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Shrinking surplus: the outlook for Russia's spare gas productive capacity

Introduction

The notion of Russia having a vast spare productive capacity of natural gas has been a byword for market watchers since 2012, when Gazprom's long-anticipated launch of a new generation of Russian gas supply – the Yamal province – coincided with a dwindling call on Russia's gas abroad and stagnant demand at home. This resulted in Russia being unexpectedly left with an enormous amount of spare productive capacity in natural gas, amounting at times to an excess of 200 Bcm on an annual basis[1], exceeding the country's total annual gas exports to Europe.

But since 2016 the situation has started to shift as far as demand is concerned. The rapidly increasing call on Gazprom's gas in Europe in 2017-18, along with some recovery of Russia's domestic gas consumption, have changed the demand side of the equation. In turn, the supply side has responded. The resulting ramp-up of production at new Russian gas fields to maximum planned levels and higher output at balancing fields in response to higher demand have reduced spare productive capacity. At the same time, the natural decline in production at older gas fields has been taking its toll. Now, at the end of 2018, worries over the availability of Russian gas for meeting peak demand have returned to centre stage.

Spare productive capacity metric and the gas industry

Spare productive capacity has been one of the most important gauges for the state of the global oil market for many years, indicating relative scarcity or, conversely, abundance of supply. The safety valve of spare productive capacity is important for commodity markets which are prone to extreme price volatility and pronounced cyclical movements on the demand side and geopolitical shocks on the supply side. Historically, Saudi Arabia has been the global swing producer and key holder of spare capacity for the global oil market. It has usually kept more than 1.5 - 2 million barrels per day of spare capacity on hand for market management. As the largest producer of low-cost oil within OPEC and the world's largest oil exporter, Saudi Arabia was in a position to either withhold oil from the market or, conversely, deliver the required volumes at relatively short notice. Recently, however, Saudi spare capacity has declined markedly as a result of the battle of wills between US tight oil and OPEC+.[2]

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[1] Gas volumes in this report, unless otherwise stated, are in Russian standard units. In Russia the measurement of gas volume is performed at 20 degrees Celsius as opposed to 15 degrees in Europe. According to Gazprom's annual report, 1000 cubic meters of Russian gas equals the equivalent of 8850 kcal/1000 cubic meters. To convert to European standard cubic meters - 9500 kcal/1000 cubic meters or the equivalent of 39.8 MJ per thousand cubic meters multiply Russian volume by 0.916.

[2] Yermakov, V. Supply Dynamics among the "Big Three" Oil Producers: Russia, Saudi Arabia and the USA. – IICEC Energy and Climate Research Paper, Istanbul, July 2018

Vitaly Yermakov, Head of Centre for Energy Policy Research,
National Research University,
Higher School of Economics, Moscow

In contrast, for gas markets that until recently have remained regionalized and largely shielded from disruptions by a web of long-term contracts (many of them with embedded volume flexibility), spare productive capacity was not a priority issue. Each national market had to plan its long-term natural gas supply via a rigid system of point-to-point deliveries and manage seasonal demand fluctuations via flexible nominations and use of storage. The growth of the LNG business opened opportunities for greater flexibility regarding the choice of suppliers, but for many years the chance for LNG trade to facilitate the creation of a truly global market for gas has been muted by the restrictive destination clauses in legacy contracts. Gradually, over the past decade, the growth of new flexible LNG volumes has led to increased connectivity between gas markets and greater arbitrage opportunities. Thus, "the globalization of the gas market is leading to a situation where analysis of spare supply capacity is becoming as important a theme in the gas industry as it has been for some time in the oil market"[3].

The accepted definition of spare productive capacity for crude oil refers to production that can be brought on stream within 30 days and sustained for at least 90 days[4]. As a metric, spare capacity is expressed in million barrels of oil per day, as seasonal swings on the production side are relatively insignificant. For the gas business, the situation is very different, since gas output usually follows a very pronounced seasonal cycle. Therefore, in order to analyze spare productive capacity for natural gas, it is crucially important to determine peak spare capacity for the "high season" on a monthly basis or its lack thereof, in addition to estimating average daily or annual spare productive capacity.

Recent analysis by Bros suggests that global spare productive gas capacity shrank dramatically in 2017, with the lion's share currently maintained by Russia's Gazprom.[5] The paper looks at the evolution of Russia's spare productive capacity in natural gas in the past few years and argues that gas spare capacity needs to be carefully monitored. One major conclusion from the research is that this topic is likely to become an important game changer for many aspects of Russia-Europe gas trade in the years to come.

News from Russia: the gas surplus is shrinking quickly

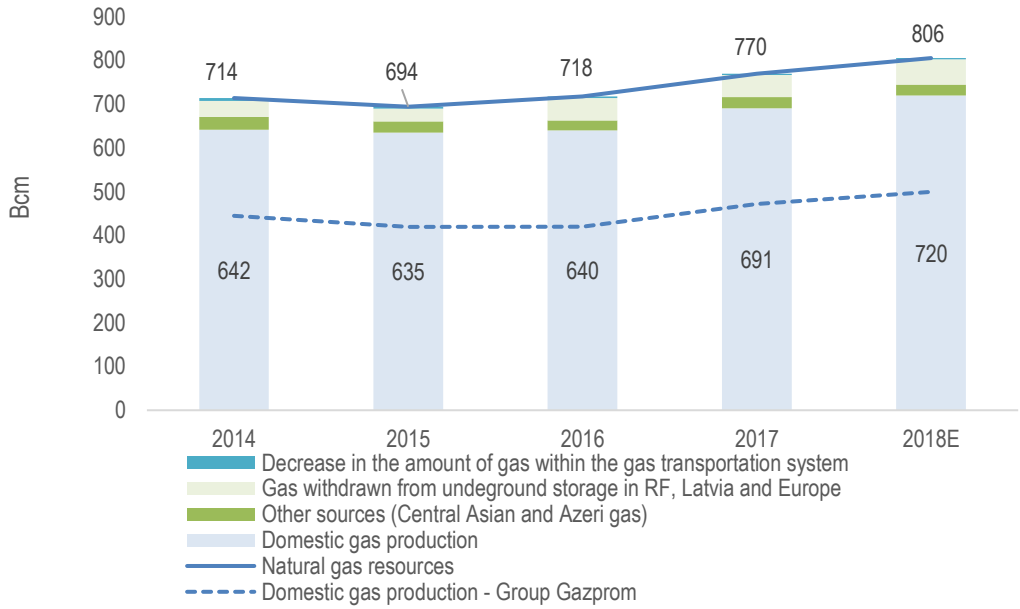
In times when the availability of Russian gas statistics has deteriorated to the point where the Ministry of Energy no longer provides data on Russian gas production on its website and the difficulty of obtaining the statistics necessary to analyze the state of the industry is growing day by day, it pays to review carefully the official records of meetings in the Kremlin between President Vladimir Putin and Gazprom CEO Alexey Miller. On January 20, 2017, Miller had a scheduled meeting with Putin to report on the performance of the state company during the previous year. At that meeting he told the President that Gazprom's overall productive capacity at the start of 2017 was 570 Bcm, and its spare capacity was about 150 Bcm.[6] At a similar meeting held later that year on November 28, 2017, Miller's estimate of spare productive capacity had drastically changed. He stated that Gazprom's total productive capacity at the end of 2017 had fallen to 550 Bcm, and expected annual production was about 470 Bcm, resulting in a 47 per cent decrease in the estimate of spare productive capacity, to about 80 Bcm.[7] The scale and speed of the drop call for an explanation. Even more importantly, have we seen the start of an emerging trend whereby Russia's current position of being a (potential) swing gas supplier ready and willing to meet spikes in demand at home and abroad is going to give way to supply-side constraints in the future?

[3] Bros, T. *Oxford Quarterly Gas Review*, March 2018
[4] US EIA *What Drives Crude Oil Prices?* Retrieved November 25, 2018, https://www.eia.gov/finance/markets/crudeoil/supply-opec.php
[5] Bros, T. *Oxford Quarterly Gas Review*, March 2018
[6] http://www.gazprom.ru/press/news/2017/january/article299819/
[7] http://www.gazprom.ru/press/news/2017/november/article383359/

Surge in export demand for Russia's gas drives higher output

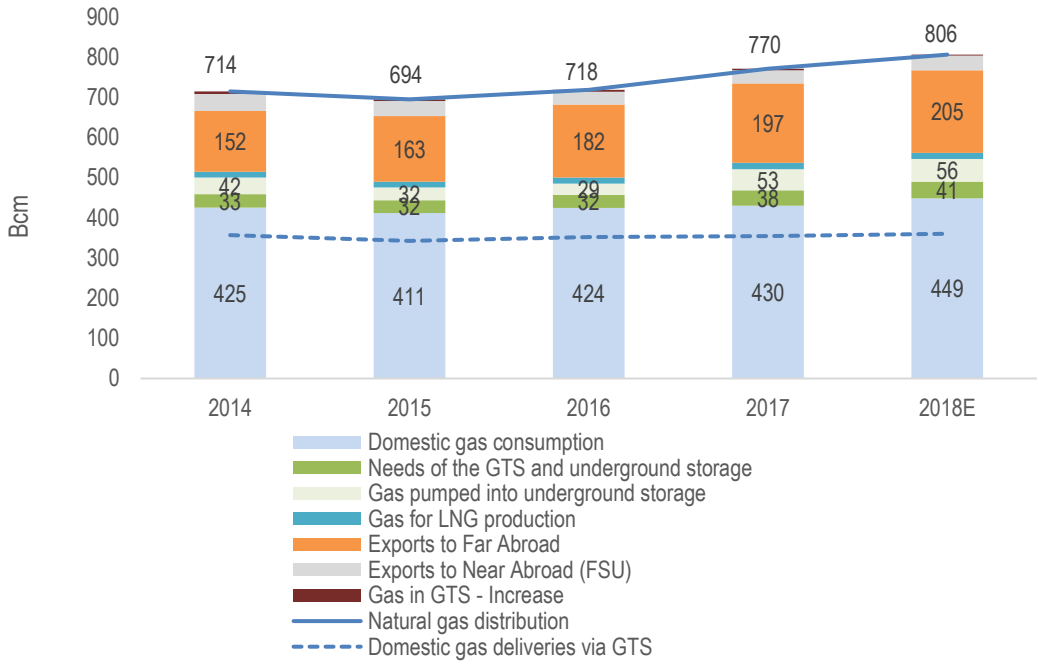
Reviewing changes in Russia's gas balance over the past few years reveals two main reasons for the higher call on Russian gas and the corresponding increase in production, namely higher export deliveries and an increase in gas storage fill, the latter reflecting the expected continuation of robust demand in the near term (see Figure 1 and Figure 2).

Figure 1: Russia's gas balance – supply sources



Source: Gazprom

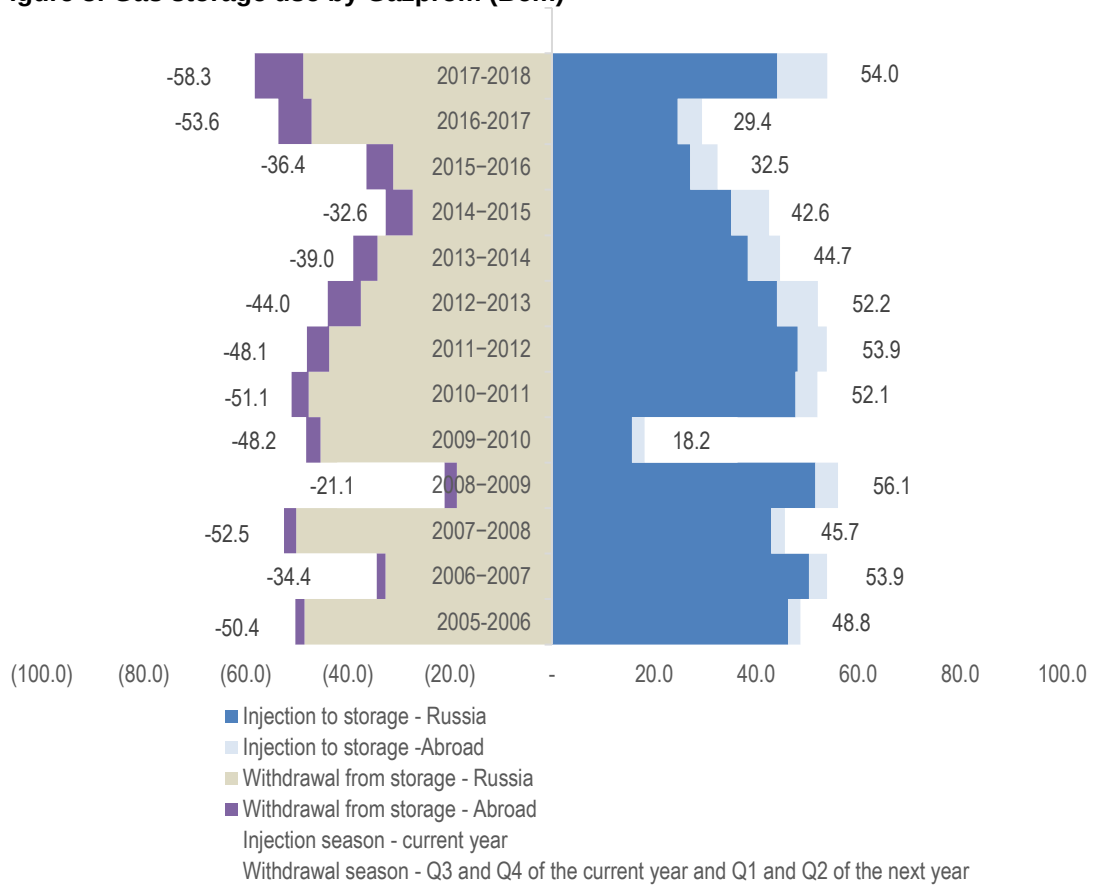
Figure 2: Russia's gas balance – distribution



Source: Gazprom

Exports to the so-called "Far Abroad"[8] increased by 15.7 Bcm in 2017 year-on-year, and the estimated increase for 2018 is about 8 Bcm, to 205 Bcm in total. This estimate is conservative, as Gazprom Export reported a significant increase in its exports to Europe and a moderate increase in exports to the CIS for the first nine months of 2018 (see Table 1). It is also noteworthy that over the 2015-2016 and 2016-2017 gas seasons, gas withdrawals from storage significantly exceeded injections. Storage levels had to be replenished, which led to a sharp increase in gas storage re-fill during Q3 and Q4 of 2017 and Q1 and Q2 of 2018 (see Figure 3).

Figure 3: Gas storage use by Gazprom (Bcm)



Source: Author, data from "Gazprom in Figures"

[8] This category combines Russian pipeline exports to European countries including Turkey but excludes exports to the Baltic states that are reported under exports to "Near Abroad".

Table 1: Gazprom export gas sales, January-September 2018

	9m2017, Bcm	9m2018, Bcm	Incremetal Change, Bcm	Percentage change
Western Europe	**112,7**	**119,0**	**6,3**	**6%**
Germany	37,9	42,7	4,8	13%
Italy	18,1	18,3	0,2	1%
Turkey	21,2	17,9	-3,3	-16%
France	8,9	9,8	0,8	9%
Austria	6,0	8,0	2,0	34%
Great Britain	12,1	10,8	-1,3	-11%
Other	8,5	11,5	3,0	36%
Central Europe	**26,7**	**29,3**	**2,6**	**10%**
Hungary	4,5	5,6	1,1	24%
Poland	7,7	8,6	0,9	12%
Slovakia	3,4	3,3	-0,1	-4%
Czech Republic	4,3	4,6	0,3	7%
Bulgaria	2,5	2,3	-0,1	-6%
Croatia	1,5	1,7	0,2	15%
Other	2,8	3,1	0,3	11%
FSU	**23,1**	**25,1**	**1,9**	**8%**
Ukraine	1,6	1,8	0,2	11%
Belarus	13,4	14,3	0,9	7%
Moldova	1,8	2,0	0,2	11%
Lithuania	0,9	0,9	0,1	8%
Latvia	1,7	1,0	-0,6	-38%
Estonia	0,3	0,3	0,0	-11%
Kazakhstan	1,8	2,3	0,5	28%
Armenia	1,4	1,4	0,0	1%
Azerbajan	0,0	0,8	0,8	-
Other	0,3	0,2	-0,1	-17%
Total	**162,6**	**173,4**	**10,8**	**7%**

Source: Gazprom Emitent Report, 9M 2018

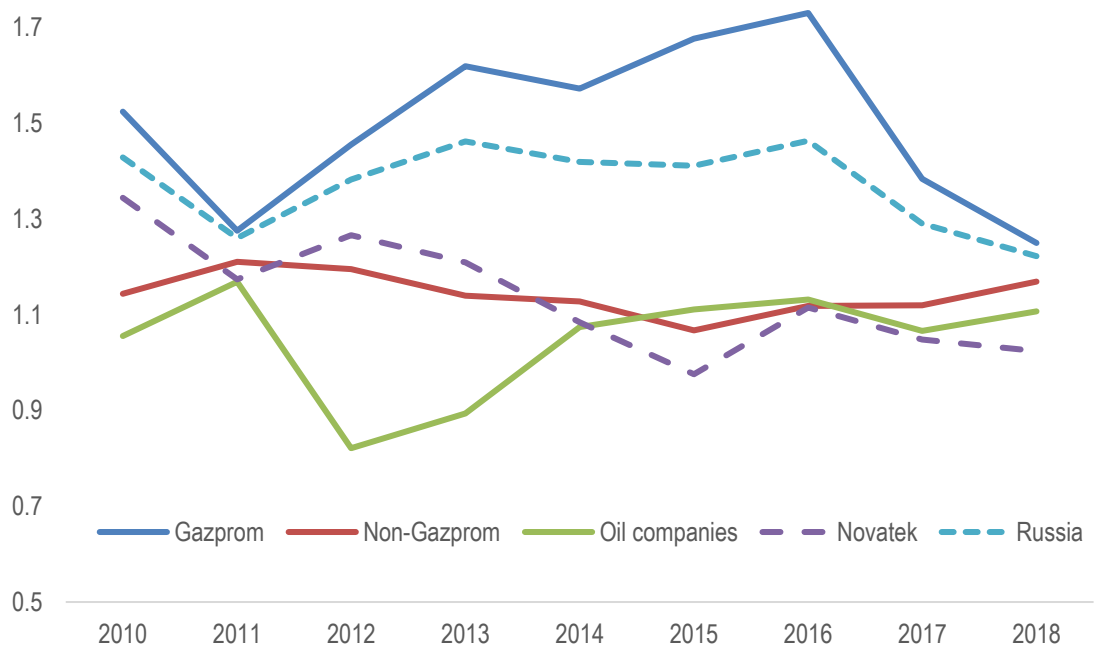
Broken pattern for seasonality of production in 2018

Russia's gas industry has had to accommodate broad fluctuations in production caused by seasonality requirements and big swings in demand, and this situation is likely to continue in the future (see Figure 4). During the past decade, Gazprom has essentially acted as the balancer for Russia's gas production, owing to three key factors: scale, assets, and customers.

Firstly, the scale of fluctuations in demand and consequently the scale of the required swings in production have been such that only Gazprom could manage the required volumes. Secondly, Gazprom's giant Cenomanian fields with their dry gas are a unique resource, almost "fit-for-purpose" in balancing output. The technological risks of stop-and-go operations for these fields remain significantly lower than for the more complex fields with higher liquids content operated by Russian independents. Additionally, the liquids production at fields owned by the independents is a high-value-added activity which also makes its interruption undesirable. The production of associated gas by Russian oil companies is a function of oil production and is also not fit for the purpose of balancing overall output,

especially because of the state regulation that (to curtail flaring) puts associated gas at the top of the domestic merit order in terms of pipeline access. Finally, Gazprom's customer base is more "seasonal," comprising both industrial and residential customers, whereas independents mostly supply large industrial consumers with more stable demand profiles. Gazprom's balancing burden can be demonstrated by comparing its index of seasonality of production (calculated as production in January divided by production in June, both for Russia and for individual producers) (see Figure 4).

Figure 4: Index of seasonality for Russia's natural gas production (Ratio of January to June output)



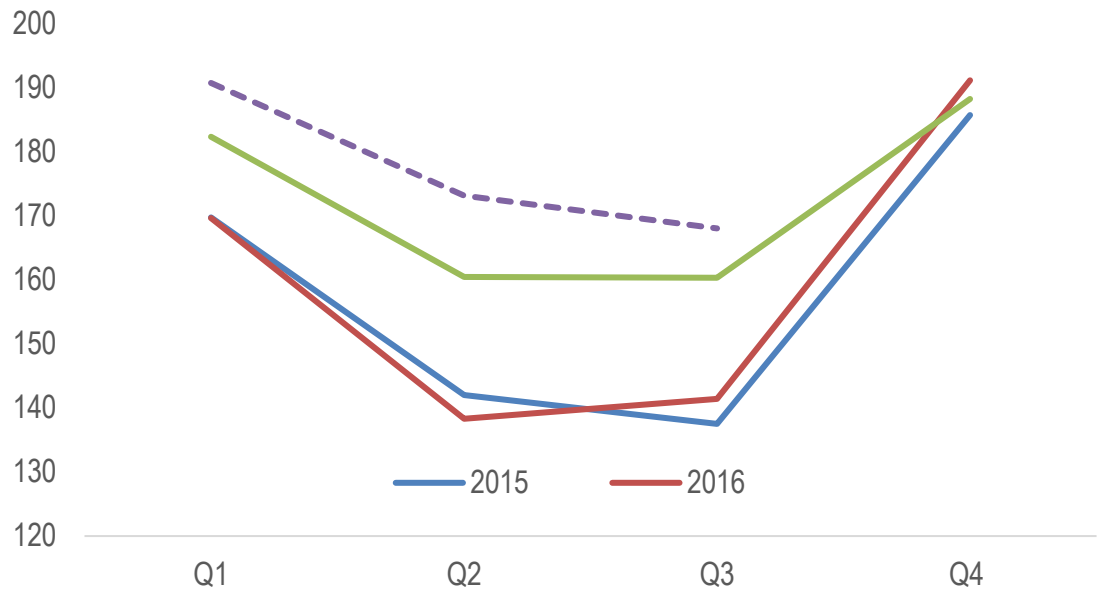
Source: Author, data on production volumes from Infotek and CDU TEK

After reaching a level of 1.7 for Gazprom in 2016, in the past two years the index has declined dramatically. This was not the result of lower winter peaks; on the contrary, much higher volumes were produced in the first quarters of 2017 and 2018 than in previous years. But gas production during the shoulder period increased even more year-on-year (see Figure 5). Most striking about the dynamics of Russia's monthly gas production in 2018 was the "broken" seasonality pattern. Record volumes were produced during March-May, which usually represent the beginning of the "lull season" as can be seen in a more "normal" 2016 (see Figure 6). Robust demand for Russian gas in 2017-18 and the supply response help explain the phenomenon of shrinking spare capacity which Miller presented to Putin. After all, when spare productive capacity is measured on an annual basis, the bulk of it is available only during the low season. What matters to consumers, however, is whether producers are going to have spare capacity at a time of peak demand; average annual numbers may be misleading. With essentially the same trend of high levels of gas production during Q2 and Q3 continuing in 2018, Russia is likely to have even less flexibility with regards to sudden spikes in demand in the future.

Correctly assessing and monitoring spare productive capacity is becoming crucial for developing the right strategy for Russia's decision makers regarding the need to plan future investments and new export commitments. Conversely, uncertainties over the levels of spare productive capacity in turn contribute to uncertainties over the development of new fields and may lead to costly strategic mistakes along the whole value chain. Unfortunately, up-to-date information on gas field productive capacities and gas production is not readily available to researchers. Russia's Ministry of Natural Resources

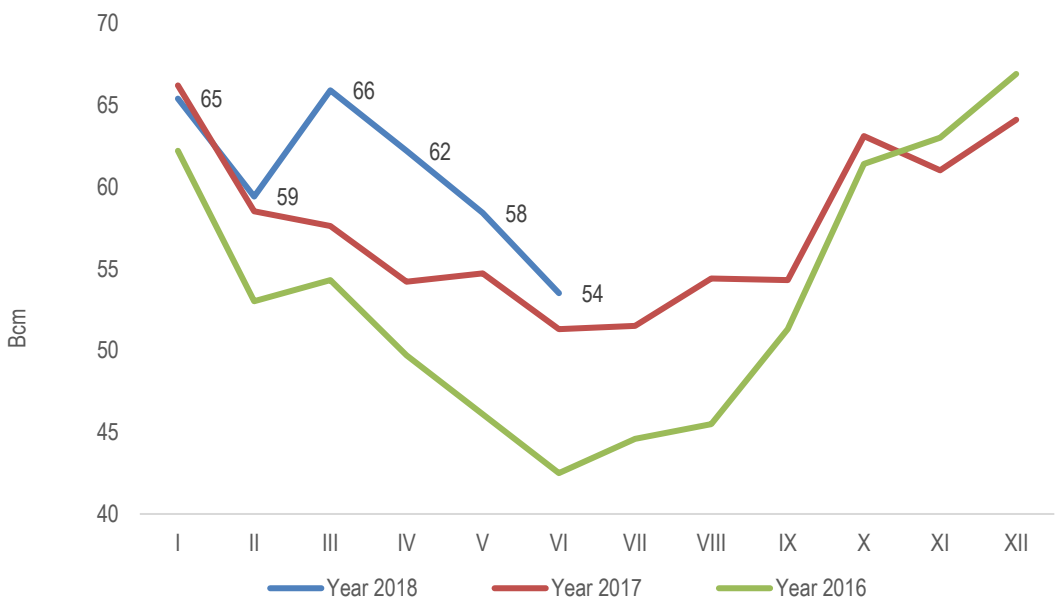
produces State Reports on Mineral Resources that have production data for Russia's largest gas fields, but these statistics are released with a significant time delay of eighteen months to two years. It is therefore almost impossible to produce the exact numbers for Russia's spare capacity, but it is possible to review information which can help to set the range and thus make a well-informed estimate.

Figure 5: Russian quarterly gas production 2015-2018 (Bcm)



Source: Gazprom

Figure 6: Monthly Russian natural gas production

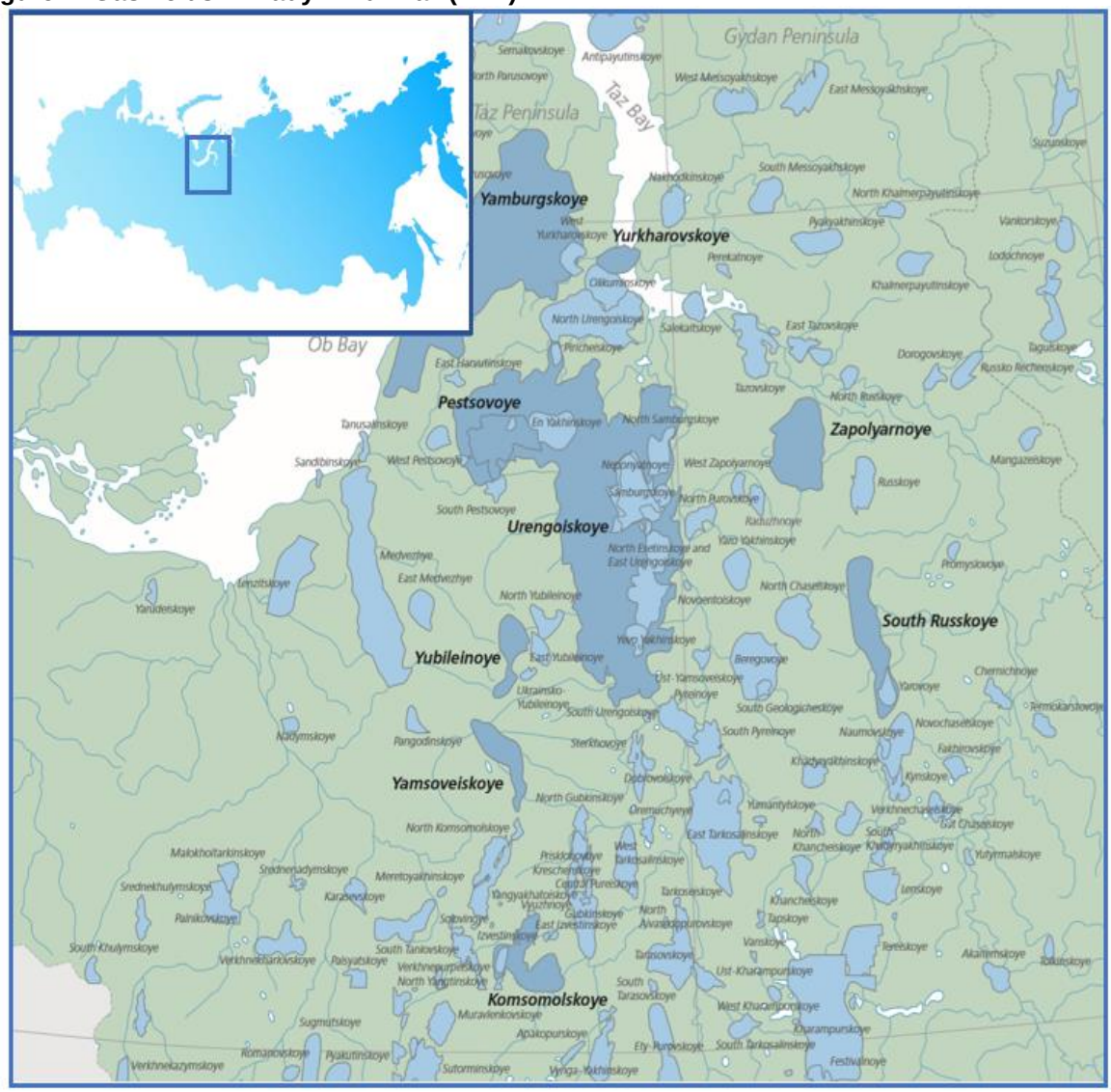


Source: CDU TEK

The setting: a brief outline of the evolution of Russian gas production

The core producing regions of Russia's gas industry are concentrated in the northern part of West Siberia. The major gas producing region of Nadym-Pur-Taz (NPT) which accounts for over 80 per cent of Russia's gas output takes its name from the three rivers that border its territory (see Figure 7).

Figure 7: Gas fields in Nadym-Pur-Taz (NPT)



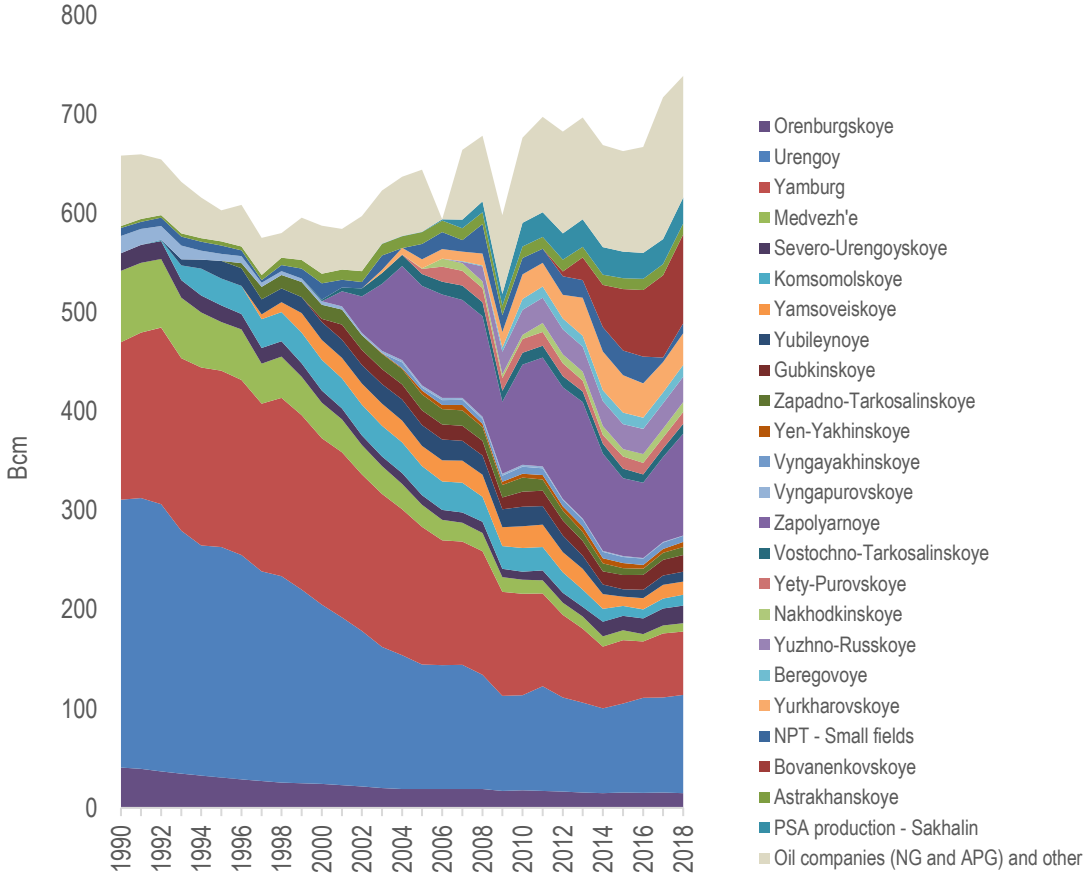
Source: Russia's Gas Atlas, Sberbank Investment Research, 2014

The history of gas production in NPT is well documented and researched.[9] The peak of production for the Soviet super-giant gas fields developed in NPT in the 1970s and 1980s – Medvezh'e, Urengoy, and Yamburg - occurred in 1992 when they produced 517 Bcm (combined) or 81 per cent of total Russian national output. These fields, which have been in operation for many years (Medvezh'e has been worked for 47 years, Urengoy, 41 years, and Yamburg 33 years as of 2018) are now in decline. Gas fields are declining assets and as diminishing returns started to take their toll, production from these fields, known as the "Big Three", started to fall fast. A new generation of smaller fields in NPT ("small"

[9] See Stern, J.P. The Future of Russian Gas and Gazprom, Oxford University Press 2005 and Stern, J.P. and Henderson, J. Gazprom's West-Facing Supply Strategy to 2020 – in The Russian Gas Matrix: How Markets Are Driving Change, Oxford University Press, 2014

in the Russian context are fields with a maximum annual plateau output of 25-30 Bcm, which anywhere else in the world would be considered enormous) was followed by the launch of Zapolyarnoye in 2001 – the last of the NPT super-giants. More recently, Gazprom moved to a new gas province in the Yamal peninsula even further north with production at Bovanenkovo, while Russian independent gas producers, primarily Novatek at Yurkharovskoye, and oil companies that wanted to realize their potential for both natural and associated gas, increased their share of the overall output[10] (see Figure 8).

Figure 8: Russian gas production by main fields



Source: Author, data compiled from MNR, Gazprom, and Ministry of Energy, estimate for 2018

Looking at the distribution of Russia's natural gas production by field, one's first impression is the tremendous complexity of multiple trends among individual fields. But just as a very complicated formula can be reduced to a relatively simple equation, the Russian gas supply can be explained by four key drivers: the rate of decline for the "Big Three"; the swings at Zapolyarnoye, Russia's main balancing field; the pace of the ramp-up at Bovanenkovo, Gazprom's latest addition to its portfolio; and the dynamics of Gazprom's production vis-à-vis the independents (see Figure 9).

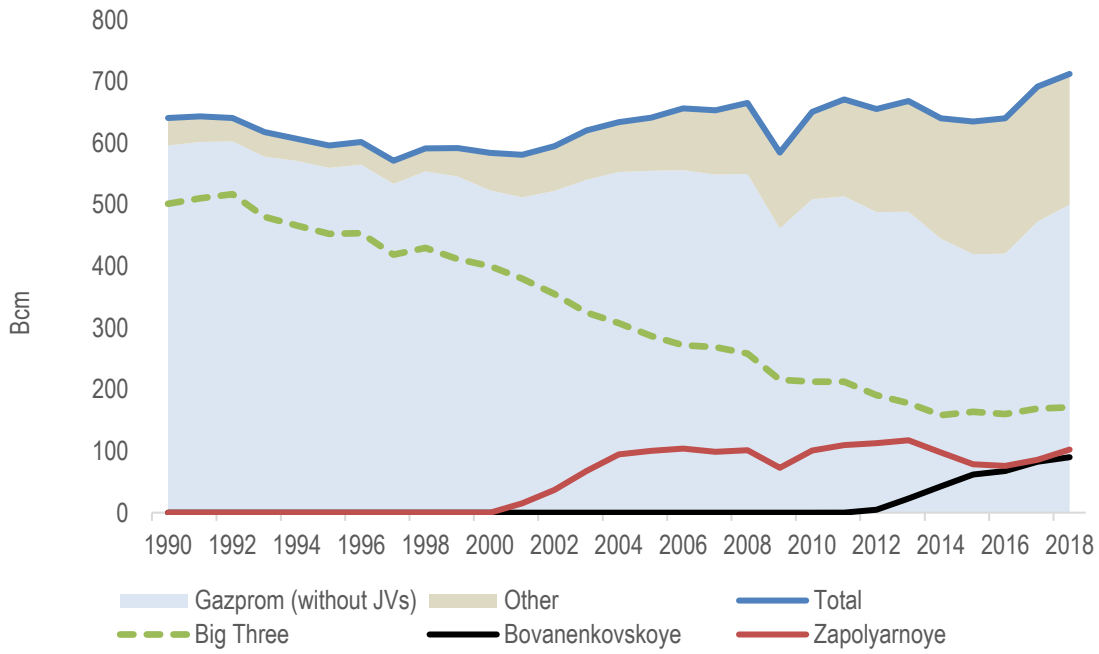
The medium-size and smaller Russian gas fields, no matter how important they might seem in terms of aggregate volumes, are producing at predictable rates and are not game-changers, at least so far. They are like the "dog that did not bark" – their significance is in making us to turn our attention to the true suspects.

[10] For a detailed discussion of the role of gas independents see Henderson, J. Non-Gazprom Russian Producers: Finally Becoming Truly Independent? – in The Russian Gas Matrix: How Markets Are Driving Change, Oxford University Press, 2014

The "Big Three": irreversible decline

By the early 1990s these fields were approaching the last years of their combined plateau production and since the start of the 2000s they have been rapidly coming off plateau. At present, the combined output of the three fields is about 170 Bcm. There has been some stabilization of output in recent years which can be explained by the extensive use of booster compressor stations to compensate for lower reservoir pressures, the start of development of new blocks within these fields, and by rising production from new, deeper layers containing wet gas (such as the Achimov deposits at Urengoy).[11] Reviewing the earlier production history of the "Big Three" suggests that the true decline rates for Cenomanian gas during the post-plateau years (when the offsetting effects of wet gas production were not present) might be higher and reach 5 - 7 percent per annum (see Figure 10). The differences in the number of years at plateau among the "Big Three" is also noteworthy. The forced record levels of production at Urengoy during the peak year were followed by a rapid decline and then stabilization at plateau which lasted for only three years. In contrast, the plateau at Yamburg lasted for eight years and at Medvezh'e for fifteen years.

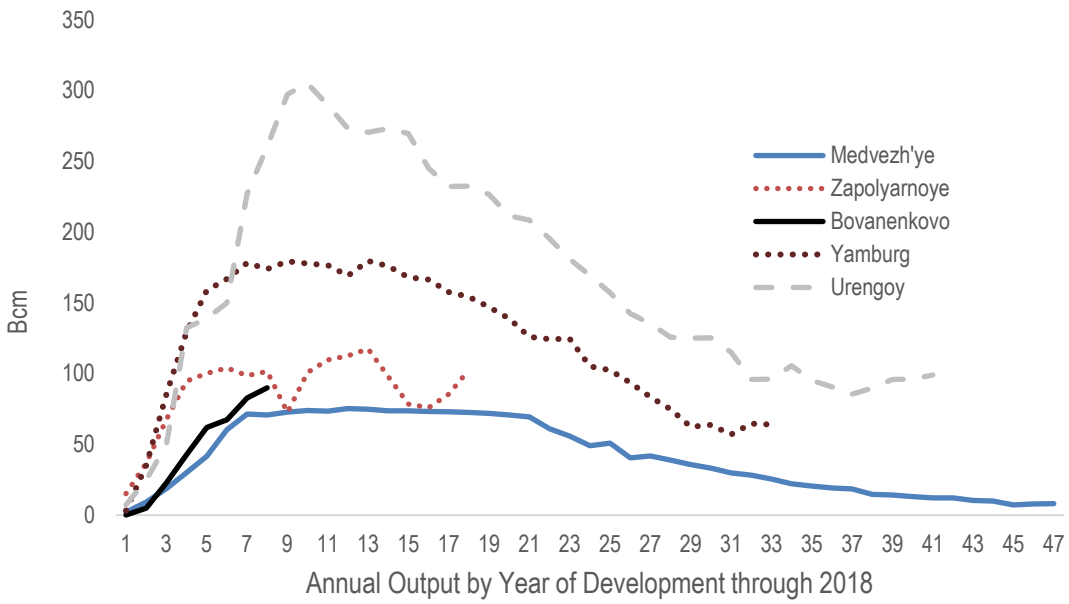
Figure 9: Key drivers for Russian gas output



Source: Author, data from Gazprom, MNR, Ministry of Energy, estimate for 2018

[11] The field production numbers in Russia's MNR reports do not differentiate field output by Cenomanian, Valanginian and Achimov. Moreover, output by non-Gazprom producers that are developing Achimov deposits at the larger Urengoy field, are bundled into the reported total production number for the field. This makes the observed decline rates (especially for Urengoy, but for other fields as well) deviate from the "normal" development pattern.

Figure 10: Production profiles at Gazprom's main fields



Source: Author, compiled from various reports by MNR and Gazprom

Zapolyarnoye: the key balancing field

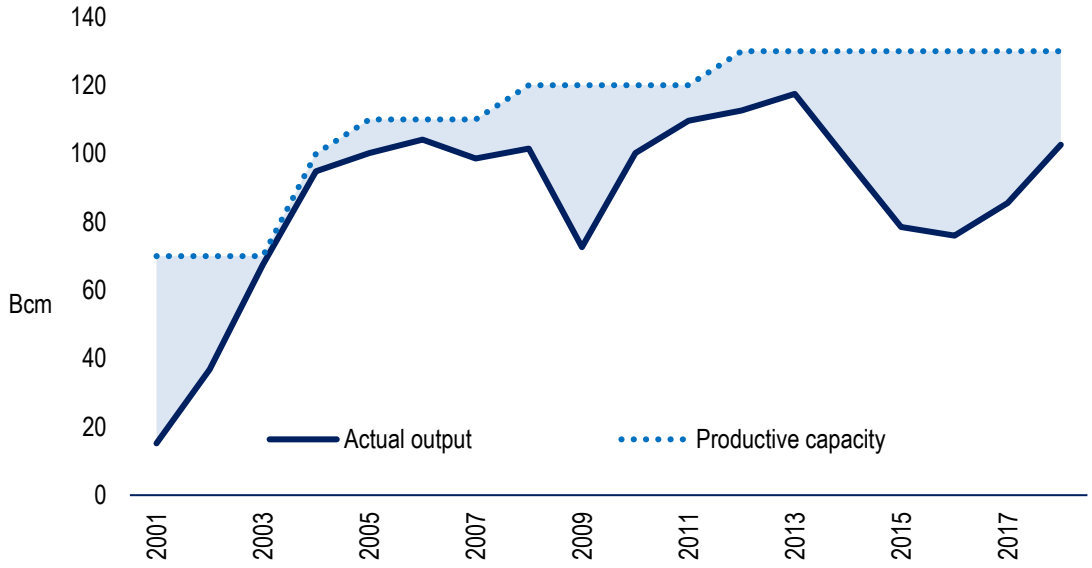
In the 2000s Zapolyarnoye emerged as the new Russian gas "workhorse" field replacing declining production at Urengoy and Yamburg. The field has been in operation since 2001, producing gas from Cenomanian layers. Output was growing rapidly until 2009 when it collapsed as a result of the global crisis and dwindling demand. Russian gas production contracted dramatically in 2009: aggregate production declined by 81.8 Bcm (down by 12.4 per cent), with the bulk of this contraction seen at Zapolyarnoye. Production from the Cenomanian layers at the field had exceeded the 100 Bcm per annum threshold in the previous year and was supposed to remain at plateau for at least the next seven years and possibly longer. The unexpected production cut at the field in 2009 amounted to 18.4 Bcm. The following year output bounced back in response to a recovery in demand. In 2011, Gazprom started production from the field's deeper Valanginian layers, which helped bring the maximum productive capacity at Zapolyarnoye to 130 Bcm per annum in 2013. Actual production that year amounted to 118 Bcm. This made Zapolyarnoye Russia's single largest producing gas field. Dwindling export demand for Russian gas in 2014-15 and the advance of the Russian independent gas producers at home (see below) forced Gazprom into reducing its output again. This time Zapolyarnoye carried an even larger balancing burden: it bottomed out at 76 Bcm in 2016, 41.5 Bcm down from its recent peak (see Figure 11).

One of the important reasons why Gazprom singled out Zapolyarnoye as a balancing field related to tax optimization under the conditions of a new differentiated upstream gas tax which resulted in a wide variety of effective tax rates for different gas fields. The emergence of significant spare gas productive capacity for Gazprom (150 Bcm per annum at the start of 2017, according to Alexey Miller's statement cited earlier in the paper) allowed the company to essentially choose the tax burden for a significant share of its overall production, as it could make the decision about which of its fields to work and which to keep idle or underutilized. A much lower gas Mineral Resource Extraction Tax (MRET, the equivalent

of a mineral royalty) at Bovanenkovo[12] compared to Zapolyarnoye gave Gazprom a strong tax incentive to hold back its output at the latter while ramping up volumes at the former.[13]

In 2017 Bovanenkovo almost reached its capacity and Zapolyarnoye finally bounced back again to meet the growing call on Gazprom gas. We understand that the trend is continuing in 2018. The estimated production at Zapolyarnoye this year remains well below its nominal capacity, but it is not clear if all this difference can be classified as spare productive capacity. After all, the field has been at plateau (despite remarkable ups and downs) for over ten years. Have the swings prolonged the plateau or shortened its life span? In any case, Gazprom Dobycha Yamburg, the company operating the field, has announced that the period of natural gas lift at Zapolyarnoye is over, and that it is moving to the wider use of booster compressor stations to counteract the losses in reservoir pressure and to sustain output levels. The deployment of booster stations at the field has been ongoing since 2016. Their impact on production dynamics at Zapolyarnoye is an important signpost and is an industry development to monitor for the future.

Figure 11: Zapolyarnoye: capacity vs. actual output



Source: Author, data from MNR and various press-releases, Author's estimate for 2018

The fact that this is a low-depth Cenomanian field apparently helps achieve the technical task of swinging output without apparent losses to overall productive capacity. Note that the balancing burden is carried by dry Cenomanian gas, while production of wet Valanginian gas is relatively stable throughout the year (see Figure 12).

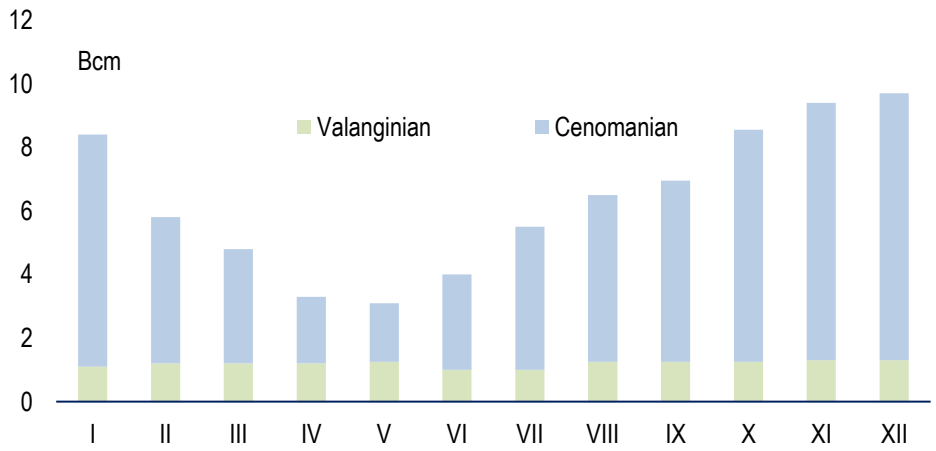
Of course, it is not possible to say conclusively that production at fields which have experienced intentional swings could not be ramped back up to capacity again in the future. The issue very much boils down to individual characteristics of the fields, or rather individual wells. In some cases, “idling” the wells can lead to the formation of additional pressure underground that would support future extraction. But in some cases, pressure will be lost permanently, and the formation of hydrates will damage the wells. So far, Zapolyarnoye has been acting as a balancing field in an orderly fashion

[12] Bovanenkovo pays lower gas MRET owing to a special “Yamal” discount – a lower coefficient in the formula for fields in the new gas province.
[13] See Yermakov, V. and Kirova, D. Gas and Taxes: The Impact of Russia’s Tinkering with Upstream Gas Taxes on State Revenues and Decline Rates of Legacy Gas Fields OIES Energy Insight, October 2017

without apparent loss to its overall productive capacity. For older fields in NPT the jury is still out on the outcome. In any case, this is one of the areas of future research that needs to be done to evaluate the longer-term outlook for Russian gas production.

It has been assumed that the present productive capacity of Zapolyarnoye has gone off its peak design of 130 Bcm. After all, the massive switch to the use of booster stations is happening precisely because the natural reservoir pressure has fallen, and production has started to decline. It seems that the levels of production reported for December 2016 represented the current output ceiling for the field (if these levels were to be maintained throughout the year, the field would end up producing 116.4 Bcm or just shy of its historical peak output in 2013 when Zapolyarnoye delivered at 90 per cent of its maximum design capacity). The difference between 116.4 Bcm and the actual output of 76 Bcm in 2016 gives an estimated maximum amount of spare productive capacity for Zapolyarnoye in that year of about 40 Bcm. In fact, it would not be possible for the field to keep producing at maximum levels throughout the year, as the facilities need to undergo regular maintenance. It is more likely that the actual spare productive capacity at Zapolyarnoye was about 35 Bcm (or 23 per cent of Gazprom's 150 Bcm total at the start of 2017 that Miller reported to Putin – see the beginning of this paper). The reported output for Zapolyarnoye in 2017 was 86 Bcm, up 10 Bcm year-on-year. This leaves the maximum possible spare productive capacity of circa 25 Bcm for the field at the start of 2018 (note that Miller's estimate for Gazprom's total remaining spare capacity at this point is 80 Bcm – again, see above). Given the robust demand for Russian gas during the first half of 2018 and the reported significant incremental increase in total Russian gas output – up 21 Bcm for the first six months of the year - it appears inevitable that Zapolyarnoye, the largest field in Russia by spare capacity, continued to ramp up its output this year. Hence the production estimate for Zapolyarnoye for 2018 is 102.6 Bcm. If this logic is correct, the year-end spare productive capacity for the field is no more than 10 Bcm at present.

Figure 12: Monthly gas output at Zapolyarnoye in 2016



Source: Gazprom

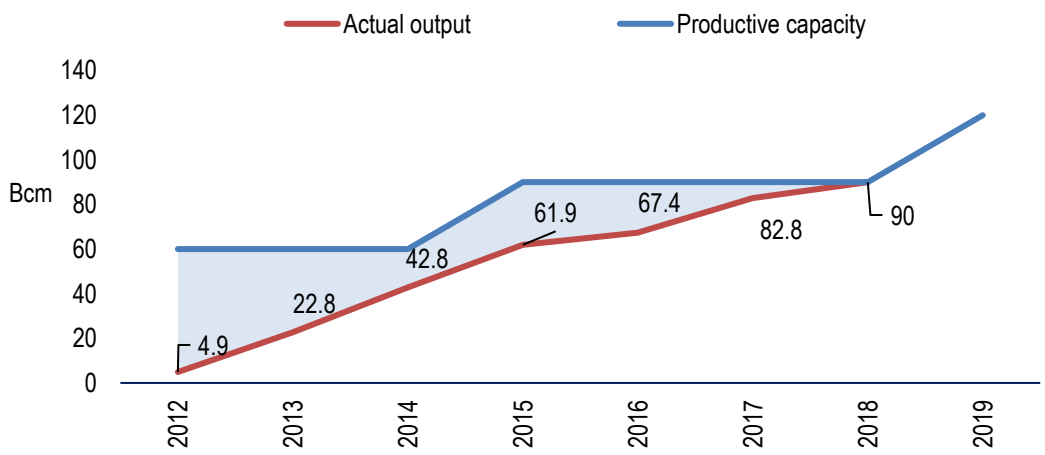
Bovanenkovo: Gazprom's new crown jewel

The launch of gas production in October 2012 at Bovanenkovo, the most important new-generation gas field in Gazprom's portfolio, marked the beginning of a new era for Russian gas. Bovanenkovo was the first in a series of new Yamal gas fields that will ultimately replace the declining production in NPT. Yamal, meaning "the end of the world" in the local language, has vast reserves of natural gas, over 26.5 Tcm, according to Russian geologists' estimates. Bovanenkovo's gas reserves are 4.9 Tcm, according to Gazprom.

After some delay with the production increases caused by lower than expected overall demand for Gazprom's gas in 2014-2015, Bovanenkovo started to catch up and produced 61.9 Bcm in 2015. In 2017 the completion of the Bovanenkovo-Ukhta 2 gas pipeline doubled the takeaway capacity from the field from 60 Bcm to 120 Bcm and in the same year Bovanenkovo produced 82.8 Bcm from its Cenomanian and Aptian layers. It is likely that in 2018 output has reached the maximum level of the annual capacity of the first two production complexes GP-2 (60 Bcm) and GP-1 (30 Bcm) (*gazovye promysly*), amounting to total production of 90 Bcm per annum (see Figure 13). Gazprom reported that the maximum daily productive capacity for Bovanenkovo had reached 264 million m^3 which translates into a maximum monthly output of 8.2 Bcm and an annualized figure of 96 Bcm (the planned output of 90 Bcm is 94 per cent of this maximum, a very high level of capacity utilization). This means that by the end of 2018 there will be no spare productive capacity at Bovanenkovo.

However, this situation is unlikely to last. At the beginning of December 2018 Gazprom officially started the third production complex (GP-3) at Bovanenkovo which will be fully operational in 2019, bringing the total installed capacity at the field to 120 Bcm and output to 115 Bcm by 2020-21. These higher volumes are supposed to flow into Nord Steam 2 once it commences operations. Note that this haste to complete the next stage of Bovanenkovo development should not be considered surprising if Gazpom's spare productive capacity is indeed shrinking. The additional gas production from the Neocomian and Jurassic layers in the future will eventually bring Bovanenkovo's output up to its ultimate peak of 140 Bcm per annum. Gazprom has also announced that it is moving forward with the development of Kharasavey, a 2 Tcm field north of Bovanenkovo and the natural extension of operations there. Production at Kharasavey is due to start in 2023 and reach 32 Bcm per annum at plateau.

Figure 13: Bovanenkovo: capacity vs. actual output



Source: Author, data from Gazprom press releases, Author's estimate for 2018

Russia's independents: still struggling to realize their full potential

Following the emergence of independent gas players in Russia in the early 2000s, there has been a growing "division of labour" among Russian producers: over the past decade while Gazprom has focused increasingly on more lucrative export markets, the independents have been meeting incremental growth in domestic demand and, in so doing, have increased their share of the domestic market. Currently, the independents and vertically-integrated oil companies which produce both natural

and associated gas account for over one-third of Russia's overall production and half of supplies to domestic consumers (see Table 2).

The main reasons behind Gazprom relinquishing its domestic market share were as follows. When in the early 2000s the call on Russian gas both externally and internally began to exceed available productive capacities, Gazprom's bridging strategy for promoting alternative supply (until its new gas reserves on the Yamal Peninsula could be brought into production) allowed the independents to fill certain niches. These included well-paying industrial consumers, especially those located in Russian provinces in close proximity to West Siberia where gas transportation tariffs were low enough to provide them with a positive margin. In 2008-2010 the independents gained more ground by signing initial long-term contracts with power plants, their most important end-use customers (5-year and 10-year contracts became a new feature at that time for Russia's domestic gas market which had historically been dominated by Gazprom's gas rationing via renewable one-year contracts). This helped the independents secure sales and improve margins. Gazprom, meanwhile, focused on the export market, where record high gas prices were providing the company with its best ever revenues despite lower export volumes. Another factor in the expansion of non-Gazprom production was better access to the Gas Transportation System (GTS) for third-party gas since 2012 when associated gas production by oil companies moved up in the merit order as a result of a Kremlin-orchestrated campaign to discourage flaring and increase associated gas utilization. Finally, the independents used price discounts to wean consumers away from Gazprom. While Gazprom is obligated by law to sell gas under government-regulated tariffs in Russia, the independents can sell at any price they find commercially viable. When the domestic market in Russia was short (before the 2009 recession), the independents sold at a premium to the regulated price. But when the market become long, independents started offering 5–15 per cent discounts from the regulated prices. Gazprom could not follow suit because of regulatory requirements. Thus, ironically, the growth in regulated domestic prices in Russia in 2009-2012, which Gazprom actively lobbied for, gave the independents hefty sales margins and allowed them to undercut Gazprom's market positions.

Table 2: Main sources and uses of gas in Russia, 2017

Main Sources and Uses of Gas in Russia in 2017

(Bcm)

	Russia Total	Gazprom	Novatek	Rosneft	LUKoil	Gazprom neft	Oil Companies (VICs) total	PSA operators
Gas Extraction- Total	704,1	455,2	45,9	51,3	21,6	18,1	107,9	25,6
including								
Natural gas	*550,4*	*454,0*	*14,7*	*13,0*	*10,0*	*6,7*	*31,4*	*17,5*
Associated petroleum gas	*98,3*	*1,3*	*2,5*	*38,3*	*11,6*	*11,4*	*76,5*	*8,1*
Gas from gas condensate fields	*55,4*	*0,0*	*28,7*	*0,0*	*0,0*	*0,0*	*0,0*	*0,0*
Deliveries to Gas Processing Plants	82,2	24,4	0,0	17,5	4,3	6,2	37,5	16,8
Gas processing at own facilities	11,5	0,7	0,0	9,0	0,0	0,0	9,0	0,0
Deliveries to Gas Transportation System	540,6	384,8	41,7	9,8	8,9	6,0	26,2	0,4
Deliveries to Other Users	18,2	0,4	2,6	1,3	2,9	1,0	6,0	2,9
Gas re-injection	13,3	0,0	0,0	5,4	1,6	0,2	7,2	4,2
Own use of gas	23,9	4,7	1,4	4,0	3,3	1,9	13,3	0,9
Losses	1,9	0,2	0,1	0,6	0,1	0,0	0,8	0,0
Gas Flaring	13,0	0,0	0,1	3,8	0,5	2,8	7,8	0,4

Source: Author, data CDU TEK

At the beginning of 2014, the future looked bright for Russia's gas independents[14]. They had not had access to the export market like Gazprom and therefore could not benefit from the extremely high export netbacks achievable in the early 2010s. But by 2014 they had secured their position for further advancement at home and were looking forward to an acceleration in Russian regulated gas prices. The Russian government had announced a new policy of bringing internal prices up to parity with export netbacks via a series of hikes in regulated prices and had been proceeding with this approach. The strategic plans of the independents and their upstream investment programs for new gas development consequently assumed domestic gas prices would reach levels of $150-180 per Mcm by 2017.

But the reality turned out to be very different. The triple whammy of low oil prices, a stagnating economy, and international sanctions hurt Russia and caused it to put all reforms, including domestic gas price liberalization, on hold and to use an easy fix of massive ruble depreciation to balance the budget. As a result, domestic Russian gas prices expressed in dollar terms in 2015-2018 declined rather than rose and have been hovering around $60-70/Mcm for the past three years (see Figure 14).

At the same time, the Russian government increased the MRET, squeezing the independents' margins (see Figure 15). Suddenly, the economics of many of the new gas projects envisioned by the independents became doubtful.

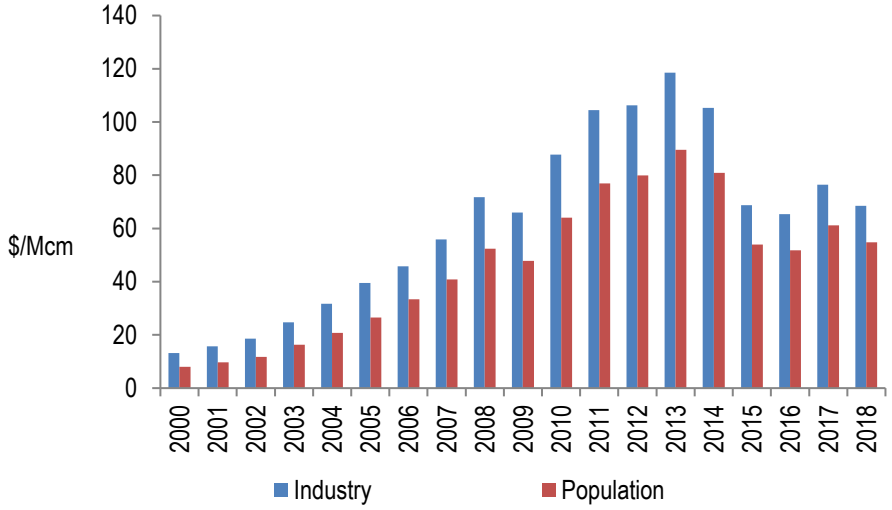
Novatek's production from its legacy fields – Yurkharovkoye, East Tarkosalinskoye, and Khancheyskoye – entered the decline phase. Novatek's strategy is now to put a stronger emphasis on LNG developments that are giving it direct access to export markets. The successful launch of three trains of Yamal LNG by the end of 2018 based on production from South Tambeyskoye – ahead of time and on budget – has been a pleasant surprise for market watchers at a time when many alternative new LNG projects are experiencing delays and significant cost overruns. Novatek's long-term plan envisions flat output for gas assets delivered into the GTS but robust growth of gas production from the fields that will supply gas to its new LNG plants.

The returns on Rosneft's prospective new gas projects that were primarily targeting further market expansion at home have now become inferior to the returns for export-oriented oil projects within the company's overall portfolio. It is now not clear whether Rosneft is going to stick to fast realization of its earlier announced target of producing 100 Bcm of natural gas in Russia[15]. So far, its subsidiary Rospan has been increasing output more slowly than was expected, but on the other hand, a much-anticipated start of gas development at Kharampur next year may help Rosneft increase its overall gas production volumes.

[14] In 2011 Novatek was the first independent to sign a 5-year contract with Inter RAO, for 15 Bcm of annual supplies. Then in 2013 the company added to its end-user contracts by concluding direct sales deals with other large power sector consumers: Mosenergo (a 3-year contract for 9 Bcm of annual supplies), Fortum (a 4-year contract for 4 Bcm of annual supplies), and E. ON Russia (a 15-year contract for 7–11 Bcm of annual supplies). In 2012, Rosneft concluded a 25-year contract for 35 Bcm of annual deliveries to all Inter RAO power stations starting from 2016, thereby supplanting Novatek and securing a significant domestic market share.

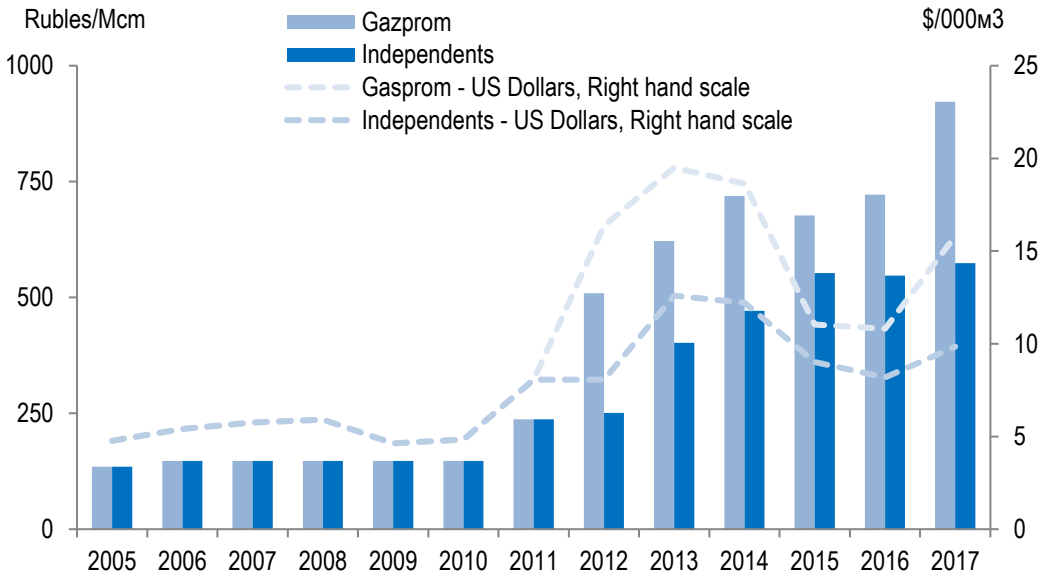
[15] For a detailed analysis of Russia's gas independents see Henderson, J. *Non-Gazprom Russian Producers: Finally Becoming Truly Independent?* – in *The Russian Gas Matrix*, ed. By Henderson and Pirani, Oxford University Press, 2014, pp. 314-346

Figure 14: Russian regulated wholesale prices (Moscow pricing zone)



Source: Author, data from FAS and FTS

Figure 15: Unit rates of MRET for natural gas in Russia

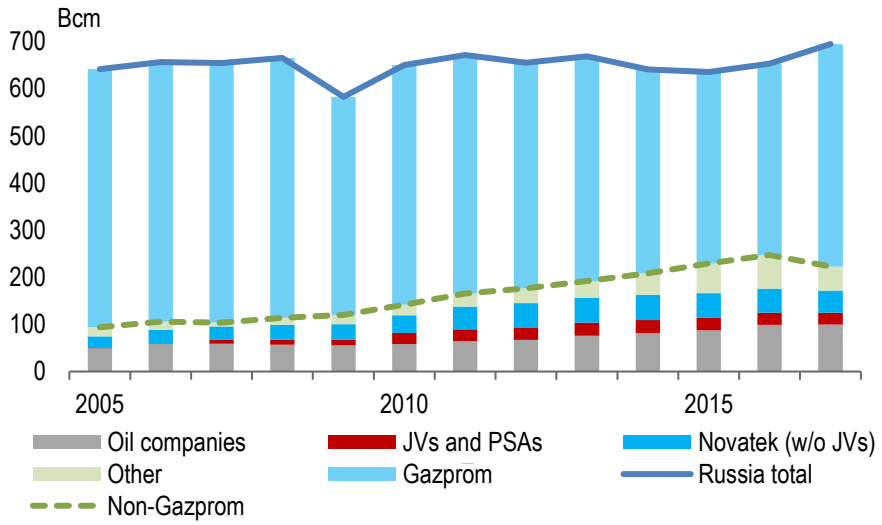


Source: Author, data Russia's Ministry of Finance

After several years of output cuts owing to insufficient aggregate demand for its gas, Gazprom struck back in 2017-2018. In 2017 its gross production increased by 13 per cent year-on-year, up 53 Bcm incrementally (see Figure 16). This robust growth continued in 2018, with Gazprom expected to produce about 500 Bcm this year. Since the main driving force on the demand side has been a higher export call on Russian gas, this has diverted Gazprom flows away from the domestic market and allowed the independents to maintain their market share. But should the dynamics change, and export demand suddenly fall in the future, the fight between Gazprom and independents for market share in Russia may start in earnest.

Returning to the main theme of this paper, do Russian gas independents have spare productive capacity? Certainly not in a sense of volumes ready to flow at a push of the button, but they do have significant gas reserves waiting to be monetized. Of course, the ability to connect upstream gas production potential with the end consumer depends on the location of their fields relative to the transportation network and availability of capacity at the entry points to the GTS. For most of the independents' new gas fields in NPT, the Central corridor of the GTS that delivers gas to Central Russia and then connects with the Ukrainian transit gas pipeline system to bring Russian gas to Europe is the only transportation option for incremental volumes. Gazprom's production in the NPT region is declining, which would ultimately create more available pipeline capacity at entry points to the Central corridor. But the uncertainty over the future of Ukrainian transit also carries the risk that at the exit points these deliveries via the Central corridor will be limited to Russia's regions along the way as export flows would be diverted north and south. Russia's domestic gas consumption has been stagnant, especially in the European part of the country, which limits the growth potential of this market niche for independents. In addition, the combined effects of regulated wholesale prices and regulated gas transportation tariffs for independents in Russia have been discouraging them from supplying customers located far from the centres of production, as the sales margin progressively declines for longer-distance deliveries. The conundrum is obvious: despite the upstream potential, its realization for independents remains highly uncertain.

Figure 16: Russian gas production by main producer



Source: Author, data CDU TEK

Russia's spare productive capacity in natural gas at the end of 2018: the final analysis

Firstly, it is instructive to understand the productive capacities above ground. Gazprom publishes the total installed capacity of its GTUs (gas treatment units) at the fields (see Table 3). The total number of Gazprom's GTUs went down from 177 in 2011 to 169 in 2017, although their aggregate annual installed capacity increased from 1003 Bcm to 1128 Bcm. The lion's share of the incremental GTU installed capacity increase of 125 Bcm for the period can be attributed to new gas facilities at Bovanenkovo (90 Bcm productive capacity for the first two production plants currently in operation), where production started in 2011 and reached 82.8 Bcm in 2017. If the annual GTU installed capacity numbers are converted to monthly capacity, and then adjusted to assume a range of 75 - 90 per cent utilization to

account for the likely lower working capacity of the older GTUs, and then compared to the amounts of peak monthly gas production (assuming here that all Gazprom's gas and 75 per cent of non-Gazprom gas is being treated at these GTUs), a proxy range for peak capacity on the GTU side is found. The years 2015 and 2016 emerge as times when significant spare capacity at the GTUs was available, and 2017 marks a reduction. However, these calculations only indicate the upper range for capacity based on the technical limitations for the existing GTUs. The most interesting part of the story is about the spare productive capacity changes at the gas fields themselves.

Table 3: Gazprom Group's production capacity (excluding entities, investments in which are classified as joint operations)

	As at 31 December								
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Fields in operation, units									
Commercial production				118	122	126	135	136	136
Pilot production				6	11	13	11	15	18
Total fields in operation	**121**	**120**	**124**	**124**	**133**	**139**	**146**	**151**	**154**
Gas production wells, units	7 310	7 403	7 504	7 717	7 744	7 816	7 881	7 916	7 945
including those in operation	6 775	6 806	6 988	7 226	7 263	7 293	7 358	7 441	7 438
Booster compressor stations, units	47	48	49	49	49	52	53	58	58
Installed capacity of booster compressor stations, MW	4 508,1	4 572,1	4 730,1	5 015,2	5 046,4	5 265,4	5 080,3	5 669,8	5 789,8
Comprehensive and preliminary gas treatment units (GTU), units	174	176	177	179	170	171	170	171	169
Comprehensive gas treatment units (GTU) aggregate installed capacity, bcm per year	994,5	1 001,2	1 003,2	1 072,9	1 099,7	1 119,7	1 119,7	1 119,7	1 127,9
Incremental additions to GTU capacity		6,7	2,0	69,7	26,8	20,0	0,0	0,0	8,2
Monthly installed capacity of GTU, Bcm	82,9	83,4	83,6	89,4	91,6	93,3	93,3	93,3	94,0
Peak monthly capacity of GTU at 90% utilization	74,6	75,1	75,2	80,5	82,5	84,0	84,0	84,0	84,6
Peak monthly capacity of GTU at 75% utilization	62,2	62,6	62,7	67,1	68,7	70,0	70,0	70,0	70,5
Russia's gas production in January	55,0	63,9	63,9	63,3	65,3	65,9	61,7	62,2	66,2
Gazprom gas production in January	45,0	51,0	49,5	48,0	48,5	47,8	41,4	41,5	45,9
Non-Gazprom production in January	10,0	12,9	14,3	15,3	16,7	18,0	20,3	20,7	20,3
Total gas to GTU in January (Assuming 75% of non-Gazprom gas treated at Gazprom's GTU)	52,5	60,7	60,3	59,5	61,1	61,4	56,7	57,0	61,1
Gas at GTU in January as percent of GTU actual working capacity (assuming as 90% of installed)	70%	81%	80%	74%	74%	73%	67%	68%	72%
Gas at GTU in January as percent of GTU actual working capacity (assuming as 75% of installed)	85%	97%	96%	89%	89%	88%	81%	81%	87%

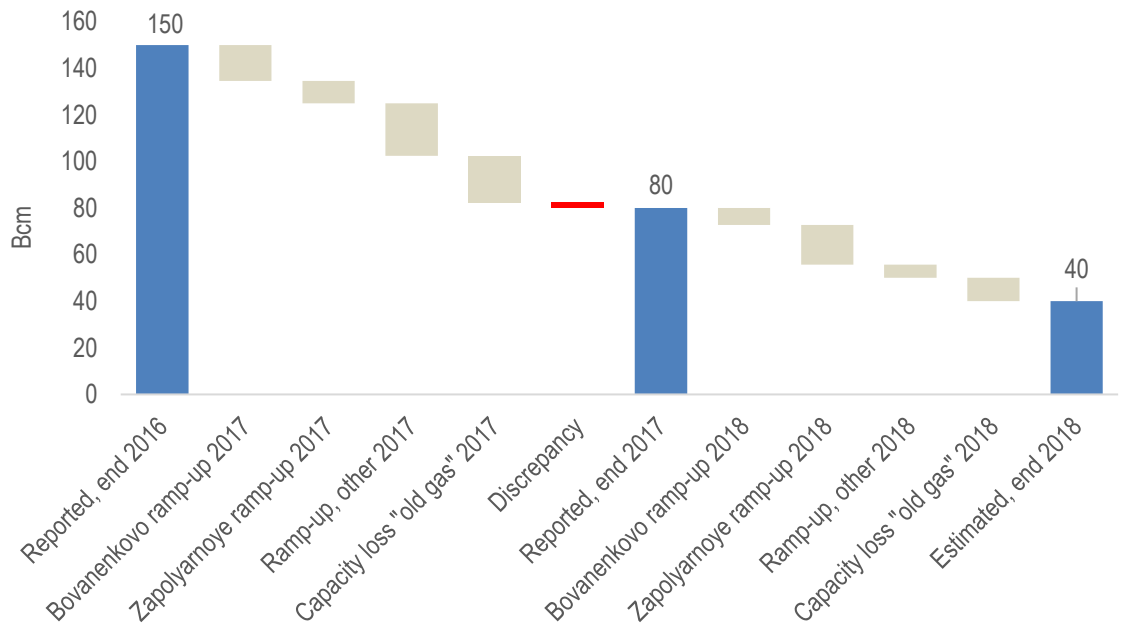
Source: Gazprom Figures, Author's calculations of production to GTU capacity ratios

Estimates for spare productive capacity at Zapolyarnoye and Bovanenkovo have already been highlighted. Using the amount of Gazprom's total spare capacity at the beginning and end of 2017 as reported by Alexey Miller as the first and the last stepping stones, it is possible to attempt to recreate the missing elements for 2017. The exercise will then be repeated for 2018 (see Figure 17).

The production levels for Bovanenkovo and Zapolyarnoye were reported for 2016 and 2017. Both fields ramped up their output in 2017, thus reducing the overall spare capacity for Gazprom, so it is easy to start the calculation by subtracting these increments from Alexey Miller's reported spare capacity level of 150 Bcm. At Urengoy, the decline in production from the Cenomanian layers was compensated for by additions from new projects that developed the Achimov layers of the field, so the overall reported output for Urengoy increased in 2017. If this number is combined with data for the incremental upward change in production for two dozen of Gazprom's medium-sized gas fields and a handful of small-size fields in NPT from our database, it is possible to add the next stepping stone. In aggregate, this group's production in 2017 also went up, which worked towards further reducing the spare productive capacity. Finally, from Alexey Miller's statement, the reported overall level of productive capacity for Gazprom fell by 20 Bcm during 2017. Taking all of this into consideration, the calculation for 2017 results in 82.4 Bcm of spare capacity – just a notch higher than the 80 Bcm reported by the Gazprom CEO.

For 2018, the numbers are not reported statistics, but estimates based on the continued output growth for Gazprom for the first nine months of 2018 as reported in its International Financial Reporting Standards (IFRS) disclosure, combined with insights from various press releases by Gazprom's upstream subsidiaries about their performance during the year. It is apparent that production at the first two blocks at Bovanenkovo was ramped up to full capacity (up to 90 Bcm) in 2018. Press releases from Gazprom Dobycha Yamburg indicate overall strong growth in output, and it is clear that the bulk of it occurred at Zapolyarnoye, not at Yamburg, the other field being developed by the company. It should also be noted that, given the choice, Gazprom would employ Zapolyarnoye as its last resort option for raising overall output because of tax considerations[16]. Therefore in 2018 additional production from Zapolyarnoye was higher, and additional production from other Gazprom fields was much smaller than in the previous year. The final stepping stone is the capacity loss as a result of lower operating pressures at older fields. It is understood that Gazprom has been actively working on arresting the decline rates at its older fields by adding booster stations this year which will result in less capacity loss in 2018 compared with 2017, but this is a judgement call, not exact knowledge. Taking all the above into consideration, the amount of spare gas productive capacity for Gazprom is estimated at about 40 Bcm on an annual basis by the end of 2018.

Figure 17: Evolution of Gazprom's spare productive capacity, 2016-2018



Source: Author's calculation

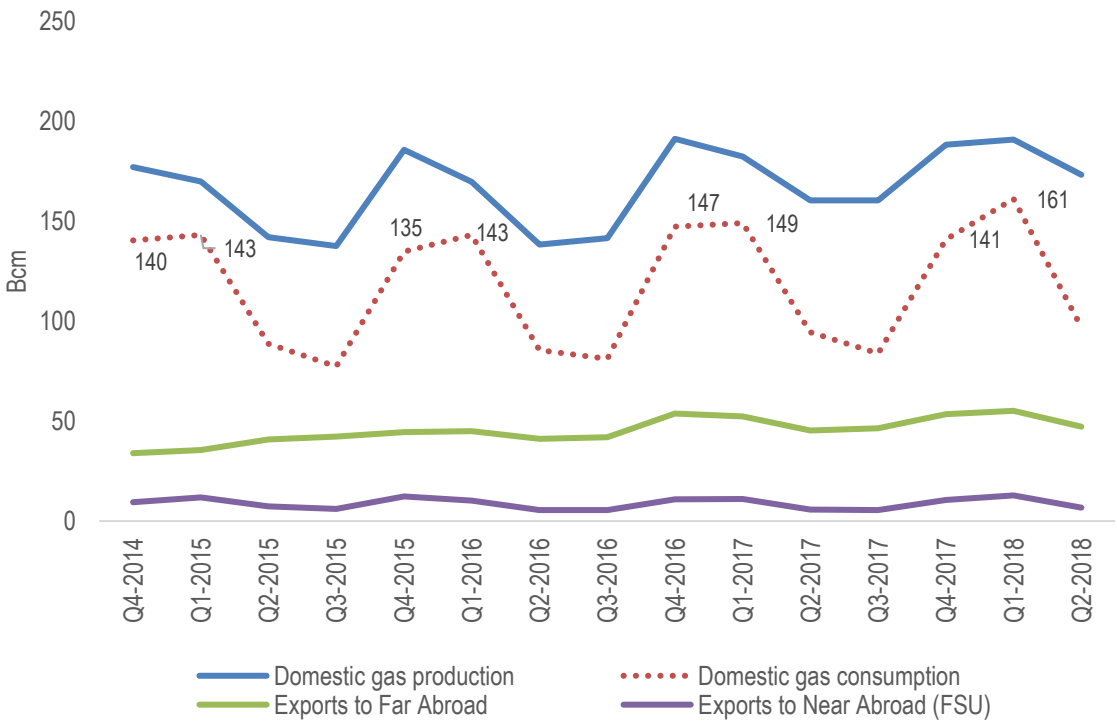
This may sound as though there is a lot of spare productive capacity remaining but recall the point about seasonality swings in demand (see Figure 18). Domestic consumption in Russia has become more prone to peaks, so in cold winter weather the industry is producing at full capacity and lifts gas from storage at maximum withdrawal rates to meet demand.

[16] Zapolyarnoye has one of the highest rates of MRET for gas. For a detailed analysis see Yermakov, V. and Kirova, D. *Gas and Taxes: The Impact of Russia's Tinkering with Upstream Gas Taxes on State Revenues and Decline Rates of Legacy Gas Fields* OIES Energy Insight, October 2017

Russia still has plenty of gas

On a reassuring note, Russia is and will remain the world's number one source of gas reserves for many years to come. According to the BP Statistical Review of World Energy, Russia's natural gas reserves in 2017 amounted to 35 standard Tcm, or 18.1 per cent of world's total, implying a reserves-to-2017 production cover of 55 years[17] (see Figure 19).

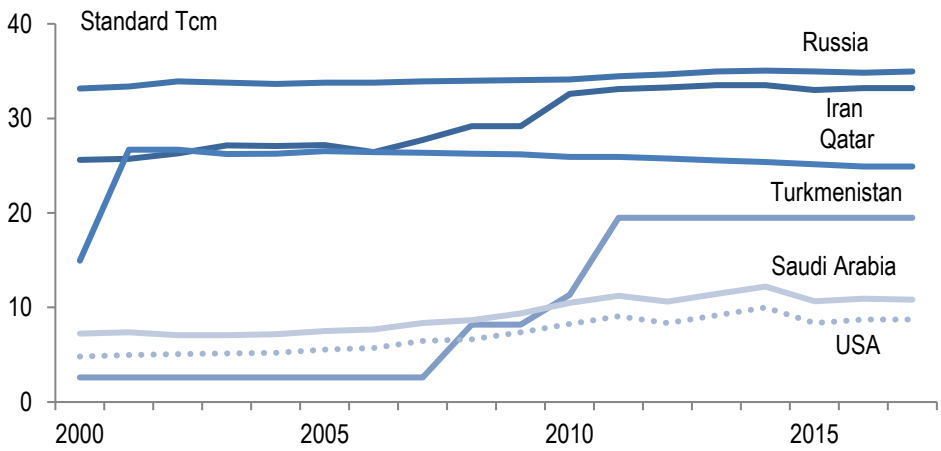
Figure 18: Russia's gas production, consumption, and exports by quarter



Source: Gazprom

[17] BP Statistical Review of World Energy, June 2018 at http://www.bp.com/statisticalreview
BP uses the international standard definition of proved reserves as quantities which are immediately accessible and economically viable to be produced at existing prices and costs. Their data set based on common definition allows international comparisons among many countries that use different methodologies of reserves estimation.

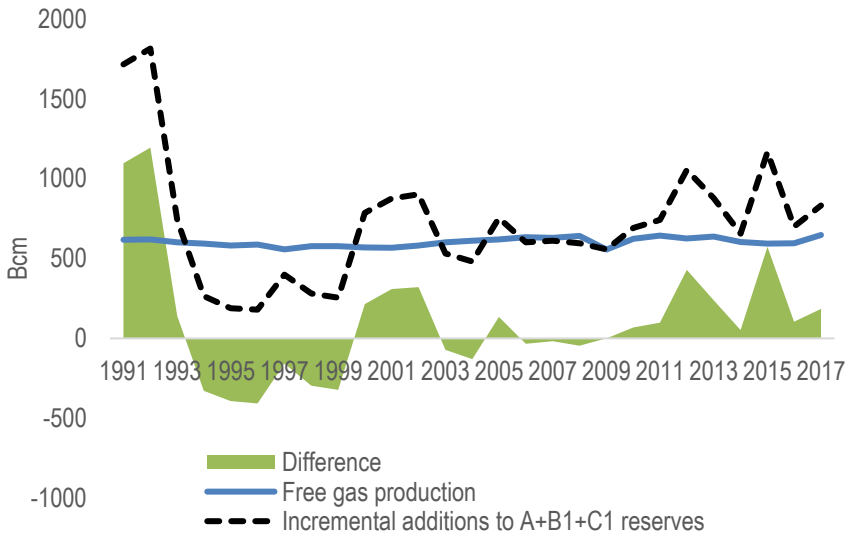
Figure 19: Natural gas reserves dynamics



Source: BP Statistical Review 2018

Russia's own classification of gas reserves (A+B1+C1)[18] gives a higher estimate of 50.7 Tcm. Russian official statistics also suggest that the difference between reserves replenishment and the extraction of natural gas which was often negative during the anarchic 1990s, has moved into positive territory since 2009 (see Figure 20).

Figure 20: Gas production vs. reserves additions in Russia

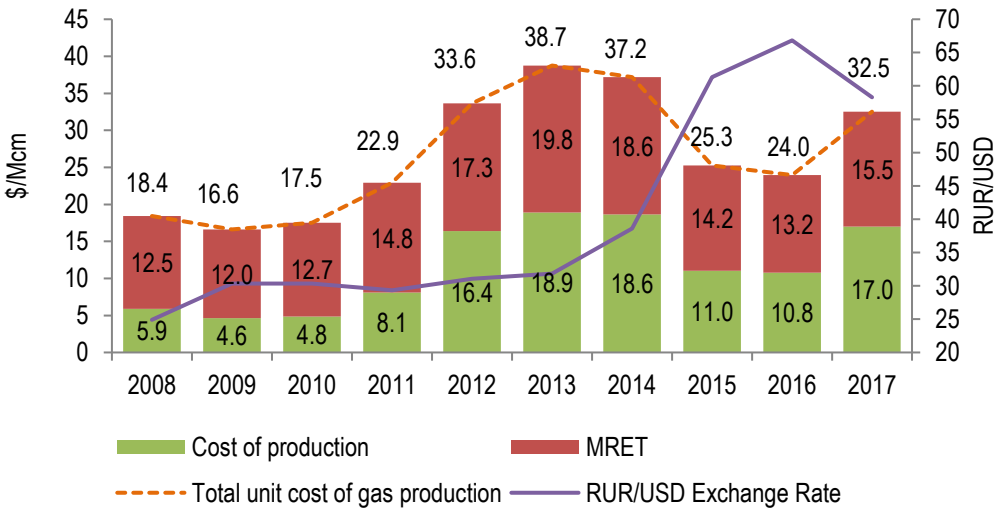


Source: Author, data from Russia's Ministry of Natural Resources (MMR)

[18] Russia's methodology is more focused on estimates of gas in place based on scientific confidence and engineering evidence for the existence of these volumes and then differentiating the reserves by technical recoverability, rather than on interpreting what share of this volume can be produced under existing economic conditions.

Another concern has been that Russia is running out of low-cost gas. Indeed, for almost thirty years Russia's gas output has been supported by the Soviet legacy of super-giant Cenomanian gas fields containing essentially network-quality dry gas that was extremely cheap to produce. Over time, the development of these and newer fields included the production of wet gas from deeper layers, initially from Valanginian, and recently from Achimov deposits. This gas is costlier to produce owing to the necessity of creating dedicated processing infrastructure necessary to deal with natural gas liquids (NGLs). In addition to higher lifting costs, the cost of Russian gas production has been affected by higher upstream taxes. As a result, upstream costs for Gazprom almost doubled in 2012-2013 compared with 2010 in US dollar terms.

Figure 21: Gazprom reported average cost of gas production



Source: Author, data from Gazprom

The booster shot of the ruble depreciation in 2015-18 helped Gazprom turn back the clock on the cost escalation that occurred in 2012-13. The average cost of production at the wellhead for its seven key upstream subsidiaries is currently under $1/MMBtu.

Russia is not running out of natural gas. Moreover, when it started to run out cheap natural gas the trend was quickly reversed following the massive ruble depreciation in 2015. But, as demonstrated in the analysis, Russia is quickly running out of spare gas productive capacity.

Conclusion: implications and potential game changers

Russia inherited from the Soviet Union a vast framework of long-term gas contracts with Europe that originated in the early 1970s when the first contracts were signed with Austria, Germany, Italy, and France. Over time these contracts were prolonged and extended, some of them as recently as a few years ago. After the collapse of the Soviet Union, a series of contracts with East European countries was signed. At present, the combined annual contract quantities (ACQ) of Russian gas supply contracts with Europe are around 200 Bcm (Russian standard). Until recently Russian gas exports to Europe were hovering around 80-85 per cent of maximum annual contract quantities, but in 2017-18 Russia's European exports almost reached their maximum contracted levels and started to exceed them.

Speaking at the Saint Petersburg International Gas Forum on October 4, 2018, Gazprom CEO Alexey Miller said: "In 2018 Gazprom will set a new record for gas supplies to Europe. …Our European supplies will come close to, or may even reach, 205 billion cubic meters of gas. That is the maximum

annual amount for all our European supply contracts. The total will cover 100 per cent of our obligations to our partners. This is a new frame of reference without a doubt. We need to reflect on that. Meanwhile, the demand for Russian gas continues to grow. …We now have a seller's market in the gas sector. This is new. We didn't have that ten or five years ago"[19].

Historically, Gazprom's motto was: "First we sell gas, and only after that we start producing it". The buyer's market in Europe had changed things in early 2010s, but now the pendulum has swung back. With a rapid demise in Groningen production, declining output in the North Sea, and limited availability of LNG owing to the strong pull from premium markets in Asia, it seems that Gazprom is going to get back at least part of its former leverage. Gazprom has already established a platform for gas auctions for European buyers that may serve for peak-shaving purposes and has been successfully marketing its gas: in 2018 sales ended sooner than planned because Gazprom ran out of available gas.

Another possible game changer to watch out for is the future of Ukrainian gas transit. A recent analysis by OIES suggests that Nord Stream 2 and the second string of the Turkish Stream are very unlikely to be operating at full capacity by 31 December 2019, when the current transit contract between Gazprom and Naftogaz expires[20]. Failure to reach agreement over the continuation of Russian gas transit via Ukraine is not implausible, implying a heightened risk of supply disruptions, physical constraints, and further geopolitical tensions. While in the short term the economic results of this negative scenario would involve a massive switch to LNG and a spike in prices in Europe, the longer-term damage to gas's prospects of becoming part of Europe's energy supply future might be devastating for an industry already struggling due to the EU's decarbonisation strategy.

Europe remains a core market for Gazprom. But Russia has embarked on a course of gas exports diversification – both geographically and in terms of mode of transportation – betting on LNG. The gas contract between Russia and China signed in 2014 is based on the so-called Eastern route, with supply coming from the gas fields in Eastern Siberia which do not have a pipeline link with Russia's gas network in the European part of the country. But negotiations on another route for gas supplies to China, the so-called Western route, also known as the Altai pipeline, have been continuing. For this route, the resource base for the supplies is the same as for Europe, specifically the gas fields in NPT. A possible new gas contract between Russia and China may become an important game-changer, starting a competition between Europe and China for scarce incremental Russian supplies.

[19] http://www.gazprom.com/press/news/miller-journal/2018/494533/

[20] Pirani, S. *Russian gas transit through Ukraine after 2019: the options.* Oxford Energy Insight, Oxford, November 2018