Scenarios for Russia's natural gas exports to 2050

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ABSTRACT

Russia is an important energy supplier as it holds the world's largest natural gas reserves and it is the world's largest exporter of natural gas. Despite a recent reduction in Russia's exports to Europe, it plans to build new pipelines. We explore the long-term (up to 2050) scenarios of Russian natural gas exports to Europe and Asia using the MIT Emissions Prediction and Policy Analysis (EPPA) model, a computable general equilibrium model of the world economy. We found that over the next 20–40 years natural gas can still play a substantial role in Russian exports and there are substantial reserves to support a development of the gas-oriented energy system both in Russia and in its current and potential gas importers. Based on the considered scenarios, Russia does not need any new pipeline capacity to the EU unless it wants to diversify its export routes to supply the EU without any gas transit via Ukraine and Belarus. Asian markets are attractive to Russian gas and substantial volumes may be exported there. Relatively cheap shale gas in China may sufficiently alter the prospects of Russian gas, especially in Asian markets. In the Reference scenario, exports of natural gas grow from Russia's current 7 Tcf to 11–12 Tcf in 2030 and 13–14 Tcf in 2050. Alternative scenarios provide a wider range of projections, with a share of Russian gas exports shipped to Asian markets rising to more than 30% by 2030 and almost 50% in 2050. Europe's reliance on LNG imports increases, while it still maintains sizable imports from Russia.

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1. Introduction

Energy sectors, including natural gas, play an important role in Russian economy. Energy exports were one of the driving forces of Russia's economic recovery from the collapse in the 1990s. The country enjoyed more than 5% annual real economic growth in 2000–2008. However, over-reliance on the revenues from energy exports was also one of the major factors for Russian economic downturn during a global recession in 2008–2009, when a reduction in demand for fossil fuels, and a collapse of oil and energy prices greatly contributed to an almost 8% GDP loss in 2009. Demand and prices recovered after 2010, leading to about 4% average annual real GDP growth in 2010–2012. GDP growth slowed to an estimated 1.5% in 2013, this time not due to the lower energy prices but for structural reasons in the Russian economy. The IMF (2013) forecasts 3–3.5% annual GDP growth for Russia for 2014–2018, but the concerns about the viability of Russian growth based on fossil exports remain.

Natural gas exports from Russia get special attention in comparison to other energy exports, because Russia has less diversified ways to export natural gas in comparison to oil and coal, which are in general easier to transport. On the demand side, it is also relatively easier to switch from one oil or coal supplier to another; hence the importers have fewer concerns about relying on a single supplier or a limited number of suppliers. As a result, Russian oil and coal exports have not had the disruptions seen in the gas transit routes through Ukraine and Belarus. Russia tries to find a way of reducing reliance on transit countries as disputes with them hurt stable gas supplies. Europe, as the largest importer of Russian gas, tries to find a way of reducing reliance on Russia by moving to liquefied natural gas (LNG) imports by tankers from Africa, the Middle East, and America. The development of shale gas in the USA has resulted in a substantial price differential between North American and European (and Asian) natural gas markets. This price differential creates a potential for LNG exports from the USA with the first U.S. LNG export facility expected to be online in 2016. Future LNG development and emergence of shale gas pose questions about the ability of Russia to keep gas exports to Europe at the recent levels, when at its peak at 2007–2008 about 5.5 trillion cubic feet (Tcf)[1] out of a production of about 21 Tcf were destined to European markets.

In the mid-2000s there were many popular predictions of a potential shortage of Russian gas exports due to the seemingly inadequate

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[1] In the USA natural gas volume is measured in cubic feet, while in Europe it is measured in cubic meters. In this paper we report most volumes in trillion cubic feet (Tcf) and also provide some number in billion cubic meters (Bcm) and million tons of oil equivalent (mtoe). Different publications use different assumptions for calorific value of natural gas in different regions. For example, Gazprom numbers in Bcm are about 10% larger than BP and Russian Ministry of Economy numbers for Russia. In this paper we follow the conversion factors from BP (2013) for reporting in Tcf and mtoe. 1 cubic meter = 35.3 cubic feet.

investments in Russian gas infrastructure (see, for example, Goldthau, 2008; Tsygankova, 2008; Victor, 2006). Those predictions of shortages are now transformed into the predictions of an excess of Russian gas exports (and switching away from them in Europe) due to LNG and shale gas competition (see, for example, Denning, 2010). Indeed, in 2009–2011 Russian gas exports to Europe decreased from 5.5 Tcf in 2008 to 4.5–4.8 Tcf in 2009–2012 due to the global recession, an increased LNG availability in Europe, and inflexible pricing arrangements for Russian gas. The exports have recovered to an estimated 5.3 Tcf in 2013 due to several price concessions, tighter LNG market, and colder temperatures in Europe.

Because of the importance of Russian gas imports in the European energy mix, many researchers have analyzed different aspects of Russian gas production and export structure (see, for example, Hartley and Medlock, 2009; Stern, 2005; Victor et al., 2006; Yegorov and Wirl, 2010). In this paper we focus on scenarios for Russian gas exports in the long-run, up to 2050. As we look forward over the next several decades, there will be several major drivers of future gas production and use:

1) The domestic gas resources that exist: with production from the current Russian gas fields stagnant or falling, will relatively new areas, such as Yamal, Shtokman, and even less developed fields in Siberia and the Far East allow Russian gas production to continue to grow at reasonable prices?

2) The state of world gas production and trade: could other regions see a similar increase in shale gas production as the U.S., and will the gas market transition to a fully integrated global market like that for crude oil or will costs and other limits on intercontinental gas transport lead to the persistence of national and regional markets where forces to resolve interregional price differences are dampened?

3) The structure of greenhouse gas policies that may be put into effect in the coming years: what form will emission reduction policies take and how stringent will the control levels be? Here natural gas also can be affected in different ways. Climate policies might increase the demand for natural gas due to a substitution from more carbon-intensive coal to natural gas. However, tighter emission constraints can reduce the usage of natural gas.

4) The recent concerns about nuclear energy: will nuclear generation be reduced and, if nuclear stations are planned to be closed as in Germany, how will power generation be replaced?

5) The development of Asian gas markets, especially in China and India.

To explore these interactions, we apply the MIT Emissions Prediction and Policy Analysis (EPPA) model (Paltsev et al., 2005, 2011), which is a global general equilibrium economic model that resolves key countries, including Russia, and includes details of natural gas resources, energy demand, and competing energy supply technologies. In comparison to many previous studies of natural gas markets, a global economy-wide model allows to account explicitly for interactions between natural gas markets and the rest of the economy. At the same time, as any model simplifies many details of market structure, the results should be viewed not as predictions where confidence can be attributed to the absolute numbers but rather as illustrations of the directions and relative magnitudes of various influences on the role of gas, and as a basis for forming intuition about likely future developments.

In addition, while in the model we account for monopoly rents in resource markets, an experience of natural gas markets so far has shown that economic decisions are heavily influenced by political considerations. In the long run, though, it is difficult to maintain policies based on political goals without appropriate economic fundamentals. In this paper, based on an economic model we illustrate the broad insights about the gas markets in the coming decades and explore if Russia has a potential for sustainable gas exports in the next 40 years.

The paper is organized in the following way. In the next section we explore the current estimates of Russian gas reserves and resources in the context of the global estimates. Section 3 focuses on the ability of Russia to export gas by pipelines and LNG, and discusses the current infrastructure and future projects. In Section 4 we consider how much Russian gas might be needed by Europe, the major market for Russian gas. Section 5 studies the prospects for non-European exports of Russia and in Section 6 we conclude.
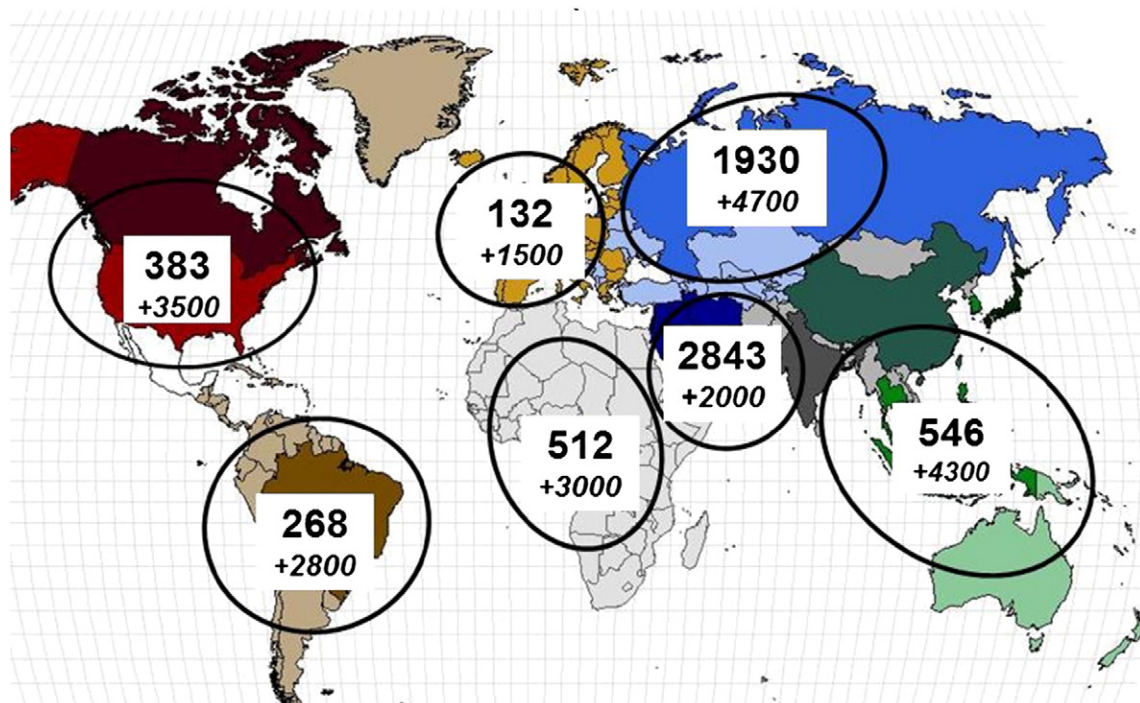

Fig. 1. Proved reserves (numbers in bold) and additional remaining resources (numbers in italic) of natural gas by region, Tcf (Data source: BP, 2013; IEA, 2013; Regional map: EPPA).