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Tight Oil Developments in Russia

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Abbreviations and Units of Measurement

| | |
|-----------|--|
| bbls | Barrels |
| bcm | Billion cubic metres |
| bcma | Billion cubic metres per annum |
| bn bbls | Billion barrels |
| boepd | Barrels of oil equivalent per day |
| bpd | Barrels per day |
| E&P | Exploration and Production |
| ESPO | East Siberia – Pacific Ocean (Pipeline) |
| FSU | Former Soviet Union |
| IOC | International Oil Company |
| kboepd | Thousands of barrels of oil equivalent per day |
| kbpd | Thousands of barrels per day |
| km | Kilometres |
| mm bbls | Million barrels |
| mcm | Thousands of cubic metres |
| mmboepd | Millions of barrels of oil equivalent per day] |
| mmbpd | Millions of barrels per day |
| mmbtu | Million British thermal units |
| mmcm | Millions of cubic metres |
| mnt | Millions of tonnes |
| mntpa | Millions of tonnes per annum |
| Mm tonnes | Millions of tonnes |
| P&P | Proved and Probable |
| tcm | Trillion cubic metres |

Conversion Factors

| <i>Equals</i> | | | |
|---------------|------------------|------|------------------------------|
| 1 | tonne oil | 7.3 | barrels of oil equivalent |
| 1 | tonne condensate | 8.0 | barrels of oil equivalent |
| 1 | bcm gas | 6.6 | mm barrels of oil equivalent |
| 1 | bcm gas | 35.3 | billion cubic feet of gas |
| 1 | bcm gas | 0.9 | mm tonnes of oil equivalent |

Source: BP Statistical Review

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Introduction

Production of unconventional oil has transformed the US energy landscape, creating the potential for that country to reduce its reliance on oil imports and to contribute to the possibility of North America's becoming energy independent by the end of this decade. As Fattouh and Sen point out, however, in their recent OIES Comment,¹ despite the forecasts of many commentators that this would cause a revolution in oil supply and prices, the impact on the global energy market has in fact been somewhat less dramatic than expected. This working paper aims to take a similarly realistic view of the potential for tight oil production in Russia, something which has been highlighted by the recent study of global shale oil and gas resources undertaken by the USGS, which named Russia as the possessor of the world's largest shale oil reserves.²

The main focus of attention has been on the Bazhenov shale which lies beneath Russia's main producing reservoirs in West Siberia and is indeed the source rock for many of the giant fields that have been at the core of the country's oil output, which is now running at approximately 10.5 mmbpd. Rosneft, LUKOIL, GazpromNeft and others have highlighted the potential for the Bazhenov and Russia's other tight oil reservoirs to help achieve the government's objective of maintaining overall production at current levels in the face of the natural decline in many of the country's older fields. Joint ventures with ExxonMobil, Statoil and Shell have started to introduce international expertise and technology, and the future output from Russia's tight oil reservoirs has been estimated by the Ministry of Natural Resources at up to 1 mmbpd by 2025.

The exploitation of this underdeveloped resource, however, is at a very early stage and a number of issues have already emerged. The geology of many of the reservoirs seems very heterogeneous, with markedly different well results being produced only kilometres apart. Well costs are high and, in common with most shale reservoirs, decline rates are rapid, meaning that costs need to be recovered early in the production cycle if an economic return is to be made. The current tax system in Russia, however, does not anticipate this type of well performance, being focussed on revenues rather than profits, and tax rates are also very high. Although reductions on specific taxes have now been introduced, they may not be enough to encourage wide-scale investment. Furthermore, it is not just oil company investment that is required but also significant expenditure by oil service companies on new rigs and fracking equipment, a lack of which could easily delay the achievement of production targets.

As a result, this paper aims to address these and other issues in order to assess the potential progress in the development of Russia's tight oil reserves. Section 1 provides some initial context of the potential importance of unconventional oil in Russia as a means of alleviating the declining production of existing West Siberian assets and as a bridge towards the longer term development of areas such as the Arctic offshore. Section 2 then outlines a definition of what is described in Russia as 'hard-to-recover' oil, differentiating between shale reservoirs such as the Bazhenov and other tight oil reservoirs such as the Achimov and Tyumen formations which are often found in the deeper layers of existing fields. Section 3 then reviews corporate activity in the sector to date, highlighting in particular the new joint ventures formed by Rosneft, the development work carried out by GazpromNeft and Shell in the Salym area and the new focus of LUKOIL on its deeper and tighter oil assets.

Section 4 then moves on to a discussion of the commercialisation of Russia's tight oil resources, and in particular highlights the tax concessions that have already been granted for 'hard-to-recover' oil, while also discussing

¹ Fattouh, B. and Sen, A., 12 Sept 2013, 'The US Tight Oil Revolution in a Global Perspective'.

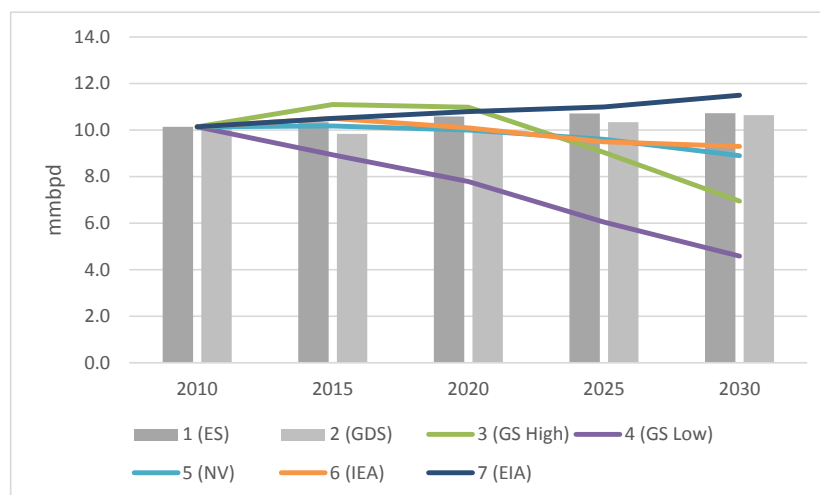
² US EIA, June 2013, 'Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the US'.

further changes that may be needed to catalyse full scale development in projects with a very different cash-flow profile to traditional Russian oil fields. Section 5 addresses another key issue for the industry, namely the availability of rigs of high enough quality and power to drill the numerous horizontal wells that will be needed if 1 mmbpd of production is to be achieved. It concludes that not only will it be difficult to build enough new rigs, but also that the oil service industry may well be reticent to invest heavily until it more fully understands what the future of the unconventional oil industry in Russia may be. Section 6 then reviews a number of other issues that could hinder development of tight oil in Russia such as a corporate landscape dominated by a few large players, the Law of Strategic Reserves, the Licensing Laws and Environmental and Water issues. Section 7 then offers some conclusions which suggest that, although the potential for a significant increase in unconventional oil production in Russia certainly exists, the achievement of the aggressive Ministry of Natural Resources target is likely to take longer than anticipated.

1. Unconventional Oil in the context of Russia’s Energy Strategy

The Russian government’s Energy Strategy to 2030 indicates that it is keen to maintain the country’s oil production at or above the level of 10.4 mmbpd seen in 2012,³ and the outlook for 2013–2015 remains quite positive as new fields are set to be brought onstream⁴ and existing developments arrive at peak output. A number of domestic and international commentators are now, however, forecasting that Russian oil production could be close to its peak, with the inevitable decline of Soviet era fields prompting an overall fall in output by 2020. Figure 1 and Table 1 show two Russian government targets, contained in the Energy Strategy to 2030 and the Geology Development Strategy, both of which see a gradual rise in output towards 10.7 mmbpd by 2030, but the more independent forecasts also shown suggest that these targets may be rather optimistic. The most radical low case scenario, produced for the Government Energy Commission in 2011, shows a collapse in oil output to below 5 mmbpd by 2030 if the current tax and regulatory conditions in the Russian oil sector are not changed. Even the less pessimistic forecasts, which anticipate some government reaction in terms of tax breaks and other encouragement of investment, see production falling to a range of 7–9 mmbpd. Only one forecast, that from the US Energy Intelligence Administration, sees production exceeding the Russian government targets.

Figure 1: Russian oil production targets and forecasts



Sources: see Table 1

³ Data from Russian Energy Ministry showed production of 518 million tonnes.

⁴ For example LUKOIL and Bashneft started production at the new Titov and Trebs fields in August 2013.

Table 1: Russian oil production targets and forecasts

| <i>million bpd</i> | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|-------------|-------------|-------------|-------------|-------------|
| Energy Strategy to 2030 (1) | 10.1 | 10.3 | 10.6 | 10.7 | 10.7 |
| Geology Development Strategy to 2030 (2) | 10.1 | 9.8 | 10.0 | 10.3 | 10.6 |
| General Scheme of Oil Industry Devt (2011) High (3) | 10.1 | 11.1 | 11.0 | 9.0 | 6.9 |
| General Scheme of Oil Industry Devt (2011) Low (4) | 10.1 | 8.9 | 7.8 | 6.0 | 4.6 |
| Neftegazovaya Vertikal (2010) (5) | 10.1 | 10.2 | 10.0 | 9.6 | 8.9 |
| IEA 2012 (6) | 10.1 | 10.5 | 10.1 | 9.5 | 9.3 |
| EIA 2013 (7) | 10.1 | 10.5 | 10.8 | 11 | 11.5 |

The debate about the exact extent of any possible decline has largely focused on whether the Russian government will provide sufficient tax incentives to encourage the development of fields in new regions of Russia such as East Siberia and the Offshore, with a particular recent focus on the Arctic following the announcement of Rosneft's joint ventures with ExxonMobil, Statoil and ENI.⁵ It has become increasingly clear, however, that the likely start date for any production from this region will not be until well into the next decade, given that the first exploration well is not due to be drilled until 2014 and the subsequent appraisal and development of any discovery would be likely to take at least a decade.⁶ Indeed some Russian oil industry players remain sceptical about the economics of any major developments in the Far North. In 2013 LUKOIL's Leonid Fedun was quoted as stating that 'if someone asked me to invest money in Arctic exploration and development, I wouldn't give a kopeck. We have many more investment opportunities that carry less risk.'⁷

One of the specific investment opportunities to which Mr Fedun is referring, and into which his company is currently investing significant funds, is the exploitation of Russia's unconventional oil resources. Although the development of what is often referred to in Russia as 'hard-to-recover' oil is not a new topic, with the discovery of shale oil in Russia dating back as far as 1967,⁸ it has become much more interesting following the improvements in the technology for the extraction of shale oil and gas developed in the US over the past decade.⁹ Indeed the other main focus of Rosneft's JVs with both ExxonMobil and Statoil is the application of new technology on the company's tight oil reserves in West Siberia and European Russia,¹⁰ and a number of recent estimates suggest that the resource base to be exploited across Russia is enormous, although uncertain. The level of this uncertainty is captured in the wide spread of high and low estimates: total tight oil reserves in Russia have been put in the range of 15 billion to 1.05 trillion barrels.¹¹ Even individual companies have very broad assessments of their own resources, with Rosneft quoting numbers in the range 6–18 billion barrels and TNK-BP offering

⁵ http://www.rosneft.com/Upstream/Exploration/arctic_seas/, accessed 9 Sept 2013.

⁶ http://www.rosneft.com/Upstream/Exploration/arctic_seas/ sourced on 27 Aug 2013.

⁷ Financial Times, 31 Mar 2013, 'Red Lenin leads Russia's oil revolution'.

⁸ Siberian Oil Magazine, May 2012, 'A Suite for Oil Barons'.

⁹ As discussed by Geny, F, Dec 2010, 'Can Unconventional Gas be a Game Changer in European Gas Markets', NG 46, Oxford Institute for Energy Studies'.

¹⁰ Rosneft Press Release, 21 June 2013, 'Rosneft and Statoil advance Cooperation Agreement Implementation'.

¹¹ Rosneft Non-Deal Roadshow, 5 Oct 2012, slide 6.

forecasts of between 4 and 19 billion barrels.¹² Given that Russia's total proved reserves are estimated at 87 billion barrels¹³ it is clear that even numbers at the lower end of the range would be significant additions to the country's oil reserve base. This potential was further confirmed by a recent assessment of global shale resources by the US Energy Information Administration which calculated that Russia has the world's largest shale oil resources with a total of 75 billion technically recoverable barrels.¹⁴

2. Defining Unconventional Oil in Russia

Before progressing from these resource numbers to potential production estimates it is important to emphasize that the definitions of unconventional reserves in Russia are somewhat blurred in a multitude of terms used to describe the hydrocarbons being explored by various companies. The broadest definition is 'hard-to-recover' oil, and this is often used by companies looking for a catch-all to describe reserves that need tax breaks from the government to encourage investment. 'Hard-to-recover' reserves include shale resources, such as those found in the often-cited Bazhenov geological layer, but also include bitumen, a very viscous crude that is extracted from shallower reservoirs using mining or steam heating techniques, as well as oil that comes from conventional reservoirs that happen to have low permeability and/or porosity. Indeed this breadth of definitions is one reason why the Russian government has been relatively slow to introduce tax breaks for the oil industry, for fear that companies would use 'creative reserve auditing' to bring as much of their production as possible into the 'hard-to-recover' category.

Narrowing the definition to more traditional unconventional shale and shale-like reserves, the US EIA tight oil resource estimate for Russia specifically includes only the Bazhenov layer. This layer is highly significant as it is believed to cover the entire 2.6 million km² area of the West Siberian basin and to act as the source rock for 85 per cent of the conventional oil fields located there.¹⁵ The Bazhenov is located at a depth of 2,700–3,100 metres in the Upper Jurassic rock strata (see Figure 2), and has a permeability of less than one millidarcy¹⁶ with a porosity of between 2 and 6 per cent and a reservoir thickness of 20–30 metres, making it comparable to the Eagle Ford and Bakken shale formations in the USA.¹⁷ As with many tight reservoirs the oil tends to be light (34–43 degrees API, with an average of 38 degrees compared to the Urals blend figure of 32–33 degrees) and has a relatively low sulphur content of 0.6%.¹⁸ As a result it can flow quite freely once the tight sandstone reservoirs have been accessed through horizontal wells and broken open using multi-stage fracking techniques.¹⁹

The Bazhenov, however, is not the only new tight oil play in Russia, as similar types of resources are also found in two other layers, the Achimov and the Tyumen, that have not been included in the US EIA analysis because of a lack of available data. Nevertheless, they are very much part of the tight oil development work that a number of companies in Russia are currently undertaking and are certainly included in any definition of 'hard-to-recover' oil. The Achimov layer is generally located just above the Bazhenov at a depth of 2,500–3,200 metres (see Figure 2), with the oil trapped in tight sandstones confined by shale. The reservoirs tend to be of average porosity but low permeability, but nevertheless have a tendency to have better flow rates and lifetime production than the

¹² Interfax, 25 Sept 2012, 'TNK-BP carrying out three of seven tight oil projects at cost of \$100 mln'; Interfax, 12 Feb 2013, 'TNK-BP estimates its tight reserves at over 2.6 bln tonnes'.

¹³ BP Statistical Review of World Energy 2013.

¹⁴ US EIA, June 2013, 'Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the US'.

¹⁵ Wood Mackenzie Consultants Unconventional Play Service, April 2013.

¹⁶ Millidarcy is the unit of measurement used to express the permeability coefficient of rock. One darcy is equal to the passage of 1 cubic centimetre of fluid having a viscosity of 1 centipoise for 1 second under the pressure of 1 atmosphere through a medium having a volume of 1 cubic centimetre

¹⁷ This compares with average porosity and permeability in West Siberia which can range up to 25% and 35 millidarcies respectively.

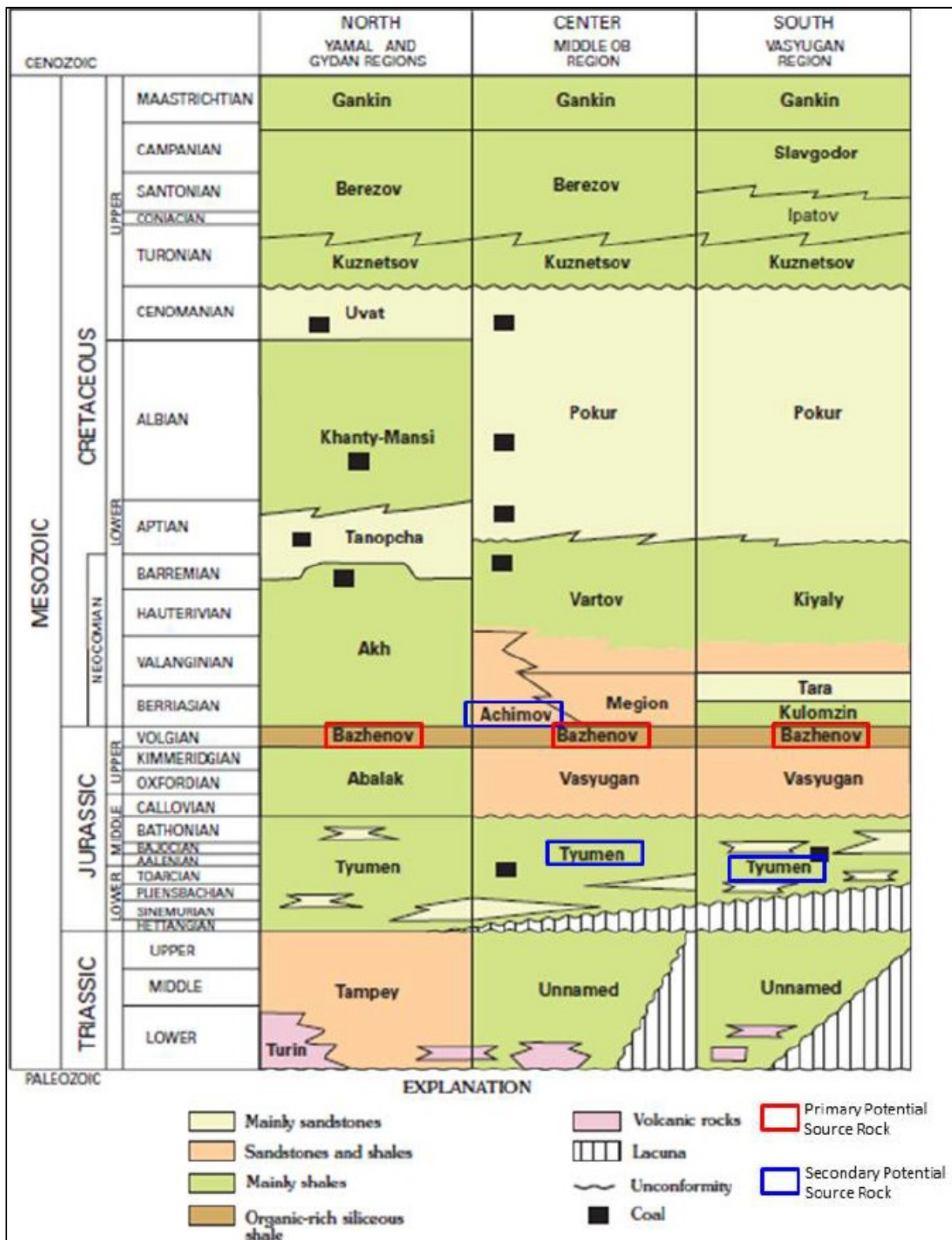
¹⁸ Rosneft presentation 'New Age of Petroleum', March 2013, slide 12.

¹⁹ ROGTEC Magazine, 25 May 2011, 'The Bazhenov Suite; Unlocking the Potential'.

Bazhenov layer. A number of gas condensate fields have already been developed from this rock layer, including by the Gazprom/Wintershall JV Achimgaz, and the shallower depth of the reservoirs means that they tend to be cheaper and easier to operate than their deeper counterparts. In contrast the Tyumen layer, which covers the same geographic area as the Bazhenov but at a lower depth of 2,800 to 3,200 metres, tends to contain narrower reservoirs with mixed permeability, making it a more difficult target for drilling and generally more expensive to develop.²⁰ Nevertheless, a number of companies, including LUKOIL and TNK-BP, have been exploring the potential of this reservoir below existing conventional fields and see it as another potential boost to overall production capacity.

²⁰ Ulmishek, G.F., 2007, 'Petroleum Geology and Resources of the West Siberian Basin, Russia', USGS, Washington.

Figure 2: Stratigraphic Column of the West Siberian Basin

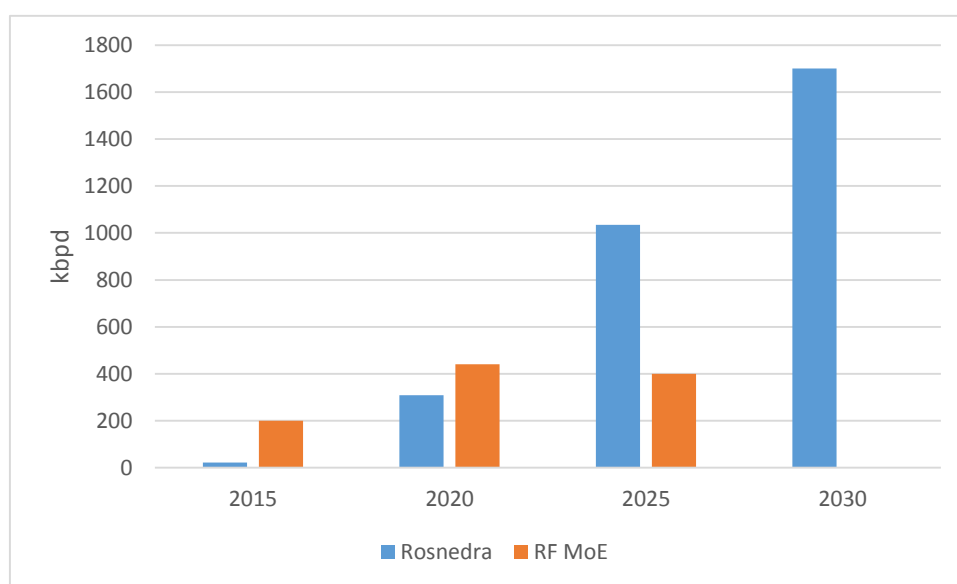


Source: US Energy Intelligence Administration, June 2013

The geographical extent of these three tight oil reservoirs and the large resource estimates associated with just one of them (the Bazhenov) have encouraged the Russian government and oil industry to believe that the development of unconventional oil in Russia could be the short-to-medium term solution to the risk of a potential

production decline. Indeed a number of corporate and ministry production forecasts have been made that suggest the possibility of significant output being achieved by the end of this decade. Rosneft has tentatively estimated that it could be producing 300,000 bpd of unconventional oil by 2020,²¹ while TNK-BP has more cautiously forecast output of 50,000 bpd on the same timescale and GazpromNeft has suggested that it could produce a similar amount.²² More optimistic overall forecasts have emanated from the Russian Energy Ministry and the Ministry of Natural Resources, and as shown in Figure 3 the latter suggests that total tight oil production in Russia might exceed 1 million bpd by 2025 and reach 1.7 million bpd by 2030. The uncertainty surrounding the development of this new resource, however, is underlined by the fact that the Energy Ministry forecast, although positive, is much lower at only 440,000 bpd by 2020 before declining to 400,000 bpd by 2025.

Figure 3: Government forecasts for tight oil production in Russia



Source: Ministry of Energy of Russian Federation, Ministry of Natural Resources of Russian Federation

This uncertainty reflects difficulties in a number of areas, including licensing, levels of taxation, definition of strategic resources, environmental legislation, availability of sufficient oil service equipment and a lack of variety in the companies developing the resources, but at the most basic level the issue of geology remains the primary concern at present. On the positive side, it is asserted by a group of scientists led by Ivan Nesterov at the Russian Academy of Sciences that the high oil saturation across the key Bazhenov shale layer means that oil can be produced commercially at any point across its geography.²³ Other specialists such as Valeriy Soloviev, Chief Expert of Gazpromneft's Research and Technical Center (NTC), are also positive and believe that 'taking into account the potential resources of the Bazhenov formation, it is a great candidate for further exploration and development'.²⁴

An alternative view is presented by scientists such as Vladimir Teploukhov, Head of the Logging Data Interpretation Department at NTC, who stresses that 'the Bazhenov formation stores too many surprises, and the surprises are still there despite decades of research. The main challenge for geologists and development engineers is how to accurately pinpoint recoverable reserves and the areas of their concentration. The volume of

²¹ Rosneft Non-Deal Roadshow, 5 Oct 2012, slide 6.

²² Maximov, O., October 2012, 'Russian Oil and Gas – The Unconventional Issue'.

²³ Siberian Oil Magazine, May 2012, 'A Suite for Oil Barons'.

²⁴ See fn. 23

effective oil-saturated pore space of the Bazhenov formation has not been identified with the desired precision. Data on permeability and porosity of the Bazhenov rocks are insufficient. In addition, the characteristics may vary enormously in different locations. Sometimes even neighbouring wells produce completely different data. For as long as these issues remain unanswered, the development of the reserves continues to be too risky'.²⁵

It is clear, then, that despite the huge resource potential of the Bazhenov and associated tight oil strata in Russia, the geology is yet to be fully understood, and it is this fact that has heightened calls for increased government support for companies which are preparing to investigate the possibilities for commercial production. Before discussing what levels of government support may be needed, as well as what other issues may need to be resolved, it is worth first reviewing the major corporate activity to date in order to assess how companies currently view unconventional oil prospects in Russia.

3. Corporate Activity in Russia's Tight Oil Reservoirs

Rosneft

As befits Russia's National Oil Company, Rosneft has taken the leading role in the development of the country's tight oil reserves, in particular since the announcement of its joint venture with ExxonMobil in 2011.²⁶ Initially the most significant part of this joint venture appeared to be the exploration of Russia's Arctic offshore regions, in particular the South Kara Sea, but when the companies confirmed their joint plans in June 2012 it became clear that the near term benefits would most likely be seen in the development of Rosneft's extensive Bazhenov and Achimov resources, including tight oil and shale oil reservoirs.²⁷ The companies' plans will focus on a pilot project covering 23 licences with an area of over 10,000 km² and will include the drilling of new vertical and horizontal wells in addition to the deepening of existing wells and the revival of idle wells. The latest fracking technology will then be applied to the formations during a trial period covering 2013–2015, after which an assessment will be made about a broader potential development scheme.²⁸ Rosneft also has a second international partnership for its shale resources, since it will work with Statoil in the Samara region to explore the Domanic formations in twelve of its licences. As in the case of the ExxonMobil JV Statoil will be providing financial support and technical expertise in co-operation with Rosneft's domestic employees in the region.

Rosneft has provided a number of estimates of its tight oil potential, including an assessment in Spring 2012 that its Bazhenov and tight oil resources amounted to 18 billion barrels,²⁹ followed by a lower 5.8 billion barrel estimate at an investor presentation in October 2012,³⁰ which was then increased to 10.3 billion barrels of 'hard-to-recover' resources stated at a roundtable for analysts in Moscow in May 2013.³¹ This disparity in estimates reflects not only the varying definitions of shale, unconventional, 'hard-to-recover' and tight oil reserves and resources mentioned above but also the fact that the application of the new technology being introduced by ExxonMobil is at a very early stage. As a result, another Rosneft estimate that production from its unconventional resources could reach 300 kbpd by 2020 must also be viewed with some caution.³²

Nevertheless, Rosneft does have some experience of its own in exploring for and developing tight oil resources, having undertaken an initial project to produce oil from the less permeable reservoirs at the Salym suite of fields via its Yuganskneftegas subsidiary. Its results were not particularly positive, although it did manage to establish

²⁵ See fn. 23.

²⁶ Rosneft press release, 30 Aug 2011, 'Rosneft and ExxonMobil to join forces in the Arctic and Black Sea offshore'.

²⁷ ExxonMobil press release, 15 June 2012, 'Rosneft and ExxonMobil Agree to Develop Tight Oil Reserves in Western Siberia and Establish Arctic Research and Design Center for Offshore Developments'.

²⁸ Nefte Compass, 13 Dec 2012, 'Rosneft, Gazprom Neft advance tight oil schemes'.

²⁹ Forbes Magazine, 4 June 2013, 'Meet the oil shale 80 times bigger than the Bakken'.

³⁰ Rosneft Non-Deal Roadshow, 5 Oct 2012, slide 6.

³¹ Nefte Compass, 6 June 2013, 'Rosneft, Gazprom Neft Update on Unconventionals'.

³² Rosneft Non-Deal Roadshow, 5 Oct 2012, slide 6.

that flow rates of 10 tonnes per day (c.75 bpd) could be sustained over several decades from vertical wells drilled into the Bazhenov and Abalak formations.³³ This level of production, however, and the very low overall recovery rate of 7 per cent, would not make such a development economic on a widescale basis, hence the need for the more modern techniques planned to be used in the JV with ExxonMobil.

Surgutneftegas

Development of the tight oil resources around the Salym field has also been a focus for Surgutneftegas, and indeed the company has the longest history of any Russian company in the search for an economic way to develop 'hard-to-recover' oil. Over the past 30 years Surgutneftegas has drilled more than 600 wells into the Bazhenov formation on its licences, but the mixed results again highlight the difficulties in developing the resource successfully.³⁴ 37 per cent of the company's wells have been dry, demonstrating the problems with understanding the properties of a reservoir which is not homogenous, although more encouragingly the 63 per cent of wells that have been successful have flowed up to a maximum of 300 tonnes per day (c.2,200 bpd). Over the life of its operations to date Surgutneftegas has produced almost 9 million barrels of Bazhenov oil, and although this equates to a rather low average of 800 bpd over the entire 30 year period the company estimates that it should be able to recover a further 30 million barrels during the next two decades. Given the somewhat conservative outlook that it adopts towards international co-operation and partnership it seems unlikely that Surgutneftegas will be at the forefront of Russia's shale oil developments but will rather be a secondary player as it continues to develop its own technical solutions to the development of tight oil reservoirs.

Gazpromneft

Gazpromneft, on the other hand, is taking a more proactive approach and has two tight oil projects underway while also planning to further develop its exposure to shale and tight oil reservoirs through the purchase of additional licences. Shell is the company's core partner in its first tight oil project, which is exploring the development of resources in the license area that contains existing conventional production from the Upper Salym field as part of the SPD³⁵ 50:50 joint venture between the two companies. The JV partners have put together a plan for the implementation of an \$80mm pilot project at the North Salym field, which contains deposits in the Bazhenov shale layer,³⁶ and the intention is to further expand the JV in order to bid for new licences in the Khanty-Mansiysk region as part of a four year plan to bring major shale deposits into production in the region.³⁷ Indeed Gazpromneft has set out initial targets for the JV to commence production in 2015 before reaching peak output of 35 kbpd by 2024 and to ultimately exploit up to 650 mm barrels of reserves.³⁸

In addition to its partnership with Shell, Gazpromneft is also undertaking a project to review and potentially exploit the Palyanovskaya zone in the Bazhenov layer of the giant Krasnoleninsoye field.³⁹ In August 2013 the company announced that that it would begin a four well pilot project by the end of 2013, with a plan to drill inclined wells into the tight oil layers over the next 18 months before deciding if a commercial development of the resource is possible. Gazpromneft is well-placed to make this assessment as it has already brought 60 million barrels of tight oil into production from beneath existing fields in 2012 and plans to bring five more tight oil plays to the development phase from 2013. It also has extensive experience of using horizontal wells and hydro-fracking at its conventional fields in West Siberia, with plans to drill 120 horizontal wells and to conduct 90 multi-phase hydro-

³³ Siberian Oil Magazine, May 2012, 'A Suite for Oil Barons'.

³⁴ ROGTEC Magazine, 27 Aug 2013, 'In Search of Big Shale in Upper Salym'.

³⁵ Salym Petroleum Development.

³⁶ Bloomberg, 5 Mar 2013, 'Russia's oil lead threatened as taxes strangle drilling'.

³⁷ Interfax, 23 May 2013, 'Gazprom Neft, Shell to decide sections for new JV in Khanty-Mansiysk district by year-end'.

³⁸ Gazpromneft Presentation of Financial Results for Q1 2013, 16 May 2013, slide 16.

³⁹ Financial Times, 31 Mar 2013, 'Red Lenin leads Russia's oil revolution'.

fracs in 2013.⁴⁰ As a result it should be in a good position to deploy these skills in lower horizons, although the company has warned that a shortage of technical resources in Russia could be a limiting factor in the full exploitation of the Bazhenov resource.

LUKOIL

LUKOIL has been expressing its enthusiasm for tight and shale oil resources for the past two years, with company vice president Leonid Fedun describing it as 'our Bakken' and stating that 'we have the reserves, and sooner or later we will get them out'.⁴¹ Indeed LUKOIL has already begun to exploit the deeper and less permeable resources below its existing fields in West Siberia, noting in its 2013 Databook that it is increasing output at the Vostochno Perevalnoye and Potochnoye fields using multi-zone fracturing of horizontal wells to exploit the Achimov deposits in its licences.⁴² Although neither field is large (they have a combined proved reserve base of c.350 million barrels) the techniques being used there have helped to reverse production declines and that will also be applicable as the company moves to develop other tight oil reservoirs, including the Bazhenov, at current and new licences. In 2012 the company acquired the licences to the Imilorsky deposits in the Khanty Mansiisk region, which contain significant tight oil resources, and has also announced during a recent conference call that it is looking to acquire one or two more 'hard-to-recover' assets in the near future in order to take advantage of the improved economics for such reserves.⁴³

LUKOIL also owns a 100 per cent subsidiary RITEK which has for some time been specialising in the recovery of 'hard-to-develop' reserves. Indeed the company, whose acronym stands for Russian Innovative Fuel Energy Company, is currently pioneering the development of Bazhenov shale reserves using a combination of horizontal drilling, hydro-fracking and thermal gas treatment technology.⁴⁴ Two pilot projects, at the Galyanovskoye and Sredne-Nazymovskoye fields, are currently investigating whether thermal gas treatment can help to improve the feasibility of producing shale oil by heating it up and allowing it to flow more easily through low permeability reservoirs, using techniques similar to those seen in the development of Canadian bitumen reserves. Although the trials are at an early stage it is hoped that the combination of heating and fracking could allow a much broader development of shale reservoirs throughout the LUKOIL portfolio.

TNK-BP

Although TNK-BP is now owned by Rosneft and no longer reports its activities separately, the company's tight oil development plans before the takeover included seven pilot projects in West Siberia with a resource estimate of approximately 4.5 billion barrels. Indeed the company has been quoted as stating that it has almost 7.5 billion barrels of tight oil resources in West Siberia alone,⁴⁵ with more than 20 billion barrels of total 'difficult-to-recover' resources overall.⁴⁶ A number of the pilot projects are aimed at the development of new reservoirs at existing fields, with the North Khokhryakovskoye field being a good example. Current production from the conventional layers of the field is 1,600 barrels per day and the company aims to double this figure in 2013 by exploiting the 350 mm barrels of tight oil reserves at the field using the standard techniques of horizontal drilling and multi-stage fracking.⁴⁷ Although the production numbers are relatively small, the project will provide an indicator of the best methods to be used in the company's tight reservoirs, and up to \$100 million will be spent in 2013 to further the

⁴⁰ Interfax, 4 Feb 2013, 'Gazpromneft to be developing 60mm tonnes of tight oil by 2015'.

⁴¹ Financial Times, 31 Mar 2013, 'Red Lenin leads Russia's oil revolution'.

⁴² LUKOIL Fact Book 2013, pp.29–30.

⁴³ Interfax, 28 May 2013, 'LUKOIL looking to buy 1 to 2 tight oil assets in Russia'.

⁴⁴ Oil and Gas Eurasia, 8 Apr 2013, 'RITEK to extract Bazhenov shale oil with thermal gas treatment technology'.

⁴⁵ Interfax, 27 June 2012, 'TNK-BP starts intensifying production of hard-to-recover oil in Western Siberia'.

⁴⁶ Interfax, 12 Feb 2013, 'TNK-BP estimates its tight reserves at over 2.6bn tonnes'.

⁴⁷ Interfax, 23 Jan 2013, 'TNK-BP to double production at North Khokhryakovskoye field in 2013'.

company's understanding across all of its seven projects. A similar pilot will be conducted at the Ryabchik field on the borders of the giant Samotlor development, where almost 800 mm barrels of tight oil is believed to have development potential,⁴⁸ while the company's subsidiary Varyeganneftegaz plans to carry out a further three projects in partnership with Schlumberger in order to exploit the 2 billion barrels of 'hard-to-recover' reserves that it has on its books.⁴⁹

Partnership has also been a theme in TNK-BP's other two pilot projects, with the company working alongside Halliburton to exploit the Yem Yegovskoye field, another asset that is part of the huge Krasnoleninsky group of fields. TNK-BP's share is estimated to contain around 750 mm barrels of light, tight oil, and Halliburton has taken on a risk contract to use its drilling and fracking technology to improve field performance, receiving bonus payments for beating specified operational targets.⁵⁰ Prior to its takeover by Rosneft the company was looking to sign a similar deal to undertake its final pilot project at the Van Yogan field, with one of the company's Deputy General Directors pointing out that the need for foreign contractors was based on the fact that 'I think that in order to find some kind of efficient technology, we need to solve a whole lot of complex issues. Here we need quality well drilling and new completion methods, and it is precisely foreign service companies that have achieved success in these matters.'⁵¹

Small Company Activity

Aside from the large vertically integrated Russian oil companies and their foreign partners there are also a few small oil companies that are starting to investigate the country's unconventional oil potential. Ruspetro is an independent company quoted on the London Stock Exchange that is primarily focused on the production of tight oil reserves in West Siberia. It operates licences in the Krasnoleninsky area, where it has gained access to licences covering 1,234 km² of acreage with Bazhenov potential,⁵² and it has commenced initial exploratory work on these deeper reservoirs that are located below fields that already contain the company's 1.8 billion of proved and probable reserves.⁵³ Meanwhile in the Tomsk region of Siberia Imperial Energy, a company now 100 per cent owned by Indian National Oil Company ONGC, is also looking to exploit the shale and tight oil reserves in its licences in order to offset steep declines in production over the past two years.⁵⁴ The company believes that it may have up to 2.1 billion barrels of tight oil resources in its portfolio, and it is planning to start pilot projects in 2013 to investigate how much might be recoverable.⁵⁵ However, Imperial is seeking a strong partner to bring the technical expertise and the financing that it will require to fully appraise and develop its potential reserves, and although there has apparently been some interest from potential partners no deal has been struck to date.⁵⁶ Also operating two licences in the Tomsk region, Petroneft is another small company that has begun production from traditional reservoirs but has also identified potential resources in the Bazhenov shale layers below its existing fields. The company has yet to undertake any significant appraisal work, but provides another example of potential upside from the deeper unconventional layers in West Siberia.

⁴⁸ Interfax, 24 Jan 2013, TNK-BP launches pilot project building economic wells in Khanty Mansiisk district.

⁴⁹ Interfax, 25 Sept 2012, 'TNK-BP carrying out 3 of 7 tight oil projects at cost of \$100mmm'.

⁵⁰ Interfax, 22 Jan 2013, 'TNK-BP signs drilling contract with Halliburton for Yem-Yagovsky area'.

⁵¹ Interfax, 12 Feb 2013, 'TNK-BP might bring foreign service partner to Van-Yogan field'.

⁵² Ruspetro presentation, April 2013, 'Strategic Review', slides 27–28.

⁵³ Reuters, 26 July 2013, 'Ruspetro says tight oil tax relief to provide big boost'.

⁵⁴ Russia Beyond The Headlines, 31 Jan 2013, 'Falling oil output makes Imperial Energy a liability for ONGC in Russia'.

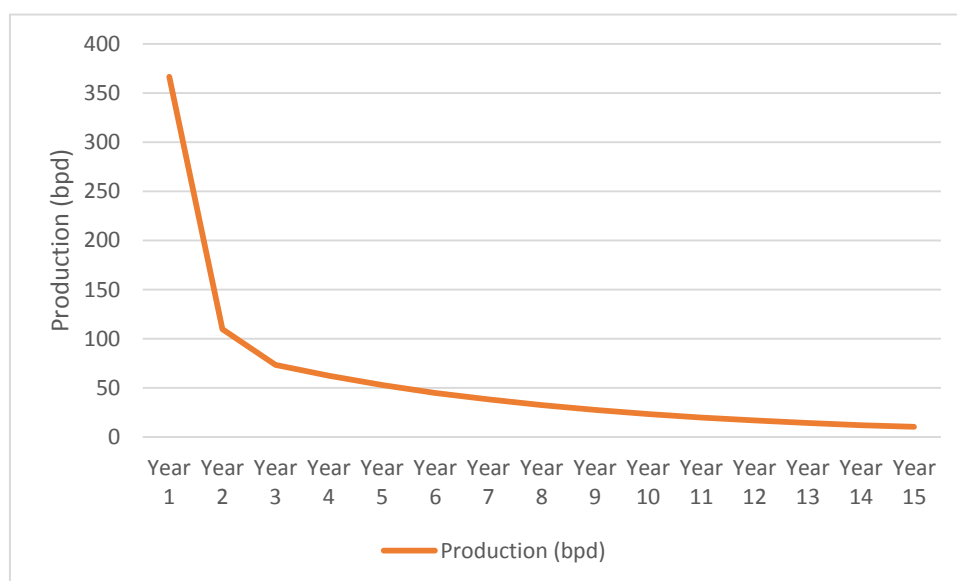
⁵⁵ Imperial Energy press release, 'Production results of 2012 and plans for 2013' at <http://www.imperialenergy.com/en/pressarea/pressreleases/full/100/> accessed on 6 Sept 2013.

⁵⁶ Rusenergy, 'Imperial Energy invites a strong partner to the Russian Bazhenov formation oil production projects and offers a share in the capital' from <http://www.rusenergy.com/en/news/> accessed on 6 Sept 2013.

4. Achieving the Commercial Development of Russia's Tight Oil Resources

It is clear from the descriptions above that although corporate enthusiasm for exploration of Russia's unconventional resources is rising, and is also starting to involve international companies, most of the activity concerns pilot projects to assess the size of the resource and the commercial realities of its extraction. First results appear to have confirmed the geological uncertainties mentioned earlier, with initial flow rates from wells varying from 75 bpd day to 2,000 bpd, and in some extraordinary circumstances to 7,000 bpd.⁵⁷ They also confirmed the well-known shale phenomenon of rapid production decline from individual wells, with output in year 2 being on average only 30 per cent of year 1 production,⁵⁸ and year 3 output falling to only 20 per cent of the initial flow rates before a long decline output tail (see Figure 4 for a typical production profile). The greater risk that this has generated has been further compounded by the higher cost of drilling the necessary horizontal wells to a greater depth than has historically been associated with oil field development in Russia. While an average vertical well into a conventional West Siberian oil field might cost \$1–2 million, a horizontal well into the deeper Bazhenov layer is more likely to cost in the region of \$8–10 million, with some drilling companies estimating a possible cost as high as \$15 million for more complex wells.⁵⁹ By comparison US company Hess has reported that its average cost for drilling and completion of a well into the Bakken shale in North Dakota is now \$8.6 million,⁶⁰ while Marathon Oil reported that its average well cost into the Eagle Ford shale was in the region of \$8–8.5 million in the fourth quarter of 2012.⁶¹ In Russia some companies have mentioned much lower drilling costs, with Rosneft citing a figure of \$5 million per well,⁶² but it seems very unlikely that the average cost for the drilling and full completion of a well would be lower than in the very competitive US market.

Figure 4: Typical Bazhenov well production profile



Source: Author's estimates based on company data

In light of these high well costs, variable flow rates and sharp decline rates that are so different from the traditional Russian oil field model, the economics of developing tight oil from the Bazhenov shale reservoirs

⁵⁷ Siberian Oil Magazine, May 2012, 'A Suite for Oil Barons'.

⁵⁸ ROGTEC Magazine, 27 Aug 2013, 'In Search of Big Shale in Upper Salym'.

⁵⁹ Nefte Compass, 18 Oct 2012, 'Tax breaks pose a balancing act for Russia's Bazhenov Shale'.

⁶⁰ <http://bakkenshale.com/news/hesss-bakken-drilling-days-well-costs-down/>, accessed on 28 Aug 2013.

⁶¹ Marathon Oil conference call with investment analysts, 13 Feb 2013.

⁶² Wood Mackenzie Consultants, June 2013, 'Latest Unconventional Plays to Watch'.

require a tax system that allows swift cost recovery. The current Russian system, however, has been created for an industry largely producing from existing fields with low capital expenditure requirements. It is based on a revenue-based royalty (Mineral Extraction Tax or MET for short) and export tax regime that is applied to every barrel equally, from first production to final depletion, making no allowance for profitability. As a result, it has historically been very difficult to justify the commercial development of unconventional oil in Russia, especially as the effective tax rate at a \$100 per barrel oil price has been around 60 per cent, assuming that 45 per cent of production is exported and 55 per cent sold domestically. For example, the author estimates that a Bazhenov well with a cost of \$9 million and an initial flow rate of 50 tonnes per day (370 bpd) would have an IRR of minus 5% at an oil price of \$100 per barrel under the tax system prevailing in the first half of 2013. Indeed it would need an export oil price of well over \$200 per barrel to achieve a 15 per cent hurdle rate (assuming that 45 per cent of the oil is exported).

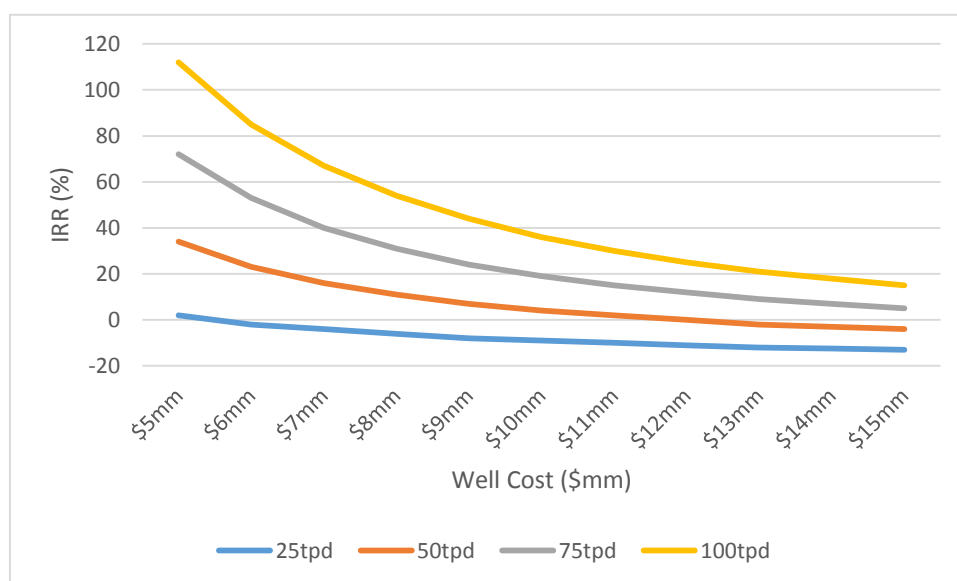
As a result, a lengthy discussion has been continuing between the oil industry and the Russian government concerning either the introduction of a profit based tax system or a reduction in the current rates of MET and/or export tax. This has resulted in the passing at first reading of a bill that will significantly reduce, and in some cases remove, the MET royalty tax from tight oil developments.⁶³ The bill, which attempts to give tax breaks to a broad range of 'hard-to-recover' oil, essentially differentiates between reservoirs according to their permeability, the extent of field depletion and the size of the oil-filled formation. Various co-efficients are then applied to reduce the level of MET, with for example oil produced from layers with very low permeability and no thicker than 10 metres being given a co-efficient of 0.2 (that is, they pay 20 per cent of the current MET rate), while similar reservoirs with a thickness more than 10 metres will have a co-efficient of 0.4. The deep Tyumen deposits mentioned above will have a co-efficient of 0.8, meaning that there will not be much tax relief for any oil produced, but the shale layers in the Bazhenov and its associated Abalak, Khadum and Domanik reservoirs will have a co-efficient of zero, meaning that they will incur no MET for a period of 180 tax periods (equivalent to 15 years).⁶⁴

The immediate impact of this tax change on a standard shale well producing 50 tonnes per day and costing \$9 million is impressive, but not completely persuasive. The IRR increases from minus 5 per cent to plus 7 per cent, but with most companies setting their hurdle rate in the range 15–20 per cent this would still not be enough to justify investment. This highlights the key problem with the MET tax break, namely that it continues to apply the same break to all wells irrespective of cost or initial output, without regard to profitability. In essence, this is the same problem being faced by the Russian oil industry as a whole, except it is magnified because of the high costs involved and the huge range of uncertainty around many of the basic assumptions in the economic calculations. Figure 5 demonstrates the dramatic differences in the economic results between various well cost and initial output assumptions and underlines the continuing issue for all oil companies looking to develop Russian unconventional oil resources.

⁶³ Interfax, 2 July 2013, 'State Duma passes bill to differentiate tight oil tax at first reading'.

⁶⁴ See fn. 63

Figure 5: The Economics of Russian Unconventional Oil



Source: Author’s calculations based on Urals Blend oil price of \$100 per barrel

As can be seen, a well with an initial output of 50 tonnes per day and a cost of \$9 mm has an IRR of 7 per cent, but the same well producing 75 tonnes per day has an IRR of 24 per cent, and at 100 tonnes per day the IRR leaps to 44 per cent. Similarly a 50 tonne per day well has an IRR of 16 per cent at a \$7 mm well cost but only 2 per cent at an \$11mm cost. Although it might not seem surprising that a 50 per cent increase in output should produce a large increase in IRR, the key point here is that well output of 75 or 100 tonnes per day is well within the parameters of likely outcomes, but 25 tonnes per day is also perfectly possible, at which point the IRR barely gets above zero even if the well cost falls to \$5 mm. Furthermore, these economics only take into account the cost of successful well development and make no allowance for the cost of the possible 35 per cent of wells that could be dry or non-commercial. Even if this ‘dry-hole’ percentage is reduced to 25 per cent or even 20 per cent the impact of the additional cost of one ineffective well in five would effectively add more than \$2mm to the cost of each producing well, and as Figure 4 shows this could easily tip even a 75 tonne per day well into marginal economic territory.

With the average well in the Bazhenov having an initial flow rate of 50 tonnes per day⁶⁵, however, it is not surprising that a number of companies are continuing to press for further tax breaks, including a reduction in the rate of export tax, from the Russian government.⁶⁶ At present such a move is not under consideration, in particular because the impact on an already stretched Russian budget that relies heavily on oil export taxes would be too significant for the Ministry of Finance to countenance. As a result, although the current MET exemption is certainly a positive step towards the development of Russia’s shale and tight oil resources it may not be enough to encourage the full scale exploitation of the resource in the short term. A key indicator of the suitability of the tax regime is likely to emerge only after the completion of the Rosneft/ExxonMobil pilot project in 2015, as this will provide some more accurate estimates for the key production and cost parameters for the economic calculations and ExxonMobil would be very unlikely to underwrite further significant expenditure unless this was accommodated within a suitable tax environment.

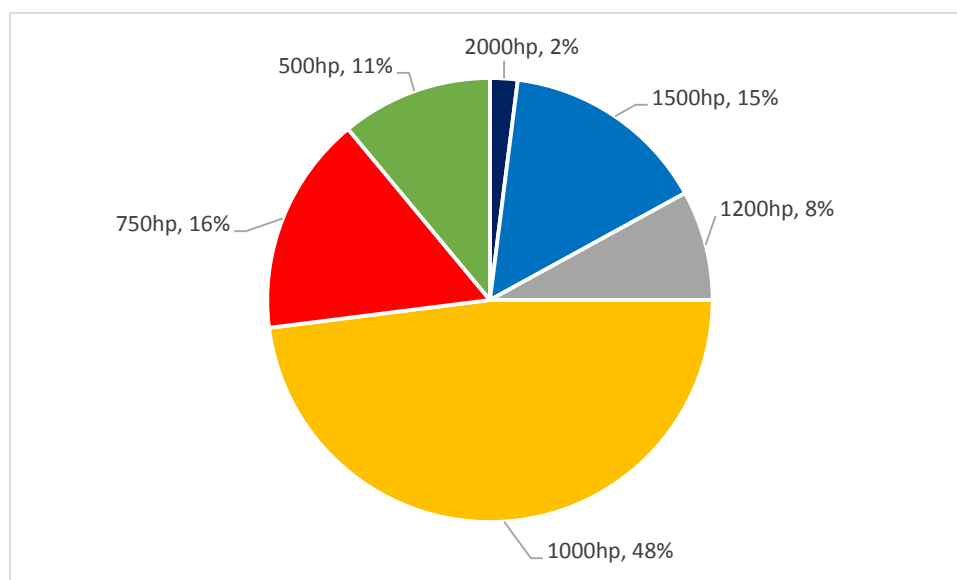
⁶⁵ Wood Mackenzie Consultants assumes a flow rate of 40tpd in its base case economics for the Bazhenov, while Rosneft has guided investors towards a 50tpd flow rate from the Bazhenov at its Yuganskneftegaz subsidiary. At the high end of the range GazpromNeft has cited 80tpd as a good initial flow rate, with the caveat that a well next door could produce at a much lower rate - <http://www.gazprom-neft.com/press-center/lib/1095165/> accessed on 28 Aug 2013.

⁶⁶ Nefte Compass, 18 Oct 2012, ‘Tax breaks pose a balancing act for Russia’s Bazhenov Shale’.

5. A Practical Issue – The Availability of Sufficient Drilling Equipment

The issues of geology and taxation will clearly be critical to the development of Russia's tight oil reserves, but a further complication could also emerge in the service industry, where the provision of sufficient equipment to meet aggressive development and production objectives could be a significant problem. According to data provided by REnergyCo,⁶⁷ who produce monthly rig statistics for Russia, the total current fleet of rigs working in the country has varied between 717 in February and 978 in June 2013, and data from the Russian drilling company Eurasia Drilling would suggest that around 17 per cent of these would be powerful enough (1500 horse power or above) to drill the deep horizontal wells that are needed in the Achimov, Bazhenov and Tyumen reservoirs (see Figure 6).⁶⁸ As a result we can deduce that there are approximately 150–175 heavy rigs active in Russia at present, but it would also seem logical to conclude that they are all already active drilling the 800 horizontal wells that were completed in Russia in 2012 on existing fields, particularly in Timan Pechora and West Siberia. As a result, it would seem to be safe to conclude that, although some old rigs will be freed up to work on unconventional reservoirs, it is likely that the majority of the rigs needed to develop Russia's tight oil reservoirs will need to be built over the next few years. Indeed rig manufacturers are already anticipating a multi-billion dollar bonanza as a result of this increased activity.⁶⁹

Figure 6: Breakdown of Russian rig fleet



Source: Eurasia Drilling Company

A relatively simplistic analysis would appear to support this conclusion. If we assume, for the sake of argument, that all rigs required to carry out deep unconventional drilling will need to be new and that the Ministry of Natural Resources target of 1 mmbpd of production must be met in 10 years, then using standard assumptions for initial well output, decline rate and wells drilled per rig per year then we can estimate the number of rigs required. We assume that the initial well production will be 50 tonnes per day and will decline as shown in Figure 3 above, and on this basis the number of wells required to reach output of 1mmbpd will peak at 1800 in year 10 of a full development programme (see Figure 7). In terms of the number of rigs needed to meet this drilling programme, we assume that each well will take 35 days to drill (compared to around 26 days for Bakken wells in the USA)

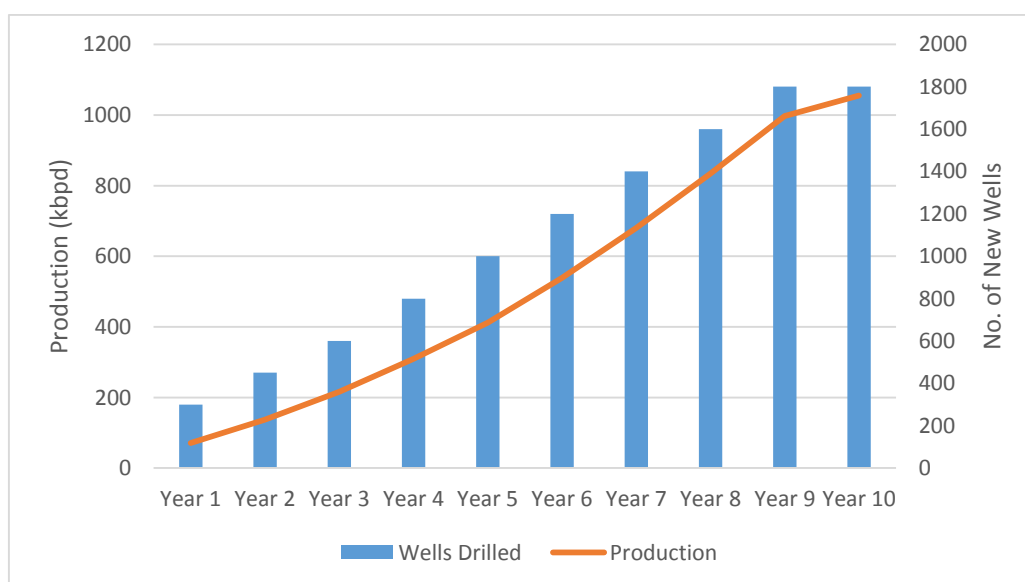
⁶⁷ <http://russian-energy-co.com/russian-rig-count.html> accessed on 28 August 2013.

⁶⁸ Bloomberg, 29 May 2013, 'Varco to Honghua vying for \$9bn of Russia oil rigs.

⁶⁹ See fn. 68.

and that there will also be time needed for movement between well sites and fields, which will probably be considerable. Eurasia Drilling estimates that it would take on average 45 days to move a rig from one field to another, but as it is likely that multiple wells will be drilled from the same site before any movement we have reduced this 'down-time' to an average of 25 days, in which case the implication is that each rig would be able to drill, on average, 6.1 wells per annum. This would imply that at the peak level of activity 220 rigs would need to be active drilling new wells to maintain output at or just above 1 mmbpd, and if one then includes a 25% contingency to allow for rig downtime and maintenance one can estimate that up to 275 new rigs might need to be constructed over the next 10 years to meet an aggressive Russian unconventional oil production target. In terms of a comparison with the US, around 180 rigs were active in North Dakota and Montana in August 2013 according to the Baker Hughes rig count statistics, supporting production of 700,000 bpd,⁷⁰ implying production per rig of 3,900 bpd, while our Russian assumptions suggest that 275 rigs will be needed to sustain 1 mmbpd, or 3,600 bpd per rig. Given the difficulties of the Russian environment and the developing nature of the services industry there, this difference in efficiency would seem to be reasonable and provides some confidence in our estimate.

Figure 7: Estimate of wells needed to meet Russia's tight oil production targets

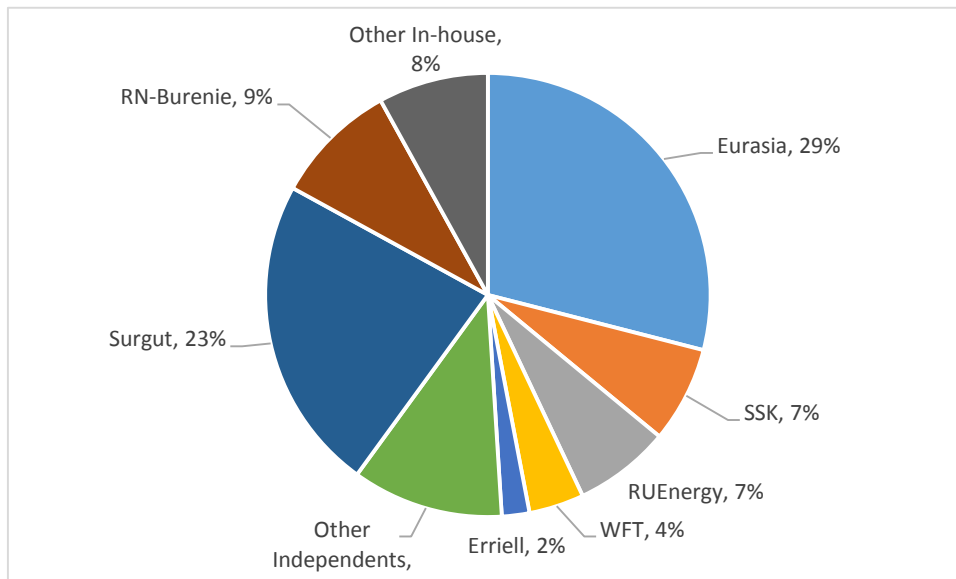


Source: Author's estimates

The key question, of course, is whether this number of rigs can be built within the given 10 year timescale. Even if the forecast outlined above is only directionally correct, achieving 1 mmbpd of tight oil output would require a tripling of Russia's heavy oil rig fleet, and with the individual cost of new heavy rigs estimated in a wide range of \$10–60mm the total bill could reach as much as \$15 billion, or around \$1.5 billion per annum over 10 years. By comparison, Eurasia Drilling, which accounted for 29 per cent of all onshore drilling in 2012 (see Figure 8) had a total capital expenditure for the year of \$600 mm. Extrapolating this to create an approximation for the drilling industry as a whole, we can surmise that total OFS drilling capital expenditure might have totalled \$2 billion in 2012, meaning that our estimate of the potential annual requirement for unconventional drilling alone would account for 75% of this if the Ministry of Natural Resources target is to be met.

⁷⁰ <https://www.dmr.nd.gov/oilgas/stats/historicalbakkenoilstats.pdf>, accessed on 28 August 2013.

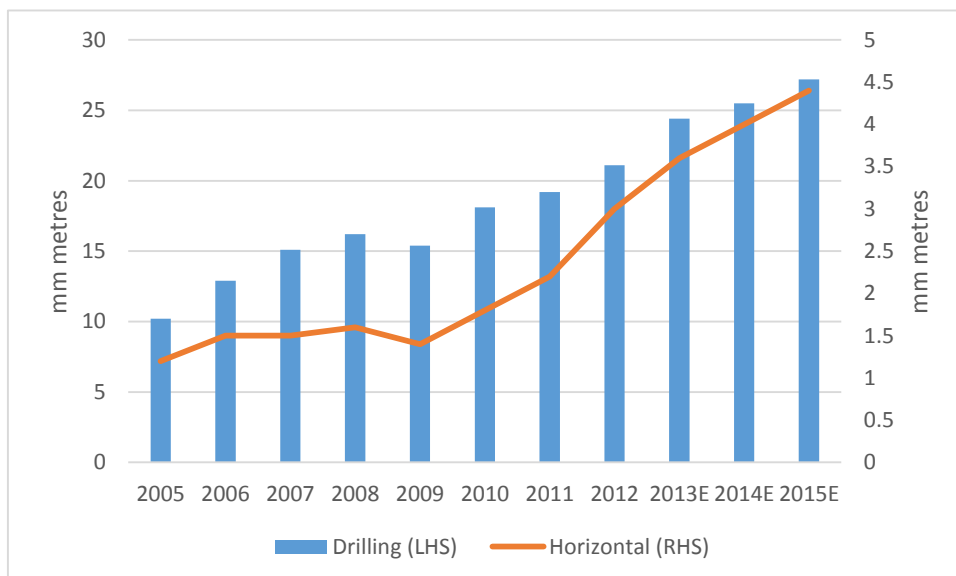
Figure 8: Company share of onshore drilling in Russia (2012)



Source: Eurasia Drilling

Of course it must be acknowledged that all these calculations are highly theoretical at present, but they do at least highlight the very real potential of an OFS industry capacity constraint over the next decade in Russia. Indeed, even short term forecasts of likely drilling activity underline the tremendous growth that is likely to occur as more intensive and deeper exploration and development activities proceed. Figure 9 shows an industry forecast for the increasing drilling volumes and the growing prevalence of horizontal drilling in Russia to underline the point.

Figure 9: Forecast of drilling activity in Russia to 2015



Source: Eurasia Drilling

One final point about the investment required in Russia's oilfield services industry is that there may be a significant risk of delay in spending while oil companies establish the true potential of the resource base. Oilfield service companies will not invest in the drilling capacity to service an industry producing 1mmbpd until they know

that this potential can be reached and therefore that their new rigs will be able to make a reasonable rate of return over the medium to long term. An outcome that saw either production targets being missed or production peaking at 1mmbpd but then going into rapid decline could spell disaster for service companies, and as a result they will be likely to invest cautiously as they see the unconventional industry in Russia grow. By default this is likely to temper the growth in production in the short term, meaning that more aggressive output targets are unlikely to be met.

6. Other issues

Aside from the major issues of the economic viability of unconventional oil development in Russia and the availability of sufficient oil service capacity, there are a number of other questions that will need to be answered before companies make significant investment decisions.

Law on Strategic Reserves: One legislative issue, at least for foreign companies, concerns the Law on Strategic Reserves which was introduced as an amendment to the Subsoil Law in May 2008,⁷¹ and which limits foreign involvement in fields with reserves above a certain size, namely 70 million tonnes (c.500 million barrels) for oil and 50bcm (c.1.75 Tcf) for gas. Any fields larger than this, or located offshore, must have a Russian company as a majority shareholder. However, because shale oil resources are much more complicated to define in compartmentalised blocks compared to conventional fields, which generally have a defined areal extent and depth below a trap of some kind, the Russian authorities may struggle to define accurately whether a particular company owns a strategic resource or not. This could in future create problems for any foreign company that might start as a majority shareholder in a license area only to find that its position is illegal. At present this potential problem is being resolved through the formation of JVs between Russian companies with a 51 per cent stake and foreign companies with a 49 per cent stake, but if the industry is to develop in a rapid and competitive fashion the issue of strategic reserves may need to be addressed in order to encourage a broader sweep of company involvement in unconventional oil development.

Corporate landscape: This raises a second more subjective question about the corporate environment needed to catalyse successful development of unconventional reserves. The Unconventional Gas Centre in North Dakota lists 89 companies that operate in the Bakken shale area of the US alone,⁷² and it is this diversity of corporate involvement as well as the small and adaptive nature of many of the companies that has been at the heart of the success of the unconventional oil and gas industry in that country. The largest producers from the Bakken shale in 2012 were Whiting Petroleum and Hess, and although these are not small companies, with market capitalisations of \$6.2 billion and \$26.5 billion respectively,⁷³ they are not the multinational IOCs that were actually quite slow to enter the US unconventional industry. As described by one industry participant 'the big international oil companies are good at being able to plan ahead...have multi-year timeframes and can execute very complex projects. But all these things become weaknesses when you are working in shale plays. You need to revisit your planning according to what you learn about the reservoir, or the market. And that adaptive planning is what the smaller companies are good at.'⁷⁴ Indeed one Chevron employee openly commented that 'we're going to do it [shale oil development] right, [but] it will probably take us a little longer than some others.'⁷⁵

The corporate landscape in Russia is in sharp contrast to the dynamic smaller company model in the US, with a few large companies leading the way, dominated by the country's NOC Rosneft. A partnership model with large

⁷¹ Subsoil Law N-2395-I, 21 February 1992.

⁷² <http://www.ugcenter.com/operators/Bakken/all> accessed on 5th Sept 2013.

⁷³ <http://www.bloomberg.com/quote/WLL:US> and <http://www.bloomberg.com/quote/HES:US> respectively, accessed on 9 Sept 2013.

⁷⁴ Financial Times, 7 July 2013, 'Smaller companies at vanguard of US shale oil revolution'.

⁷⁵ As footnote 73.

IOCs has been developed in order to introduce international technology and experience, but one conclusion from the Chevron experience might be that progress is likely to be methodical rather than rapid. It is too early to draw any conclusions yet as to whether the Russian model will ultimately be more or less successful than the US model, as the IOC/NOC partnership concept is itself at an early stage of development. All that can be said is that it is different and so inherently carries the risk of becoming a longer term rather than a shorter term project, with large companies having a broader focus of interests and concerns to act as potential distractions than the smaller and more entrepreneurial concerns that have been at the forefront of shale oil developments in the US.

Licensing: The relatively tight nature of Russia's corporate landscape is also exacerbated by the licensing regime for tight and unconventional oil, which tends to favour larger companies. Much of the Bazhenov shale reservoir lies below existing licenses and fields in West Siberia and, as has been mentioned above, is the main source rock for oil in the region. In some instances the licenses for shallower reservoirs also extend down to the deeper shale layers, and so the large companies which dominate Russian production have extensive Bazhenov exposure by default. Even if the current licenses do not currently extend down to the Bazhenov, however, it is expected that companies owning the shallower licenses will be able to extend their exploration to the deeper horizons as a matter of course. As far as new licenses are concerned, GazpromNeft has identified acreage containing a potential 8–10 billion tons (60–75 billion barrels) of resources that has yet to be allocated in the Khanty-Mansiisk region alone, so the possibility of new entrants arriving still remains.⁷⁶ Given the current government preference towards state-controlled institutions, however, highlighted by a recent Fitch ratings agency report,⁷⁷ and the implications of the Law on Strategic Reserves discussed above, it would seem likely that the majority of this new acreage will go to the same group of companies that currently dominate the industry.

Environment and water issues: Russia's huge geographical expanse means that it is unlikely to be troubled by the environmental concerns that are currently facing more densely populated countries where lobby groups are raising concerns about the possible impact of fracking on supplies of potable water and the risk of seismic disturbances. Nevertheless, Russia does have some strict environmental laws that can impose severe fines on companies that cause damage through leaks or harmful waste disposal, and it is currently unclear whether these might need to be adapted further to account for the increased activity that would result from significant horizontal drilling and well fracking involved in the development of tight and shale resources.⁷⁸ Given that activity on tight reservoirs using these techniques has been underway for some years under current legislation one might assume that this will remain the situation if drilling for unconventional resources expands. Given the difficult terrain in Siberia, however, combined with the extreme weather conditions, which means that the landscape changes from a frozen wasteland in winter to boggy marshes in summer, it would not be surprising if the Russian authorities decided that new legislation is required to manage a different type of development activity that involves high levels of liquid injection and the need to deal with the return of at least 15 per cent of injected water to the surface. Any examination of this issue could clearly take some time and cause delays to operational activity.

One of the other main environmental issues may also concern the use of water. Although there would seem to be little risk of drought in Siberia, the fact that temperatures remain below zero for a significant part of the year means that the issue of water provision could be a significant one. This may require state approval for a broader network of heated pipelines to manage winter water supply, the expansion of road transport fleets and storage

⁷⁶ Oil and Gas Journal Russia, 25 June 2013, 'There is no alternative to the alternative'.

⁷⁷ Fitch Ratings Agency report, 27 Aug 2013, 'Russian Oil and Gas Industry – Rising State Ownership, Lower Volatility, Higher Country Risk'.

⁷⁸ King and Spalding, Overview of Russian Environmental Legislation, accessed from <http://www.kslaw.com/imageserver/KSPublic/library/publication/RussianEnvironmental.pdf> on 9 Sept 2013.

facilities to cater for water provision at different times of the year and an adaptation of the rules for water extraction and injection that are currently managed by the Ministry of Natural Resources. None of these issues are insurmountable, of course, but could nevertheless lengthen the process of moving from the exploration to full development of Russia's unconventional resources.

Manpower requirements: A final, and much more subjective, question concerns the availability of sufficient skilled labour in Russia's oil heartland to meet the requirements of the much more intensive work required to exploit unconventional oil and gas. While it is impossible to be definitive at this early stage of the resource development, the development of the Bakken resource in the US is estimated to be creating 65,000 new industry-related jobs,⁷⁹ and the boom in oil production in North Dakota is causing a shortage of manpower and facilities. As one industry participant described the situation – 'we need help, we need manpower and we need intelligence.'⁸⁰ In Russia much of the country's skilled oil industry workforce is already heavily engaged in stemming the decline of the country's existing assets and indeed the economy as a whole could be facing labour shortages as the population declines,⁸¹ with the consequence that if a dramatic increase in drilling is required to accelerate unconventional output then it is likely that significant additional manpower will be required that cannot just be shifted from existing fields. Of course foreign company participation can alleviate this problem to an extent, but nevertheless there must be some question about the availability of skilled human resources in West Siberia to meet future industry needs.

7. Conclusions

Russia's traditional oilfields in West Siberia are in decline and the Russia government and its oil companies are therefore faced with some stark choices if they wish to retain the country's oil production above 10 mmbpd. Much excitement has been generated by the huge exploration potential of the country's offshore basins, with joint ventures being formed between Rosneft and various IOCs to exploit licenses in the South Kara, Barents and Black Seas and with tax incentives being provided by the Russian administration to encourage investment. A separate element of these joint ventures has also been the exploitation of Russia's tight and shale oil resources, which could in fact produce a more rapid result in terms of production to replace any decline from current fields. Indeed, with the USGS estimating that Russia is the largest holder of shale oil resources in the world, with 75 billion barrels of potentially recoverable resources, it would seem that the opportunity is huge, and the Russian Ministry of Natural Resources has set a target of 1 mmbpd of production from this resource base by 2025.

This enthusiasm, however, needs to be tempered because of a number of issues that will need to be faced if successful development of Russia's unconventional oil is to be achieved. The country's most extensive shale oil, in the Bazhenov reservoir, has been likened to the Bakken resources in North Dakota which are currently producing over 700,000 bpd, but the differences between the two areas are as interesting as the similarities. A detailed geological assessment of the more than 2 million km² of Bazhenov reservoir has yet to be completed, but even the early seismic and drilling results suggest a significant heterogeneity across even short distances, with starkly different initial flow rates and decline curves from wells only a few kilometres apart. Furthermore, there is a large difference in well drilling cost estimates that again suggests a wide variety of operating conditions, increasing the risks for operators.

⁷⁹ <http://www.minotdailynews.com/page/content.detail/id/572353/No-stoppin--the-Bakken.html>, accessed 6th Sept 2013.

⁸⁰ http://billingsgazette.com/news/state-and-regional/montana/bakken-an-industry-not-a-boom-speaker-tells-montana-audience/article_4ae8e4b0-cc87-5b49-becb-c9c8a9cecbf9.html accessed 6 Sept 2013.

⁸¹ World Bank, July 2011, "Growth and Labour Sufficiency in Russia".

In these circumstances a tax regime that focuses on royalty payments per barrel of oil produced or exported without regard for cost recovery is always going to make it difficult for oil companies to generate commercial returns from their investments. The Russian government has started to appreciate this fact, and recent legislation has offered a scale of MET royalty payments according to the difficulty of extraction, but as our analysis has shown even this may not be enough to encourage wide-scale investment. Reductions in export tax rates may also be required, but a more rational long-term approach would be a restructuring of the regulatory system to focus on taxing profits rather than revenues. The Russian administration is reluctant to do this for fear that 'creative oil company accounting' will result in the majority of oil production being classified as 'hard-to-recover', with a consequent loss in tax revenue, but it may be the case that the need to incentivise the development of Russia's unconventional resources can provide an additional spur to action on a profit-tax regime for the Russian oil industry.

Another key question for the development of Russia's shale and tight oil resources will be the expansion of the oil service industry. The number of heavy oil rigs, which are capable of drilling the deep horizontal wells needed to exploit the Bazhenov reservoirs, will need to triple if the Ministry of Resources target is to be met, raising a question about the ability of the oil service industry to meet the possible \$15 billion expenditure requirement. Furthermore, the industry will also have to expand its ownership of fracking equipment and other operational items, and this will put pressure both on its ability to finance so much purchasing in a relatively short period of time and its willingness to take the risk of investing in what remains an uncertain resource base.

The other key issue which faces the Russian oil industry as it seeks to develop its unconventional resources is the overall corporate landscape of the sector. In North Dakota alone 89 small and medium-sized companies are involved in developing the Bakken shale, while in Russia four large and vertically integrated companies (now that Rosneft owns TNK-BP) are heading the drive to develop the Bazhenov reservoirs in co-operation with their new international partners. It is too early to say whether the new NOC-IOC partnership model that is becoming prevalent in Russia will be successful in developing the country's tight and shale oil resources. The suspicion must be, however, that companies with a broad sweep of domestic and international interests will be less likely to focus on the swift resolution of the many problems that are sure to be faced than the very entrepreneurial entities that are prevalent in the US unconventional sector.

Overall, then, although Russia undoubtedly contains huge potential for the development of unconventional oil resources, it would seem unlikely that the aggressive Ministry of Natural Resources target will be met. We will know much more about the geological and commercial issues that the industry faces once the Rosneft-ExxonMobil pilot project is completed in 2015, but the suspicion is that the Russian government may need to show even more flexibility in its tax arrangements in order to encourage full scale development of the Bazhenov shale. On a positive note, this could produce the ultimate catalyst towards a full revision of the oil tax system towards a profit-based model, in order to ensure that production remains above 10 mmbpd. A less encouraging development would see continued concerns about a short-term loss of tax revenue leading to a continuation of the status quo with ad hoc adjustments, thus undermining the development of the industry and preventing even the more conservative Ministry of Energy targets for shale and tight oil production being met.

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