

The Impact of the “Shale Gas Revolution” on Russian Energy Strategy



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I. INTRODUCTION

The successful development of shale gas extraction and production in North America has spread a positive outlook within the international energy community, which envisages that a great availability of gas in the next years will contribute to diversifying the energy mix, reducing emissions, and enhancing energy security. However, the emergence of the “shale revolution” is perceived as a serious energy threat by Russia, because it could severely affect its role as a major gas supplier. Thanks to the combination of LNG developments and shale gas production, a growing gas availability in global markets poses questions about the ability of Russia to keep gas exports to Europe at current levels and to develop the Eastern vector through growing gas exports to Asian markets.

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II. SPECIAL REPORT BY FABIO INDEO

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The successful development of shale gas extraction and production in North America has spread a positive outlook within the international energy community, which envisages that a great availability of gas in the next years will contribute to diversify the energy mix, reducing emissions, and to enhance energy security.

However, the emergence of the so called “shale gas revolution” is perceived as a serious energy threat by Russia, because it could severely affect its role as main gas supplier. As a matter of fact, a growing gas availability in the global markets (thanks to the combination between LNG developments and shale gas production) poses questions about the ability of Russia to keep gas exports to Europe at the recent levels and to develop the Eastern vector through growing gas exports to Asian markets.

The aim of this research is to analyze perspectives of shale gas development in E.U. - Russia’s core export market - and China - potential huge market for Russian exports - in order to evaluate the impact and linked repercussions to Russian energy exports. In addition to the shale gas, we can observe that Russia energy sector also suffers from endogenous factors, which could hinder Russian ambition to expand gas exports in order to meet the increase of gas demand expected by the IEA “Golden Era of Gas”.

However, European Union and China could find some difficulties and hindrance to develop shale gas production, giving Russia additional opportunities to preserve its strategic role of supplier country,

even if the correction of existent internal distortions represents a necessary precondition to achieve its strategic aim.

Russia and “Shale Gas Revolution”: A General Overview

1.1 A “nightmare energy scenario” for Russia

The perspectives of a rising availability of unconventional gas (that is shale gas, tight gas and coalbed methane) in the global energy market and the effects of the so-called “shale gas revolution” represent a dangerous threat to Russian energy politics: shale gas should become a game changer which will have a profound impact on world global energy scenario, mainly affecting Russian energy supplier status and energy strategy.

As a matter of fact, the development of shale gas production will undermine Russian leadership in the global gas market, mainly based on its world largest natural gas reserves and its role of world’s largest exporter of natural gas.

In particular, the rise of unconventional gas production in the United States, European Union and China could represent a “nightmare energy scenario” for Russia: in addition to U.S. (which has been producing shale gas since 2009), also E.U. and China could become producer of shale gas, allowing them to satisfy (even if in a variable extent) their energy needs: the main strategic consequence is that Russia would loose lucrative and wide markets for its gas exports, also weakening its strategy of using its energy exports as both a foreign policy tool and a revenue generator to support national budget[1].

Furthermore, following this potential evolution Russia could not play a leader role (as main gas supplier) in the IEA forecasted "Golden Age of Gas" scenario, based on a positive outlook for the future role of natural gas , driven by different factors: more ambitious assumptions about gas use in China; greater use of natural gas in transportation; an assumption of slower growth in global nuclear power capacity; a more optimistic outlook for gas supply – primarily though the availability of additional unconventional gas supplies at relatively low cost; conventional and unconventional gas could easily replace other fossil fuels because natural gas can lead to lower emissions of greenhouse gases[2].

According these perspectives, a potential greater availability of gas at moderate prices will have the result to increase global gas demand by more than 50% between 2010 and 2035, while the share of gas in the global energy mix reaches 25% in 2035, overtaking coal to become the second-largest primary energy source after oil[3].

In this planned increasing scenario, unconventional gas reserves will play the most influent role, considering that the share of unconventional gas in total gas output will rise from 14% today to 32% in 2035[4].

Global primary gas demand will be met through an increasing production of both conventional and unconventional gas, potentially enhancing Russia's role as gas supplier in the next decades: however, the combination between endogenous factors (most of the Russia's remaining conventional gas reserves are located in difficult Siberian areas, where the exploitation activities are more expensive, while the exploration of unconventional resources proceeds slowly) and external factors (the potential rise of shale gas production in Russia's market countries as well as the expansion of LNG energy option) would hinder Russian expectations to meet a relevant share much of the potential increased demand foreseen in IEA scenario.

Analyzing global energy scenario and the expectations of shale gas production in United States, China and Europe (which represent real and potential markets for Russian energy exports) we can observe the reason why Russia government has perceived shale gas development as a concrete threat for its energy and economic interests.

1.2 United States, European Union and China towards shale gas

Concerning this "shale gas revolution", various data from a variety of sources (eg. International Energy Agency, U.S. Energy International Administration, national energy agencies) estimate that remaining technically recoverable resources of shale gas amount to 208 trillion cubic metres (tcm): in addition to tight gas (76 tcm) and coalbed methane reserves (47 tcm), unconventional sources amount to 331 tcm, compared to 421 tcm of conventional resources[5].

At present, United States play the role of leader in the continued expansion of unconventional gas production, which covered in 2010 nearly 60% of total gas national production. Great expectations about an increasing shale (and generally unconventional) gas production appear justified considering the existing large resources: shale gas represents 32% of total U.S. gas reserves (24 tcm), which amount to 74 tcm, equally shared between conventional and unconventional[6].

The U.S. extraordinary success to develop shale gas production - which grew from 21 bcm (2005) to 141 bcm (2010), reaching 222 bcm in 2011 (according to EIA estimates)[7] could be easily labeled as "energy revolution", which change the energy status of this country, from becoming the largest LNG import market to a self-sustaining gas producer and a net gas exporter[8].

Following this evolution, in the next years United States will enhance their role as the largest global gas producer, reaching about 820 bcm of total gas production in 2035, compared with 785 bcm in Russia[9].

But the real threat for Russian interest is that the U.S. plans to become a net exporter of liquefied natural gas by 2016, allowing E.U. to reduce the dependence on Russian gas imports, even if U.S. has to build additional new liquefaction facilities or reconvert the regasification existent facilities[10].

Concerning China, remaining recoverable resources of unconventional gas totaled almost 50 tcm, comprised of 36 tcm of shale gas, 9 tcm of coalbed methane and 3 tcm of tight gas. According to the EIA Golden Rules Case, China is destined to become a major gas producer and the second-largest global producer of unconventional gas, after the United States: in 2035, 83% of total Chinese gas production will derive from unconventional sources[11].

The development and the exploitation of unconventional gas will allow China to severely cut gas imports which will be needed to satisfy future increasing energy demand, related to its economic growth: this scenario would undermine Russian ambition to expand its exports to the potentially lucrative Asian market, in order to diversify its gas exports, heavily unbalanced to E.U. markets.

Estimated total recoverable reserves in Europe amount to between 33-38 tcm, of which 12 tcm are tight gas, 15-17 tcm shale gas and 8 tcm coal bed methane; Poland and France have the largest shale-gas resources, respectively 29 % and 28% of the total, followed by Norway, Ukraine, Sweden, Denmark and the United Kingdom[12].

Even if Europe remains a net gas importer, the development of endogenous unconventional gas reserves will allow E.U. to further reduce the import dependence on Russia and other supplies, achieving an important goal in its energy security condition.

On the contrary, shale gas boom in the E.U. will represent an immediate concern to Russian plans, considering that around 70 % of Russian gas exports is delivered to E.U. markets.

These data support the idea that a success of the “shale gas revolution” will profoundly modify and change the global energy balance, downplaying the role of some gas suppliers as Russia.

At the same time, it is interesting to promptly underline that even if resources could be larger than indicated in these studies (some countries and regions – such as Russia and Middle East have not been analyzed in EIA report 2011), additional studies elaborated by geological institutes and other research centers provided significantly lower estimates, based on the real accessibility of the resources. According IEA 2012 World Energy Outlook, only 40 % of shale gas resources are accessible in U.S. (65% of tight gas, 45% of coalbed methane) and in China only 20% of the shale gas resources are assumed to be accessible (40% of the coalbed methane)[13].

However if shale gas industry in E.U. and China is at the first development stages, the unconventional gas developments in North America have already had a huge impact on Russian gas trade with Europe, both in terms of gas volumes and gas prices, further combined with other global factors: a drop in demand linked to the global recession and the creation of a "gas glut", supported by an overcapacity of LNG which has become a less expensive option than pipeline gas (based on long-term contracts), contributing to the de-linkage of the gas prices from the oil price[14].

Indeed, in 2008-2009 Russian gas exports to Europe decreased from 125,57 bcm to 92,41 bcm due to the global recession and an increased LNG availability in Europe[15]: as a matter of fact, since the U.S. achieved a self-sufficiency in its national natural gas market, large volumes of LNG previously directed to U.S. are now being diverted to Europe, where spot prices have fallen to half of that of Gazprom, the Russian gas giant. This collapse of oil and gas prices has forced Gazprom to accept large price cuts within the E.U. markets, because of the competition: Polish company PGNiG obtained a price reduction from \$500 to \$450 per 1,000 cubic meters of Russian gas, while German market leader E.ON Ruhrgas negotiated a price reduction of over €1 billion for 2012 alone[16].

The fluctuation in the energy price shows Russia's vulnerability, mainly because its economy largely depends on revenues of energy exports: half of the Russian budget comes from energy revenues, 80 % of which is from oil and 20 % from natural gas. This revenue's reduction obliges government to adopt corrective measures, such a sizeable increase of the mineral extraction tax on oil and natural gas companies by the end of 2015, in order to fill the budget gap[17].

In addition, also the political engagement of U.S. State Department to globally promote "shale gas revolution" represents a serious challenge for the Russia's position in the international energy market. In 2010 U.S. undertook the Global Shale Gas Initiative (also known as Unconventional Gas Technical Engagement Program) aimed to "achieve greater energy security, meet environmental objectives and further U.S. economic and commercial interests", also providing technical and regulatory assistance to selected countries[18]. U.S. has launched engagement programs with Poland, China and other potential shale gas producer countries: a future success of this initiative will progressively erode Russian influence in the global energy chessboard. This program can easily become a concrete and efficient tool of U.S. foreign policy in the global competition over energy resources, consolidating its geopolitical influence.

1.3 Shale gas: “a soap bubble will burst soon”

One of the main weakness of Russian energy politics has been to downplay the role and potential of shale gas in the global energy sector, a position widely supported by Gazprom official position. Even recently, in March 2013, Alexey Miller (CEO of Gazprom) defined the extraction of shale gas in the

U.S. *"a soap bubble will burst soon"* (same definition used by Medvedev - Gazprom deputy head - some years ago) expressing skepticism about its economic profitability[19].

Medvedev has dismissed the threat of a repeat of the U.S. success in developing shale gas resources in Europe, claiming that it was 'unimaginable' that European governments would allow the development of shale gas[20].

However, President Putin has begun to shift this approach, expressing serious concerns about Russia's underestimation towards shale gas revolution and asking Gazprom to retune its strategy adapting it to the growing threat from shale gas: during his final address to the Russia Duma - before he took over the presidency for the third time - Putin worried that U.S. shale gas production may "seriously" restructure supply and demand in the global hydrocarbons market[21].

After years of ideological underestimation and disinterest, now Russia is showing to have also a huge potential of unconventional reserves: according to Viktor Skorobogatov, director of the gas resources center at Gazprom's VNIIGAZ research unit, Russia may hold 680 tcm of unconventional resources, doubling the estimates on conventional probable gas resources (250 tcm)[22].

"No country in the world can compete with Russia in terms of the volume of natural-gas reserves and its vast resource potential in both traditional and unconventional," commented Skorobogatov[23].

However this appears as a way to dispel the threat of the "shale gas revolution", even because developments of unconventional gas - as well as for conventional gas - will require massive investments, not only in the production facilities, but also in long gas pipelines and expensive liquefaction terminals needed to bring the gas to market[24].

Threats to Russian Gas Sector: Endogenous and External Factors

2.1 Conventional and unconventional gas potential

As mentioned in the previous section, Russia has huge conventional gas resources which allow to play a strategic and geopolitical role as the biggest exporter in the world: however, Russian energy sector suffers from a combination of endogenous and internal hindrances, which combined with the effects of the "shale gas revolution" could concretely affect Russian's role of main gas supplier.

Russia holds the largest natural gas proved reserves in the world, which amounts to 44,6 tcm (representing about a quarter of the world's total proven reserves)[25]. Moreover Russia is not only the holder of the biggest gas resources, it is also the biggest exporter in the world, contributing with more than 40 % of the overall world's gas export.

However Russia has lost in the last years the role of largest producer in favor of U.S., due to the shale gas boom production.

Concerning the geographical distribution of these reserves, the majority of them are located in Siberia, with the Yamburg, Urengoy, and Medvezh'ye fields alone accounting for about 45% of Russia's total reserves: significant reserves are also located in northern Russia[26].

The production of Siberian's fields is totally delivered to Western markets (E.U., post soviet countries, Turkey). The Urengoy gas field in the northern West Siberia Basin is the world's second largest natural gas field (10 tcm of total deposits) after South Pars / North Dom Gas-Condensate field, shared between Iran and Qatar.

The Yamburg gas field is the world's third largest natural gas field, with 8,2 tcm of estimated reserves. As in the case of Urengoy, also Yamburg's production (over 200 bcm per year) is delivered to Western Europe[27]. Orenburg gas field is the largest Russian gas field outside of West Siberia. It had initial reserves of 1.77 tcm of gas and is now under production.

In the region comprising Yamal Peninsula/Arctic Circle there are other big gas fields as Zapolyarnoe - the fifth largest gas field in the world, with 2,6 tcm of gas reserves - with a production of 100 bcm per year, Kharasavey (located at the west coast of Yamal peninsula, with 1,9 tcm of proven reserves[28]).

The development of the Sakhalin Island resources - located off Russia's eastern shore - is following different phases: currently Sakhalin I and II gas production has been dedicated to enhance LNG exports to Eastern Asia markets.

According to Gazprom's estimates, Russia may hold 680 tcm of unconventional resources, two times more than conventional resources, legitimizing Russia as the world country with biggest traditional and unconventional gas reserves.

Almost 90% of Russia's unconventional resources are located in the east, mainly in the Urals and Siberia. Russia's shale-gas resources are estimated at about 5 tcm to 20 tcm: hydrates account for about 75% of all the nation's unconventional resources, or 500 trillion cubic meters, followed by tight gas at 110 trillion cubic meters and coal-bed methane at 50 trillion cubic meters[29].

While Gazprom may be seeking to buy expertise in shale gas, the company is much further advanced in the development of Russia's coal-bed methane (CBM) resources.

In February 2010, Gazprom launched Russia's first coal-bed methane production facility at the Taldynskoye field in the Kuzbass region. The Kuzbass CBM resource base is estimated at 13 tcm, which will allow to develop a large-scale production resource despite its huge resources of conventional gas[30].

However development and production activities in the shale gas sector will require financial and technological support, postponing a potential Russian role in the unconventional sector: as a matter of fact, development of hydrates and shale gas won't start before 2025 or 2030[31].

2.2 Export routes: Western and Eastern vector

According to the last BP Statistical Review, in 2011 Russia exported 221,4 bcm of gas: 207 bcm through in a westward direction and 14,4 bcm through LNG form in a eastward direction.

Western vector (comprising E.U. markets, Turkey, other Europe and Former Soviet Union Countries) is dominant within Russian exports accounting for 93-96 % of total exports: EU27 and Turkey markets alone covers 63 % of Russian exports[32].

The Yamal-Europe I, Northern Lights, Soyuz, and Bratrstvo pipelines all carry Russian gas to Eastern and Western European markets via Ukraine and/or Belarus. These four pipelines have a combined capacity of 113,28 bcm[33].

Blue Stream and Nord Stream are undersea corridors, which have allowed Russian exports to overcome the geopolitical hurdle linked to the transit in a third country: Blue Stream (with a capacity of 15,85 bcm) delivered Russian gas - crossing the Black Sea - to Turkish market, which was in 2011 the second top destination in the "enlarged Europe" after Germany and before Italy.

Nord Stream (with a capacity of 55 bcm) directly connects Russian production to Germany and northern Europe, bypassing Ukrainian and Belorussian traditional transit routes.

Eastward vector is now exclusively composed by LNG exports, waiting for the realization of the Altai pipeline to China. The Sakhalin Energy's LNG plant is currently the only LNG production facility in Russia: it has been operating since 2009 and it can export up to 10 million tons of LNG per year on two trains[34]. In 2011 Russia exported 14,4 bcm of LNG gas: Japan is the biggest market (9 bcm per year) followed by South Korea (3,9 bcm), China and Taiwan (0,3 bcm)[35].

2.3 Strategic challenges and endogenous hindrances

In order to meet the expected growing gas demand in the next years, Russia has to realize two main strategic goals: to increase its own production and to geographically diversify its energy exports, focusing on Asian markets and developing the Eastern Vector.

However, the main problem to be managed by the Russian political authorities is not the resources availability, but the capability to effectively develop them: as a matter of fact, the achievement of these targets will oblige Russian government to undertake huge financial investments aimed to explore new fields, to develop transport infrastructures and to adopt new technology ensuring an increase in the gas production[36].

One of the main urgent problems to be solved is linked to the progressive depletion of the most prolific fields in Siberia, while Russia's untapped conventional gas resources are increasingly located in remote and hostile regions, such as the Yamal Peninsula, Eastern Siberia, and the offshore areas of the Barents and Kara Seas.

The development of new fields requires significant funding and new technology in order to start production in these areas and to realize long gas pipelines and expensive liquefaction terminals to deliver the gas to markets[37].

However, with the exception of Nord Stream and the plans to realize Altai and South Stream gas pipelines, Russia appears not be able to launch and develop new projects, postponing the exploitation of untapped reserves in Barents Sea and Yamal peninsula.

On the one hand, the launch of Bovanenko gas field in October 2012 represents a positive step to help Russia and Gazprom to offset the falling gas output from other fields: this field is located at the north-western shore of the Yamal peninsula and holds relevant reserves estimates to 4,9 tcm. The forecasted production of gas will be 115 billions cubic meters per year with an increase of 140 bcm as the long-term perspective, which will be sufficient both for pipeline and LNG transportation[38].

On the other hand, the failure to develop Shtokman gas field (or better its undefined postponement) has clearly set back Russian ambition to increase its gas production and exports, mainly in the LNG form in order to consolidate its presence in this market. The Shtokman gas field was discovered in 1988 to the east of Murmansk, with estimated reserves of 3.8 tcm, but the difficult geographic location (the field lies 555 kilometres from land, in 350m of water and and lies inside the Arctic) has progressively delayed its exploitation[39]. In August 2012 Gazprom has indefinitely postponed the development of its giant gas field in the Barents Sea - which was jointly developed with Norway's Statoil and France's Total - due to a combination of factors: the changed market situation and extremely high production cost in the Arctic raised doubts about the project's profitability, given its estimated \$40 billion cost for building out the field, laying a pipeline to shore and constructing an LNG plant[40].

Furthermore, Shtokman project in the Arctic was expected to ship 90% of its production to the U.S. in the LNG form through a LNG plant in Murmansk. The success of the shale gas revolution in United States thwarted Russian plans, because U.S. imports of liquefied natural gas fell dramatically, while the U.S. has changed from a major gas importer into a potential exporter, probably by 2016[41].

The suspension of Shtokman project also implies the freezing of the correlated LNG project near Murmansk: most likely, the Shtokman project schedule will be adjusted and its gas destination will be re-routed to other markets[42], mainly Asian and not European, because these latter are widely supplied by Qatar LNG exports before destined to U.S. markets and now re-oriented to E.U.

Also the implementation of South Stream and Altai gas pipelines poses serious problems and concerns. South Stream would deliver 63 bcm of Russian gas under the Black Sea to Bulgaria and then to Central East European countries, bypassing the transit in Ukraine. Gazprom expects the pipeline to be completed by 2015 even if some economic and supplies problems still remain. Without a potential commitment of Central Asian or Azeri gas, South Stream should be necessarily fueled with Russian gas extracted in Far East or Yamal fields: it would be more rationale and economic to divert these gas volumes to supply closer Asian markets, avoiding economic costs and security hurdles linked to a long transport route.

Moreover, South Stream pipeline will also face difficulties complying with the E.U.'s energy regulations. One of them requires South Stream to provide full access to third-party gas in all distribution and transmission infrastructure in a competitive manner. Another, even more problematic regulation that will affect South Stream is the E.U. requirement for separation between transmission and production activities, or the "unbundling" of supply and trade[43].

These measures could reduce the geopolitical impact of the South Stream project, aimed to enhance E.U. energy dependence on Russian gas imports.

Concerning Altai pipeline, recent developments envisage the potential realization of this Sino-Russian corridor overcoming price dispute which has affected its implementation[44]. In March 2013, Gazprom and China National Petroleum Corp (CNPC) agreed that 38 bcm per year of Russian gas would flow to China starting in 2018 and come only from Russia's East Siberian fields. Gazprom is developing gas fields in Russia's far east and building a pipeline, called "Strength of Siberia," to take gas to a planned liquefaction plant in Vladivostok on Russia's Pacific coast. Russia would send the initial 38 billion cubic meters a year of gas to China via a spur from that pipeline. The company forecasts the total cost of its so-called "eastern gas program" at around \$50 billion. Even if China and Russia agreed for only 38 bcm of gas, rather than the planned 68 bcm, this deal shows how Russia is privileging East markets: China will become the main market for Russian exports overcoming Germany

For years, the two sides have failed to agree on price, but now they appear closer to reach a deal, as the price that Gazprom receives in Europe, its most lucrative market, has decreased. Gazprom hopes to agree a final price in the next few months. Aleksei Miller (Gazprom CEO) said China could pay in advance for the gas, allowing Gazprom to offer a discounted price. In this way Gazprom could cover the cost of exploration and of bringing its untapped East Siberian gas resources to market[45].

Considering the expected increase of the gas demand in Japan and South Korea markets, LNG could represent the best option for Russian exports, even if at present there is only a LNG plant in Sakhalin. Furthermore the development of LNG facilities could allow Russia to overcome the problem of long distances between production's centres and markets, even if Russia moves late towards LNG option and some geographical-technical hindrances must be solved.

As a matter of fact, there are four main LNG plant projects currently under discussions but their implementation show slow progress.

Murmansk LNG plant project is frozen because linked to the development of Shtokman field. Vladivostok is in earlier stages of planning and should be fueled through additional gas volumes produced by Sakhalin fields, even if costs to develop Sakhalin phases appear to be doubled.

LNG facilities should be realized in Yamal, where Gazprom is developing its Bovanenkovo field. Furthermore also the Russian independent gas producer Novatek - in partnership with Total - has undertaken a LNG project which is expected to be launched in 2017 with a total capacity of 15 million tons, exploiting South Tambeyskoye field with 1,27 tcm of gas reserves.

In the Novatek case, the Arctic Yamal peninsula project is technologically challenging because the plant will be situated on unstable permafrost and shipping will take place via the Kara Sea, which is icebound for about ten months in a year[46].

Another hindrance to be solved is the Gazprom's monopoly position on the gas sector. The consolidation of the gas sector under Gazprom state firm has had many geopolitical and economic benefits for the Kremlin, provoking at the same time some negative distortions and disadvantages.

The lack of internal competition among different energy companies has lagged the adoption of modern technologies (such as investments in the unconventional gas sector), while Gazprom's dominant position has discouraged outside investments.

With future energy projects in Russia requiring more advanced technology (due to their location and environment) and more capital, Gazprom and Russian gas sector need modernization and foreign investment[47]: in 2011 Gazprom invested \$40 billion but production has not grown since 2001[48].

The state-run Gazprom dominates Russia's upstream - producing about 80% of Russia's total natural gas output - and it also controls most of Russian gas reserves, with more than 65% of proven reserves being directly controlled by the company. In addition, Gazprom's position is further cemented by its legal monopoly on Russian gas exports, granted by Russian government[49].

The Gazprom's monopoly on exports clearly hinders independent producers such as Novatek and Itera to gain importance in national gas sector: as a matter of fact, even if non-Gazprom production of natural gas increases, these companies relies on Gazprom pipeline network for gas transportation.

Novatek is the Russia's second-largest gas producer: in 2011 alone, Novatek's gas exports rose by 45% Novatek wants the Kremlin to revoke Gazprom's export monopoly. in order to maximize economic and strategic gains linked to the planned LNG plant in Yamal. No decision has been made yet, but the Kremlin could decide to loose the monopoly by liberalising LNG exports while keeping Gazprom as the only exporter of piped gas[50].

The combination among these internal factors with the emergence of shale gas and the expansion of LNG market pose questions about the ability of Russia to keep gas exports to Europe at the recent levels and to develop the Eastern vector through growing gas exports to Asian markets.

A revision of the Russia Energy Strategy appears indispensable, considering that the existent one has been released in 2010[51].

According this strategy, the development of Shtokman deposit was expected to rise the production of the European part of Russia from 46 bmc in 2005 to 131-137 bcm in 2030, while gas exports to Asian market were expected to reach 20%[52].

But the Shtokman's failure, the lack of financial investments to modernize energy sector, the slow progress to develop Eastern Siberia and Far East gas reserves will prevent Russia to achieve the energy targets expected in the Energy Strategy 2030, which foresee to produce from 871 bcm to 926 bcm of gas by 2030.

A Shale Gas Revolution in European Union?

3.1 E.U.'s shale gas potential and energy security

The estimated presence of huge shale gas reserve in Europe - almost 10% of the global total - has supported E.U. ambition to enhance its energy security condition, to be achieved by means of an increase of European gas production and the reduction of Russian imports, as well as an implementation of LNG option and regasification infrastructures[53]. A potential development of shale gas reserves in E.U., aimed to increase European production of gas, could have several positive effects in terms of energy security and external energy dependence.

Estimated total recoverable reserves in Europe amount to between 33-38 tcm, of which 12 tcm are tight gas, 15 tcm shale gas, and 8 tcm coal bed methane, while total E.U. conventional gas reserves amount to 2.42 tcm. In theory, Europe's unconventional gas resources might be able to cover European gas demand for at least another 60 years[54].

Even if Europe remains a net gas importer, unconventional gas volumes in Europe could stabilize domestic supplies in the face of declining conventional production, contributing to diversify the energy mix and reducing the dependence of conventional gas imports coming from few suppliers (Russia, North Africa countries, Qatar)[55].

Moreover shale gas is promoted as a safe, clean energy source that can allow E.U. to undertake transition to a low carbon economy. As the E.U. Commission stated "use of natural gas for power generation is among the cheapest and fastest ways to reduce CO₂ emissions, and that additional unconventional production may help natural gas play a role as a 'bridging fuel' until a permanent transition can be made to renewable"[56].

Given the E.U. high dependence on few gas suppliers and the high costs and political risks associated with long-distance transportation, there may also be considerable economic and strategic value in the development of unconventional resources closer to the European market[57].

Russia plays a dominant position in the E.U. energy scenario, covering almost 40% of E.U. gas imports. In spite of E.U.'s several attempts to diversify its energy strategy, by 2020 Russia's gas potential export will double, reaching about 231 bcm or 300 bcm if we consider the whole Western vector of exports (also including Turkey, Ukraine and Belarus).

The consolidation of Russia as main gas supplier for E.U. will materialize easily following the implementation of the existent projects (Nord and South Stream): all gas supplies to E.U. will continue to be delivered by pipelines.

Furthermore, according to the IEA 2012 projections, E.U. gas demand will rise from 547 to 644 bcm in 2035: in spite of the support of the unconventional gas production (estimated to cover 47% of the E.U. gas production in 2035, if Golden Scenario condition will be achieved), E.U. gas production will decrease from 201 bcm to 165 bcm in the considered period[58]. Consequently E.U. will need to import 479 bcm of gas in 2035, and half of these would be covered by Russian imports.

In the last years, E.U. has implemented a diversification strategy in order to enhance its energy

security, trying to lessen this dangerous dependence on Russian gas imports, by moving to liquefied natural gas (LNG) imports by tankers from Africa, the Middle East and Latin America and by developing unconventional gas production.

On the one hand, E.U. has profitably exploited the "gas glut" in the global energy scenario - an overcapacity of LNG exports - that has led LNG to become less expensive than pipeline-gas (based on long-term take-or-pay contracts), contributing to the de-linkage of the gas prices from the oil price[59].

The E.U.'s current regasification capacity of 150 bcm looks set to double by 2020[60]: in this case, through these additional LNG imports from Qatar, Algeria and U.S. E.U. will be able to partially reduce the expected increase of Russian imports to 132 bcm, compared to a planned export capacity of 231 bcm.

On the other hand, E.U. countries have engaged to explore shale gas potential resources in order to plan an internal production which could reduce external energy dependence (mainly on Russia).

3.2 European countries towards shale gas

The traditional ideological fracture among old (western) Europe and new (eastern) Europe has emerged on the perspectives of shale gas development: as a matter of fact, France and Germany lead a group of countries that have suspended fracking activities, while Poland, Bulgaria, Romania, Ukraine - countries heavily dependent on Russian gas imports - are pushing to extend explorations trying to improve their energy security[61].

Poland has been one of the most enthusiastic European supporters of shale gas due to its dependence on gas imports from Russia and growing demand for energy supply[62].

Until recently, Poland was thought to have the largest reserves of shale gas in Europe (29%) together with France[63]: considering the high dependence on Russian gas imports (70%) the development of Polish shale gas could really represent a "game changer" in the European scenario.

This ambition was widely supported by 2011 EIA report, which puts Poland's shale gas reserves at nearly five trillion cubic meters[64]. With a yearly consumption of 17 bcm of natural gas, these enormous shale gas reserves could promote a self sufficiency, holding enough gas for 300 years of consumption.

The Polish government is encouraging exploration through fiscal incentives and more than 100 exploration licenses have been approved, involving the main U.S. energy companies such as ExxonMobil, Chevron, Halliburton and several others: more than two thirds of exploratory drillings in Europe are located in Poland[65]. According to Polish Prime Minister Donald Tusk the country's shale gas reserves could provide 'gas security' by 2035[66].

Nevertheless, in March 2012 the Polish Geological Institute contradicted that estimate, sharply revised it down to between 346 and 768 bcm, discouraging international energy companies about shale gas prospects of development[67]: ExxonMobil subsequently announced its withdrawal from Poland after the failure of commercial gas flows, while ConocoPhillips decided not to exercise its 70% option in three concessions in northern Poland, even if it continues to operate in the country as well as Chevron[68].

However, the political support to the implementation of "shale gas dream" in Poland appears growingly linked to ideological-geopolitical reasons rather than energy security issues[69]. As a matter of fact Poland is relatively energy independent - gas constitutes just 13% of its primary

energy supply - and the government is also trying to diversify gas routes by investing in a new liquefied natural gas terminal on the Baltic Sea.

The development of shale gas appears as one of the most significant project of the Polish-American special relationship and cooperation in foreign policy (after the failure of the Bush-era missile defense) aimed to achieve a shared target: an enhanced U.S. presence in the region as a deterrent of Russian foreign-policy interests in Central and Eastern Europe[70]. Through the Global Shale Gas Initiative U.S. has supported Polish attempts, enhancing energy and technical cooperation with the involvement of the main U.S. energy companies[71].

Since the re-assessment of the Polish reserves, France is estimated to now have the largest reserves of shale gas in Europe (28%) but has become the first country in Europe to outlaw fracking (in June 2011), following widespread public objections[72]. The development of shale gas reserves in Germany could be profitable, considering that it depends on 40% of Russian imports: however some estimates suggest that only between 0.7 and 2.3 tcm of the gas could be technically extracted[73].

In February 2012, Angela Merkel's government made public a draft law allowing the development of shale gas through fracking, though under certain conditions, even if environmental and political opposition asks for a moratorium on shale gas development until better techniques are found[74].

Shale gas debate is more controversial in Romania and Bulgaria, even because it is strictly linked to their condition of energy security, considering that both countries depend on Russia for over 90% of their gas supplies.

In January 2012, Bulgaria banned exploration for shale oil and gas using fracking after widespread protests, even if in June 2012 the ban on fracking was eased by the Bulgarian parliament, allowing explorations for unconventional natural gas. According to initial estimates, Bulgaria may have significant shale gas reserves of up to 1 tcm, which could lead the country to ensure its energy security, ending Russian gas imports[75].

Shale gas has been promoted in Romania as a means of improving national energy security and a way to decrease the country's dependency on Russian imports, but some controversies have arisen. Last year national government announced a one year moratorium on the exploration and exploitation of shale gas by fracking: in April 2013, after that moratorium expired, thousands of Romanians protested against the plans of U.S. giant Chevron to explore for shale gas, due to environmental concerns, demanding the government to withdraw concessions and ban drilling of the company's first test wells[76].

For Russia's energy interests to Europe, the development of shale gas in Ukraine represents a serious threat. Ukraine has the third largest shale gas resources in Europe - behind France, and Norway, benefiting of 1,2 tcm of technically recoverable shale gas reserves[77]. The Ukrainian government is concretely active in this field, inviting international investors to analyze and develop the Ukrainian shale gas deposits. In August 2012, Shell, ExxonMobil, Romanian OMV Petrom, and Ukrainian state company Nadra received joint rights to develop underwater deposits at Ukrainian deep marine shelf field under the Black Sea: moreover Chevron also obtained the right to develop gas deposits at Oleske field in western Ukraine[78].

The implementation of this project will not only strengthen Ukrainian energy independence but will also significantly reduce gas prices: Ukraine currently pays about \$430 (€322) per thousand cubic metres for Russian gas under a 10-year deal signed in 2009 by a preceding government[79].

In addition to the economic factor, implications for Russia's strategy are evident: following a shale

gas production in Ukraine, Russia would lose one of the biggest western market (33 bmc of gas per year, two thirds of its total gas consumption).

Furthermore, even if Russia tries to marginalize Ukrainian role as a transit country for export to E.U. (through Nord and South Stream project), a partial energy independence of Ukraine from Russia will represent a geopolitical failure for Moscow, losing a traditional and strategic leverage in the post soviet area and also losing one export's corridor, necessary for Russian diversification of export routes.

3.3 Revolution or slow transition?

Against this "nightmare scenario" and the Moscow's fear of losing further markets shares in its most important export market for conventional Russian gas, Russia has reacted trying to downplay the effects of shale gas in Europe and to portray very negative implications of unconventional gas production in Europe for its environment and the E.U.'s climate mitigation efforts[80].

Environmental concerns were strongly supported by Russian authorities, claiming that shale gas is a danger to drinking water, echoing concerns expressed in the U.S. suggesting that the drilling and hydro-fracturing operations associated with shale gas development are contaminating drinking water supplies[81].

According to Mark Gyetvay (Chief Financial Officer of NOVATEK and Executive Director) a "game changing" impact of the shale gas revolution - similar to the U.S. - can not be replicated in E.U. for a variety of technical, political and social motives: *"the best one can expect is some regional shifts in consumption patterns, rather than a Pan-European revolution"*[82].

Potentially, Russia's most powerful tool to fight the European shale gas revolution is the financing of local environmental groups that oppose fracking.

Fiona Hill, an expert on Russia at the Brookings Institution, a think tank in Washington. noted that industry watchers in Europe already believe Russia is bankrolling environmental groups that are loudly opposing plans for fracking in Europe, which could cut down on Russia's natural gas market, even if proofs do not exist[83].

Following the recent protests in Bârlad (eastern Romania) in April 2013, some media affirmed that "a Russian hand" is apparently behind the environmental protests against the end of shale gas moratorium[84]. Moreover, bans and moratorium on exploration and production of shale gas in some Eastern European countries concretely favor Russian energy strategy: for instance, three days after the Bulgarian parliament banned shale gas exploration, Gazprom announced that it will speed up building the South Stream gas pipeline, which will Bulgarian energy dependence on Russian imports[85].

In spite of legitimate concerns of Russia, shale gas is no threat to its energy dominant position on Europe in the medium term. Theoretically, a shale gas revolution could start in Europe, considering the availability of reserves. However several obstacles and hindrances are setting back the development of unconventional gas in Europe and future phases of production and commercialization: the relatively high population density; a lack of know-how and an experienced service industry; possibly higher exploration and production costs; environmental concerns mainly linked to the use of water and uncertainties in the regulatory and policy environment. Therefore, as a result, experts expect only a marginal growth of unconventional gas in Europe in the coming decade[86].

A big hindrance is due to the fact that shale gas production requires hundreds and thousands of square kilometers, compared with the tens or hundreds needed for conventional gas development. In Europe, this will be very problematic since the population density, being three times greater than in the U.S., will mean that negotiations for getting production rights and access to land should involve hundreds of landowners[87].

Moreover environmental concerns influence public acceptance and opposition to the future unconventional gas development. In the E.U., both policy makers and the public remain wary of the potential environmental impact of technologies like hydraulic fracturing, or fracking, used to extract shale gas. The fact that Europe is much more densely populated than the United States also makes it difficult to win government approval to tap the new energy deposits, which are often near major cities. Further complicating matters are shortages of technical expertise and drilling rigs, and regulations that differ widely among countries[88].

Concerning technology issues

European shale reserves are less accessible than North America while countries lack the necessary infrastructure and hydraulic fracturing equipment to boost domestic production.

The experience in the U.S. may not be replicable in Europe, even because Europe's shale reserves are geologically different from those found in the U.S., making extraction more difficult and more expensive[89]. The different composition of European shale rock and the higher cost of production could affect shale gas to commercially compete with traditional pipeline gas and imported LNG. Shale deposits in Poland are deeper underground than in the United States and hold additional treatments which will make them a more expensive option[90]. According to Wood Mackenzie estimates, the cost of extracting European shale gas is roughly double that of American reserves, and LNG's alternatives are a cheaper option for many of Europe's energy-hungry companies[91].

There are also concerns about the impact of shale gas on sustainable and clean energy, and more particularly about the pressure it will exert on investments in renewables. Given its high carbon intensity, the scale of expansion and level of investment needed, it is not clear how shale gas could ever be a 'transition fuel'[92].

Furthermore an increased shale gas production and availability in the markets could have the impact of falling gas prices: this cheaper energy option could also threaten the viability of low carbon alternatives.

Poland's difficulties to implement shale gas exploration and production seem to confirm serious limits on the perspectives of shale gas evolution in Europe, allowing Russia to maintain its supplier's status to E.U.. As a matter of fact, in spite of huge shale gas reserves, difficult geology, an uncompetitive service sector, poor infrastructure (most of the transmission pipelines are based in the southwest, while major shale gas areas are in the northeast), and lack of rigs have hampered development.

Moreover, strict E.U. environmental laws, as well as unclear regulatory and tax frameworks have further eroded prospects: only 33 wells have been drilled, with just eight of them fracked. Additional 270 wells will be drilled by the next seven to eight years, concretely postponing Polish ambition to become shale gas producer[93].

Shale Gas Development in China

4.1. Unconventional gas as strategic key for the energy security

According to IEA 2012 Golden Rules scenario, 80% of the growth in gas demand comes from outside the OECD; between now and 2035 global energy consumption is forecasted to grow by 50% and China and India together will account for more than half of this global growth[94].

According to BP 2012, Asia consumption of gas already reached 554 bcm in 2011[95].

Asian countries are expected to drag behind the increase of gas demand: as a matter of fact, Asia demand of gas will dramatically increase from 398 bcm (2010) to 1.199 bcm (2035) - a growth of 4.5% - driven by rising consumptions in India (from 63 bcm to 201 bcm in the 2010-2035 period, in order to diversify the energy mix), Japan (from 104 bcm to 137 bcm, in order to reduce output of nuclear energy following Fukushima) and China[96].

To further expand gas use, Asian countries need to increase both production and imports. Russia would greatly exploit Asian energy thirst, enhancing its export to Asia markets, even if substantial investments in Russian infrastructure of transport and production are a necessary precondition.

However, the discover of huge unconventional gas reserves in China (mainly CBM and shale gas) - and in lesser extent India - and their development and production will seriously frustrate Russian ambition to enhance the Eastern or Asian vector or exports.

China represents one of the main key driver within the EIA "Golden Age of Gas" Scenario, considering the government's plan to boost the share of natural gas as part of total energy consumption to alleviate high pollution - linked to the country's heavy coal use - and to diversify the fuel mix.

Gas demand in China grows over the period 2010 to 2035 by 480 bcm, reaching a total of around 590 bcm in 2035 (larger than current gas demand in the European Union)[97].

China already increased the share of natural gas in total energy requirements from 2 to 4 %: in the last decade China's demand for natural gas doubled, reaching 130 bcm per year today. According to the 12th Five-Year Plan, China plans to reach 8 % of the energy mix by 2015 (260 bcm/per year) and 10% by 2020[98].

Without an increase in national production, China will be severely exposed to additional gas imports in the next years, sharpening its energy dependence from abroad: development of shale gas reserves could help Beijing to improve its energy security condition.

China is estimated to have the world's largest exploitable reserves of shale gas -- anywhere from 25 to 31 trillion cubic metres - while coalbed methane is currently the primary source of unconventional gas produced commercially in China, with output of around 10 bcm in 2010[99].

Most of China's proven shale gas resources reside in the Sichuan and Tarim basins in the southern and western regions and in the Northern and Northeast basins. Most of China's CBM resources also are in the North and Northeast basins, the Sichuan basin in the Southwest, and the Junggar and Tarim basins in the West[100].

Considering the expected rise of Chinese gas demand, the expansion of unconventional gas production will represent a "game changer", even because China will become a major gas producer and the second-largest global producer of unconventional gas, after the United States: in 2035 China would have an unconventional gas production of 390 bcm to a total of 473 bcm, increasing the share of unconventional gas in total gas production from 12% in 2010 to 83% in 2035 in the Golden Rules case[101].

Although there is no commercial production of shale gas yet, the Ministry of Land Resources confirmed goals included in the shale gas development Plan, namely to produce 6,5 bcm of shale gas per year by 2015 and at least 59 bcm by 2020[102].

China's requirement for imported natural gas in the Golden Rules Case grows from around 15 bcm in 2010 (30 bcm in 2012) to 80 bcm in 2020 and then to 120 bcm in 2035. These volumes are about half the corresponding imports in the baseline case. Chinese gas imports at the levels projected in the Golden Rules Case could be covered by existing contractual arrangements for LNG and pipeline supplies (from Central Asia and Myanmar) until well into the 2020s, pushing back the need for additional projects aimed at the Chinese market[103]. China's shale gas production will potentially cut demand for imported LNG in 2020[104].

4.2 An uncertain future scenario

The combination between shale gas production and the expansion of LNG facilities is destined to reduce Russia's ambition to enhance its gas exports to China. On the one hand, China will double its regasification facilities by 2015 (reaching 30 bcm per year), while Russia is delaying to develop LNG terminals aimed to export to an Asian direction: Vladivostok is in earlier stages of planning, while Sakhalin's exports are mainly oriented to Japanese and Korean markets, waiting for the future developments of new fields able to enhance LNG production.

Consequently China could easily find alternative LNG suppliers for its energy needs, as enhancing its energy cooperation with Australia, which currently covers one third of Chinese LNG imports: according to EIA 2012, Australia will become an important gas supplier (thanks to the combination between conventional and unconventional resources) and its LNG exports should rise from 20 bcm (in 2010) to 120 bcm (in 2035), widely satisfying regional markets[105].

In this scenario, also the realization of the Altai gas pipeline could lose its geopolitical and strategic relevance: as a matter of fact, the recent deal (March 2013) is based on a drastic cut of the volumes of gas which Russia previously planned to export to China (38 bcm per year rather than 68 bcm) starting from 2018.

China could take advantage from this scenario - characterized by an expected rise of national unconventional gas production and the expansion of supply options - in order to successfully bargain on price with Russia: in the Sino-Russian Memorandum of Understanding signed in March, price issue remains unresolved, but Russia will not be able to obtain higher European prices due to Chinese request to pay Russian gas at the same price of Turkmen gas[106].

The development of shale gas production will allow China to reduce the environmental burden of coal and oil, diversifying its energy mix and enhancing its energy security condition. To achieve these strategic targets China has undertaken a serious program of shale gas development, opening unconventional sector to qualified foreign investors and also benefiting of Sino-American Shale Gas Resource Initiative, in order to assist China utilizing experience gained in the U.S. and providing technical cooperation to support accelerated development of shale gas resources[107].

However China could face a wide range of logistical, regulatory, social and environmental problems which could set back shale gas development, also limiting its ambition to achieve better energy security.

Firstly, China's shale gas industry is at first stages. Conducting vast, detailed exploratory surveys, training the labour force, drilling thousands of wells and building the necessary infrastructure to transport large amounts of gas from remote areas will take time and substantial planning. Moreover,

China's geology is unique and the technology developed for North American shale cannot be directly applied[108].

Secondly, China should overcome environmental and social challenges such as to manage large volumes of water for the hydraulic fracturing method -- the most practiced and economical method of shale gas extraction -- a scarce resource in many Chinese regions with potential shale gas reserves; some reserves are located in China's most densely populated regions, such as Sichuan. The use of modern technology should be mainly aimed to reduce the risk of water pollution associated with mismanaged drilling and fracturing[109].

Thirdly, the economic rationale: natural gas is more expensive than coal and shale could not be an economic option. As a matter of fact, the basic reserves are located in the west, north-west and south-west, which are not the main gas consuming regions. Consequently, there is a need to build pipeline systems to transport gas to markets and industries in the coast, which could reduce the economic gains linked to the development of unconventional gas.

Chinese difficulties to develop shale gas production could reverse the scenario, underlining a renovated dependence condition on gas imports which will open additional spaces for Russia exports and ambitions.

Supposing a reduction of 50% in 2020 and 2035 EIA estimates on unconventional gas production in China (55 bcm rather than 110 in 2020 and 180 bcm rather than 390 in 2035) and a stable demand, China will need increasing gas imports estimate at 132 bcm in 2020 and 300 bcm in 2035.

Conclusion

Shale gas could represent a "game changer" in the global energy scenario only following the achievement of a large-scale production, which could create a worldwide "gas glut" and a concrete transformation of the current relations between supplier and energy importer countries. However, with the exception of United States, a large-scale production of shale gas appears far to reach in the medium term, in spite of the existence of large unconventional gas reserves: the combination of all factors - modern technology, financial investments, environmental issues, popular opposition - differs in the perspectives of success of this energy source among countries with significant reserves.

Slow progress in shale gas development will allow Russia to preserve its strategic role of supplier country in the next years. Rather than shale gas, a concrete and present threat to Russia's energy strategy is the expansion of LNG market, an energy domain strongly underdeveloped in Russia.

In the E.U., the achievement of significant shale gas production appears strongly limited, due to bans on activities (for example in France, with largest unconventional reserves in E.U.) and different conditions compared to U.S.. Among E.U. countries with shale gas reserves, only Ukraine could become a shale gas producer by this decade, thanks to the geographic location of its unconventional reserves and the massive U.S. economic support to exploit them. However Russia could downplay the economic and geopolitical impact diverting gas export from Ukraine to the Balkan countries, through the implementation of the planned South Stream gas pipeline.

China will have more success to develop shale gas production in the next years, because of the need to satisfy rising internal energy demand: however, some hindrances could set back the establishment of a large-scale production, maintaining China in a dangerous dependence condition on gas imports. The implementation of Altai pipeline would represent for Russia a strategic tool if China fails to achieve its shale gas targets, allowing Moscow to enhance its gas exports to Beijing in order to compensate the decrease of Chinese gas production.

Consequently, Russia will have the time to better undertake specific strategies in order to reduce the shale gas threat on its gas exports: the huge availability of both conventional and unconventional gas reserves is the main card which Russia could play, enhancing national production and export volumes of gas.

Technological and economic issues will be overcome by means of a deepened energy cooperation with foreign companies, which will be attracted to invest in order to develop promising areas such as the Arctic Yamal Peninsula and Barents Sea or unconventional gas fields. However, the main precondition to attract foreign support and cooperation is to ensure more fairness and competitiveness in the Russian energy sector, reducing Gazprom's monopoly mainly on the transport pipelines.

If a "Golden Age of Gas" becomes a reality, Russia will be able to meet the increased demand for gas in spite of shale gas: as a matter of fact, the geographical proximity of potential large markets to supply (China, Japan, South Korea) will allow Russia to retune its export strategy focusing on the lucrative Eastern vector.

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