russia. So in 2003, if we add in Russia's production from 2003 to 2005 as reported by the EIA, we get a cumulative production of approximately 137 Gb up to the present time. This is reasonably close to the 142 Gb estimate that westexas is using based on Khebab's data. We could call it a wash and say 140 Gb through 2005. However, I must add that Campbell also says this.

> We add to this [the 60 Gb estimate in the chart above] 30 Gb of Arctic oil, together with substantial deposits of heavy oil in Eastern Siberia and NGL from gasfields, which are here excluded from Regular Oil by definition. The total therefore approaches the 100-120 Gb, as reported by Yukos. The jury is still out but we think that this assessment is reasonable in terms of order of magnitude.

The last ASPO newsletter makes an upward revision of the estimated Russian URR.

| ESTIMATED PRODUCTION TO 2100 | | | | Annual Rate - Regular Oil | | | | | | Gb | End 2005 Peak |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Amount | | | Gb | | | | | | | | |
| Regular Oil | | | | Mb/d | 2005 | 2010 | 2015 | 2020 | 2050 | Total | Date |
| Past | Future | | Total | US-48 | 3.6 | 2.8 | 2.2 | 1.7 | 0.4 | 200 | 1971 |
| Known Fields | | New | | Europe | 5.2 | 3.6 | 2.5 | 1.7 | 0.2 | 75 | 2000 |
| 968 | 759 | 123 | 1850 | Russia | 9.2 | 8.4 | 6.8 | 5.5 | 1.5 | 220 | 1987 |
| | 882 | | | ME Gulf | 20 | 20 | 20 | 20 | 11 | 680 | 1974 |
| All Liquids | | | | Other | 29 | 26 | 22 | 18 | 7 | 675 | 2005 |
| 1074 | 1326 | | 2400 | **World** | **67** | **61** | **54** | **47** | **21** | **1850** | 2005 |
| 2004 Base Scenario | | | | Annual Rate - Other | | | | | | | |
| M.East producing at capacity | | | | Heavy etc. | 2.3 | 3 | 4 | 4 | 4 | 151 | 2021 |
| (anomalous reporting corrected) | | | | Deepwater | 3.6 | 12 | 11 | 6 | 4 | 69 | 2011 |
| *Regular Oil* excludes oil from | | | | Polar | 0.9 | 1 | 1 | 2 | 0 | 52 | 2030 |
| coal, shale, bitumen, heavy, | | | | Gas Liquid | 6.9 | 9 | 9 | 10 | 8 | 276 | 2035 |
| deepwater, polar & gasfield NGL | | | | Rounding | | | | | -2 | 2 | |
| Revised 25/12/2005 | | | | **ALL** | **80** | **86** | **80** | **70** | **35** | **2400** | 2010 |

So, we see that the final URR is revised upward to 220 Gb which still puts ASPO as a *low end* estimator but still very close to what the Russian NOC's (combined) are estimating. Now, if we assume a cumulative production of 140 Gb with an estimated URR of 220 Gb, that puts Russia at 64% of depletion as we enter 2006. Finally, I will mention a reputable *high end* source, Ray Leonard, now with MOL (Hungary) but formerly VP for exploration at Yukos. From his ASPO Lisbon presentation (ppt) in 2005, he notes the following

> Two sets of calculations: Russian C1(proven) accurately measures reserves without economic filter while SPE and SEC measure economically recoverable reserves and actual developed reserves
>
> C1 Russian reserves are 119 billion barrels
>
> As development of past five years has taken place, gap between SPE and SEC numbers and C1 is narrowing
>
> Proven reserves are concentrated in West Siberia with about 70% in difficult to produce reservoirs

So, the takeaway message is that Russian reserves are large, the gap between SPE and Russian reserve accounting systems is growing smaller but also, most (over 80 Gb) Russian ABC1 reserves are in the mature and evermore difficult to develop regions of Western Siberia and the Volga-Urals basin (see Leonard's slide 3).

## Questions About Future Russian Production

First, let's look at a map of the main oil producing regions of Russia from Russian Oil –Current Status and Outlook by Dr.Theodor Felder of IHS Energy (thanks to HO for this link).

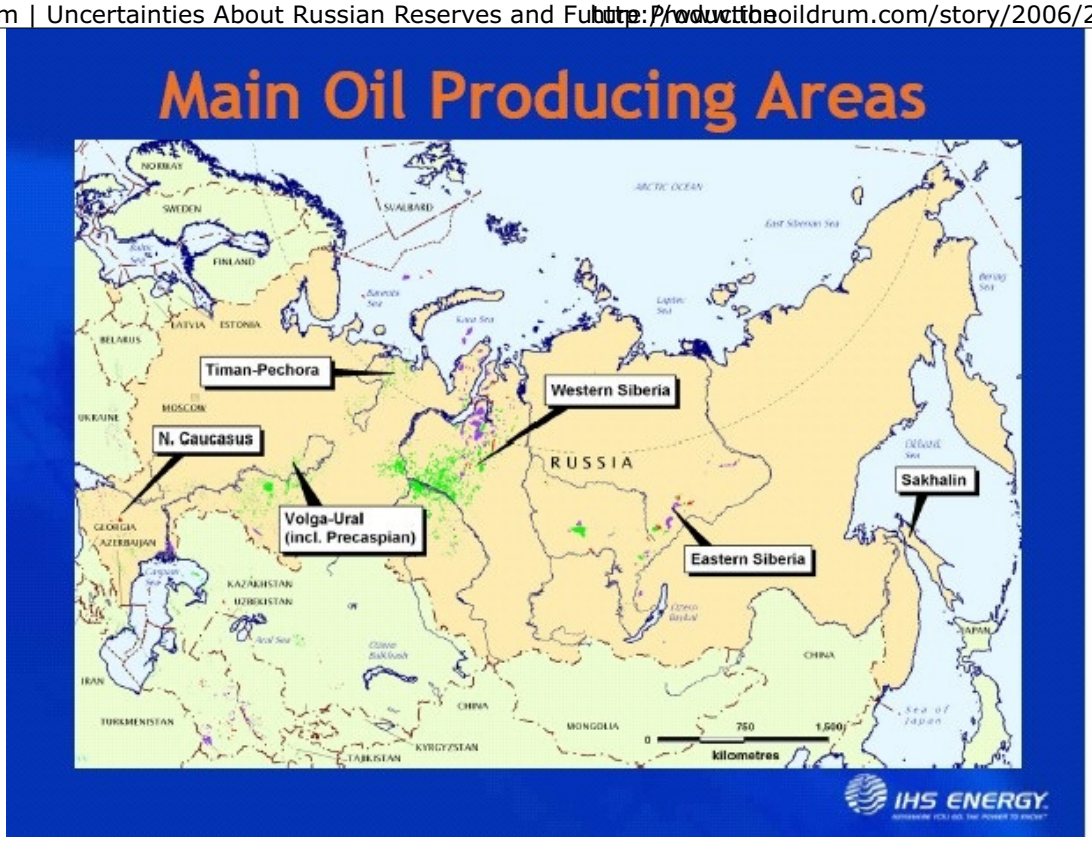
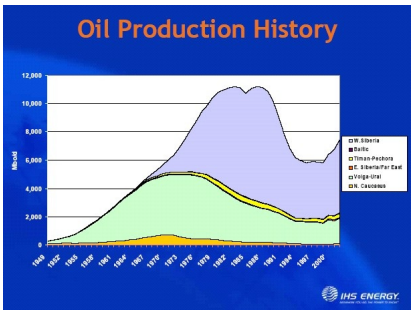
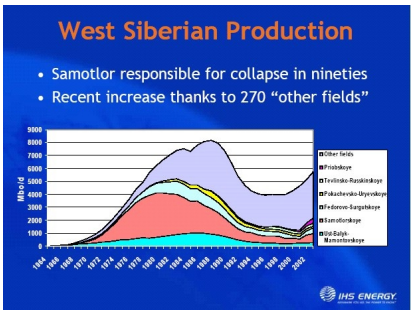



*Figure 1 - click to enlarge*

These next two figures show the recent Russian production history as a whole (*Figure 2*) and particularly in the Western Siberian basin (*Figure 3*).




*Figures 2 & 3 - click to enlarge*

Before we talk about specific regions and prospects, let's show a list of predictions of future production in the next 7 years or so. There is a lot of variance but not as much as you might expect.

**Future Russian Production Predictions**

| | |
|---|---|
| Colin Campbell (2004) | 10/mbpd in 2010 & declining thereafter |
| ASPO February 2006 | 8.4/mbpd in 2010 & declining thereafter |
| PFC Energy** | 10/mbpd in 2008 (conditional) |
| IEA | 10.4/mbpd in 2010 & increasing thereafter |
| Ray Leonard (MOL) | 9.3/mbpd in 2010 & declining thereafter |
| DeGolyer & MacNaughton* | 10.0/mbpd by 2012 & maintained thereafter |

* From Western Siberia only! Taken from What's Russia Really Sitting On?.

I should also mention that DeGolyer & MacNaughton do independent audits (pdf) for TNK-BP (see below).

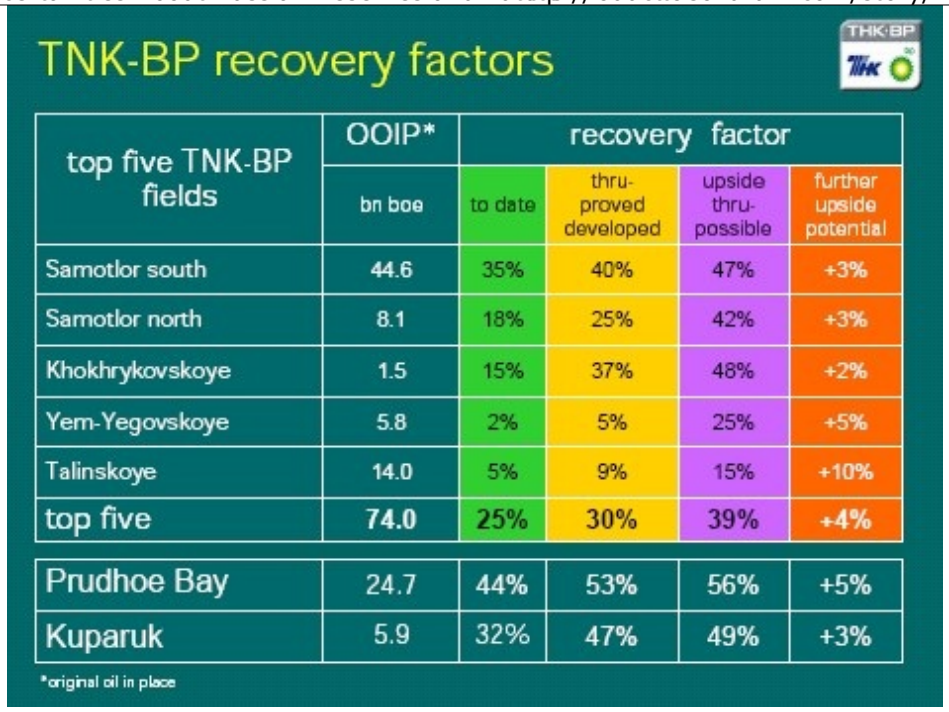
** This is from J. Robinson West of PFC Energy (link cited above). What he actually says is this

> THE RISKS in Russia are large and could mushroom. The impact of the Yukos affair, combined with under-investment and the poor management of the Russian petroleum sector in general, is serious. PFC Energy estimates that Russian production, now 9.3 million BPD, will peak at just over ten million BPD in 2008. Without a huge infusion of capital, technology and management for further exploration and production, Russian production may hit a lower peak and begin declining sooner. Billions will also be needed to expand export capacity. Without a stable legal and operating environment, Russia will fail to meet its production targets. This in turn could damage the Russian economy and the prestige of the Putin Administration.

Let's look at each Russian oil basin separately (as shown in *Figure 1*) and try to discern what is going on there and what the future production might look like.

## The Western Siberia Basin

I can not *emphasize enough* that almost all of Russia's production increases in the last 5 years have come from the Western Siberia basin in the Khanty-Mansiysk Okrug region. The conventional view is that about 2/3rds of Russian oil production comes from this region and that it contains the same percentage of Russia's reserves--whatever they are! This is due to a number of factors which I'll review below. This is shown clearly in *Figure 2*. A superficial view of the situation associates production in this area generally with the Samotlor megafield, which is in decline. However, as *Figure 3* clearly shows, the new production since the early/mid 1990's declines have come from 270 other fields in this vast region. There are a number of operators there--two of the most prominent are TNK-BP and the Russian NOC LUKOIL. TNK-BP has taken over a number of mature fields in both Western Siberia and the Volga/Urals basins. *Figure 4* below shows TNK-BP's internal projections (big pdf) about their primary Western Siberia projects. (Hat tip to Jerome a Paris at DailyKos 1/26/06).



TNK-BP recovery factors

| top five TNK-BP fields | OOIP* | recovery factor | | | |
|---|---|---|---|---|---|
| | bn boe | to date | thru-proved developed | upside thru-possible | further upside potential |
| Samotlor south | 44.6 | 35% | 40% | 47% | +3% |
| Samotlor north | 8.1 | 18% | 25% | 42% | +3% |
| Khokhrykovskoye | 1.5 | 15% | 37% | 48% | +2% |
| Yem-Yegovskoye | 5.8 | 2% | 5% | 25% | +5% |
| Talinskoye | 14.0 | 5% | 9% | 15% | +10% |
| top five | 74.0 | 25% | 30% | 39% | +4% |
| Prudhoe Bay | 24.7 | 44% | 53% | 56% | +5% |
| Kuparuk | 5.9 | 32% | 47% | 49% | +3% |

*original oil in place

As you can see, to date the fields shown have a 25% recovery rate (= 18.5 Gb) and using the techniques listed below, TNK-BP expects they may get an additional 10.36 Gb from these fields (the 39% recovery rate) which includes an additional 5.35 Gb from Samotlor South. How are they doing this? Here's what they're doing (slide 40).

- waterflood optimisation
- hydraulic fractures
- idle well recovery
- electric submersible pumps (ESP)

However, most new production from Western Siberia is coming from new fields like the Salym Group.

> Salym Petroleum Development NV is a company established on a 50:50 basis by Shell Salym Development B.V. and OAO NK Evikhon controlled by Sibir Energy. SPD holds production licenses for all three of the Salym fields, which are located in the Khanty-Mansiysk Autonomous Okrug in Western Siberia, 190 kilometres from the town of Nefteyugansk. It includes West Salym, Upper Salym and Vadelyp.
>
> Development and production from Upper Salym has already begun, and Vadelyp production is due to start in 2006. The production from West Salym, the biggest in the Salym group of fields, is expected to peak with at least 120,000 barrels per day by 2009.

Skrebowski lists Salym as coming online in 2005 with the daily production figure cited above and a URR of 0.8 Gb. And there are many, many other new fields though these are most likely not "large" fields (>75/mbpd) since Skrebowski does not list them. He *does* reference Uvatskoye (2009 with 0.2/mpbd). This TNK-BP Uvat project is in the Tyumen region of Western Siberia and represents another of the new projects expected to add to future production in this region.

> The Uvat project embraces 7 license areas comprising 8 fields and 29 promising geological structures with recoverable reserves of 60 million tons of oil and prospective resources of 200 million tons of oil. The project implies construction of 300 km of pipelines, more that 500 km of roads, and 200 km of power transmission lines in the Uvat District. Nowadays, TNK-BP is very active in this region. In the beginning of this year, Sibneft won the tender for the development of the Zimneye field.

Generally speaking, since this oil basin is vast and geographically isolated, a lot of investment in infrastructure (pipelines, processing facilties) must be built to produce these fields as the Uvat project just mentioned makes obvious. To find out what LUKOIL is up to, read here and here. The bottom line appears to be that LUKOIL is just now learning how to apply a large set of EOR techniques to its production in Western Siberia beyond simple waterflood techniques they had been using since the 1980's. I would say it's fair to conclude that as goes Western Siberia, so goes Russia. To be fair, it is hard to conclude from all this information what the daily production flows will be from this region in the near future.

## The Volga/Urals Basin

According to IHS Energy, the Volga/Urals basin contains 18% of Russia's reserves--21.6 Gb according to their own estimates. Here's the picture--it's not pretty.

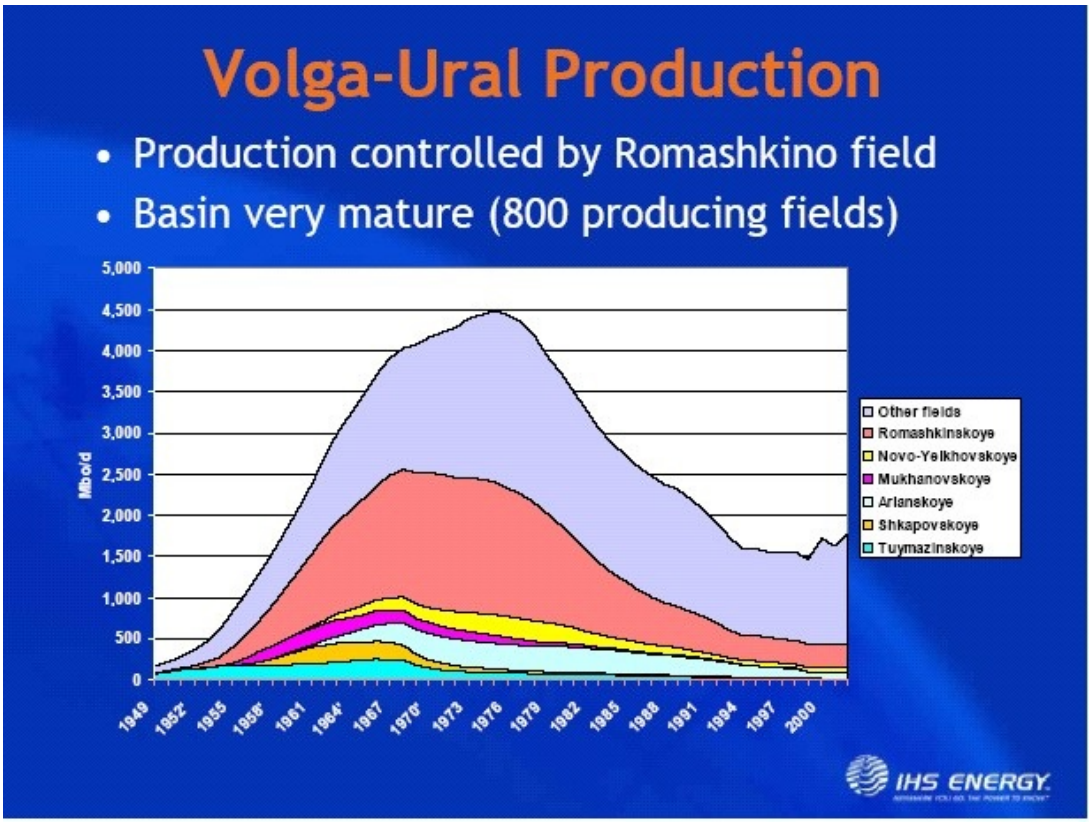



*Figure 4 - Click to enlarge*

Romashkino, the big field in this region, is clearly in decline though there has been a slight uptick in production from other fields recently. Frankly, I have little more to say about this region. It is the most mature of Russia's oil basins and there don't seem to be any exciting new developments there. TNK-BP is among the operators managing fields there and presumably using EOR techniques to squeeze out what production they can get.

## The Timan/Pechora Basin

IHS Energy puts 8% of Russia's reserves in the Timan/Pechora region. The "big news" is Rosneft/Gazprom's Prirazlomnoye field just offshore in the Pechora Sea. Skrebowski lists proven reserves of about 0.61 Gb but estimates vary. This is really the first Russian polar continental shelf project to get under way. However, this is not surprising given the geology. From this older source.

> Three structural stages are recognized in the sections of the Barents and Kara Seas. In the Barents Sea region the lowest is basement, which consists of rocks of various ages. *The middle is represented by Paleozoic carbonate and clastic rocks of the platform cover; it is an offshore continuation of the Paleozoic rocks of the Timan-Pechora oil-gas province of northeastern European Russia.*

Consequently, the offshore area is considered underexplored and many new "plays" are expected. However, what's happening in this region is a mystery. From Smoothing over Russian Subsoil we learn

> Most likely, the fattest piece of the unsold Russian subsoil to be auctioned off in 2005 will be the *Trebs-Titov group of oilfields that also includes the four segments of the Central Khorever Plateau in the Timano-Pechyora Province*. As expected, the amount of oil in the ground is left blank here, however, the Kommersant courteously informs the prospective buyers that the starting price is $419 mln. with $1.8 per one tonne of the oil reserves.
>
> Anyone familiar with the Arithmetics gets the idea that the deposit contains approximately 230 mln. tonnes (1.68 Gba) of oil. This kills two birds with one stone: the secret is still kept as ordered and the amount of oil in the ground can be estimated. These oilfields contain 6 months of Russia's oil supply at the current rate of extraction.
>
> The director of the Russian Natural Resources Ministry's department of natural resource exploitation regulations, Sergei Fedorov, shares the view that the situation with the depletion of Russia's oil reserves is quite sad.
>
> *"There are very few vacant oilfields left in the state's oil fund, 92% of Russia's oilfields have already been auctioned off. Of the remaining oilfields the large ones are the one in the Nenets Autonomous Area (the Trebs-Titov group of oilfields), the Chayandinskoye in Yakutia, and the oil and gas reservoirs on the sea shelf. The rest are small oilfields."*

So, what's going on in this oil basin is very much up in the air. Finally, Skrebowsky mentions two potential projects (no date). The first field is Val Gamburtseva field (Nenets Autonomous Region) with an estimated 0.6 Gb of proven reserves. The second is the Kharyaga field with an estimate of 0.71 Gb and currently producing 0.03/mbpd. (Skebowski lists this as having reserves of 5.2 Gb! This must be a mistake in his megafields document unless my information is wrong.)

## The Eastern Siberia/Far East Oil Basins

This section concerns the Eastern Siberian basin (see *Figure 1*) and the Sea of Okhotsk which

includes the Sakhalin oil fields. I've lumped them together just for convenience--they really are separate producing regions. However, IHS Energy claims that the two basins together comprise 3% (3.6 Gb) of their estimated 120 Gb total reserves estimate.

Sakhalin is a more complex oil & gas basin than most people realize. There are actually at least 6 separate regions, some of which are divided into multiple blocks as shown in this graphic. So, we can refer to Sakhalin N (1,2,3...).

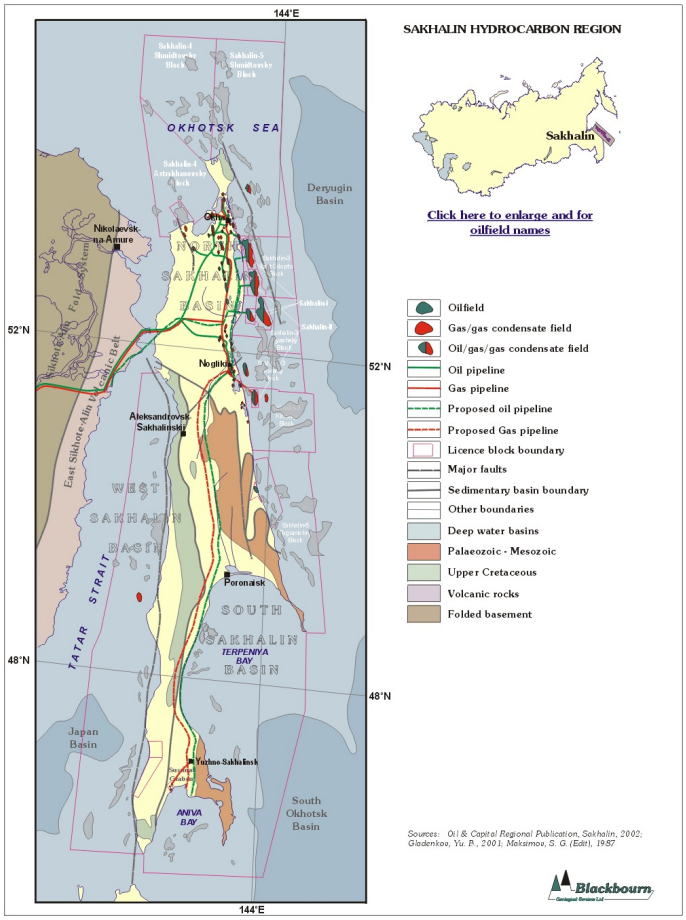


*Figure 4 - click to see the original source*

Sakhalin 1 is already producing but being developed in phases. Recoverable reserves are standardly put at 2.3 Gb.

> The Project will be executed in phases. The initial phase develops the Chayvo field. Production from Chayvo started on October 1, 2005. The initial phase of the project will produce 50,000 barrels (6,300 metric tons) a day by year-end 2005 and 250,000 barrels (30,000 metric tons) a day of oil by year-end 2006 from the Chayvo field. Associated domestic gas sales will start at about 60 million cubic feet (1.7 million cubic meters) per day, and ultimately ramp up to 250 million cubic feet (7.1 million cubic meters) per day.

Sakhalin 2 is not due to come onstream until 2007. The region is supposed to contain about 1 Gb of recoverable oil and Skrebowski shows a production of perhaps over 0.12/mbd. Shares of other Sakhalin regions (and contained development blocks) have been bought and some are still being bid on. It's a reasonable expectation that all of these regions will be ramping up over the next 5 years depending on the amount of investment from various sources. However, the numbers cited

above just for Sakhalin 1 and 2 comprise 3.3 Gb of claimed recoverable reserves and there are at least 4 more regions to develop. So, either reserve claims for the various Sakhalin regions are exaggerated or IHS Energy underestimates the amount of recoverable oil in the Sea of Okhotsk (combined with Eastern Siberia). As a prospective area, this oil basin is just about completely explored and it is unlikely any new significant discoveries will be made there in the future.

Eastern Siberia is a different story. Development is just getting underway there, the fields are smaller and this oil basin is isolated and thus requires major investment in infrastructure to develop. Skrebowski lists Vandorskoye coming onstream in 2007 at a daily production rate of 0.22/mbpd and total reserves of 0.9 Gb of recoverable oil. This field is being developed by RosNeft.

> The Vankorskoye field is based in the Turukhansky region of the Krasnoyarsk Territory (Siberia). Its oil reserves are estimated at 125 million metric tons, and natural gas at 76.8 billion cubic meters.
>
> According to Zemlyuk, the project has a number of problems. For example, the oil transportation route has not yet been determined.
>
> The vice president assured his audience that the Vankorskoye field could yield 14 million metric tons of oil a year. The company, he continued, had put $4 billion into the project and was planning to produce its first oil there in 2008.

Just recently, problems have arisen with a proposed pipeline Russia nixes East Siberia pipeline route that would run from Eastern Siberia to the Pacific Ocean. So, future development in the area is plagued with logistical problems.

There are other perhaps "giant" fields in Eastern Siberia including Verkhnechonskoye. TNK-BP is developing a pilot project due to be completed in 2008 there. This claim is made.

> The Verkhnechonskoye field is the largest oil and gas condensate field yet discovered in Eastern Siberia. Development had been hampered for many years by an absence of transportation infrastructure but it has now become possible, following last year's decision by the Russian Government to undertake the construction of the Eastern Siberia –Pacific Coast pipeline system.

Again, this is a "wait & see" situation as far as the large-scale development of this and other fields in this basin go. All and all, Sakhalin development seems mature and progressing well. The same can not be said for Eastern Siberia.

## The North Caucasus Oil Basin

This post is running long and I will give short shrift to the North Caucasus basis. According to IHS Energy, this region contains an overwhelming 1% of Russian oil reserves. Production has been flat for many years there. The only news worth reporting was the recently announced Filanovsky field discovery by LUKOIL in the north Caspian Sea area controlled by Russia.

> The new deposit is the largest oil field that was discovered in Russia over the last 10 years. Its probable reserves are estimated at 600 million barrels of oil and 34 billion

> cubic meters of gas. According to the company's preliminary evaluations, maximum level of oil production at the new deposit will exceed 5 million tons a year, while accumulated extraction will amount to about 80 million tons.

Otherwise, there's little else to say about this region.

## Conclusions

Although at the beginning of this lengthy post I said I would take *no official position* about Russian oil reserves and production potential, this does not preclude me from *having opinions*. And here they are.

- My position is in the *high camp* (over 100 Gb) on what the real remaining Russian URR is.
- Near-term future production depends almost entirely on activity in Western Siberia and Sakhalin. I think the overall production will be in the 9 to 10/mbpd range until 2010 and will decline after that.
- Longer term production will decline *fairly slowly* as the harder to develop areas (eg. Eastern Siberia, Timan/Pechora) struggle to get underway but, nevertheless, come online.
- This post has not even considered Polar Oil on Russia's continental shelves but what I've read leads me to believe that most of those new hydrocarbons will be condensates and NGLs. This subject deserves an entirely different post.
- Above the ground considerations (geopolitics and Russian internal politics & bureaucracies) were not extensively covered here but will be a *major factor* in future production of existing reserves. I recommend the Can Russian Oil Growth Be Sustained? quoted near the beginning of the post as the best resource to read on the subject. J. Robinson West's short paper is another good resource. Finally, you can read Why did oil production in Russia stop growing? (ppt) by V. Milov.

Well, that's the whole ball of wax. I hope this post is useful to you as we consider the future of Russian production going forward.