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3 Report by Anne Neumann, Leonard Göke, Franziska Holz, Claudia Kemfert, and Christian von Hirschhausen

Natural gas supply: no need for another Baltic Sea pipeline

- Natural gas supply in Europe is diversified, the importance of liquefied natural gas is increasing
- Dependence on Russian natural gas will be reduced
- The planned pipeline Nord Stream 2 is unnecessary

LEGAL AND EDITORIAL DETAILS



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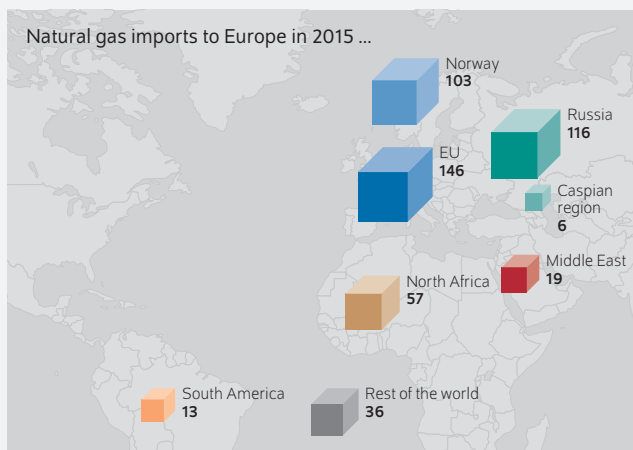
AT A GLANCE

Natural gas supply: no need for another Baltic Sea pipeline

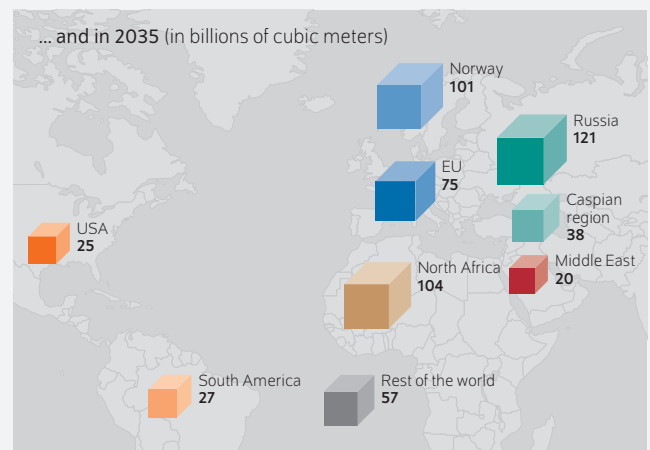
By Anne Neumann, Leonard Göke, Franziska Holz, Claudia Kemfert, and Christian von Hirschhausen

- Analysis of natural gas demand and natural gas supply security in Germany and Europe
- Nord Stream 2, the second Baltic Sea pipeline planned from Russia to Germany, is not needed to secure natural gas supplies in Germany and Europe
- The profitability studies used to justify the pipeline are based on outdated assumptions about rising natural gas demand
- The natural gas supply is already well diversified and can be supplemented by additional liquefied natural gas supplies
- Nord Stream 2 is also questionable from a commercial perspective as it is not a profitable investment project

The natural gas supply to Germany and Europe is diversified and secure without the planned pipeline from Russia to Germany (Nord Stream 2)



Source: DIW Berlin calculations using the Global Gas Model (Holz et al., 2017).



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FROM THE AUTHORS

„The plan to build Nord Stream 2 is unnecessary from an energy economic perspective, bad for the environment, and economically unprofitable.“

— Claudia Kemfert, study author —

Natural gas supply: no need for another Baltic Sea pipeline

By Anne Neumann, Leonard Göke, Franziska Holz, Claudia Kemfert, and Christian von Hirschhausen

ABSTRACT

The construction of a second Baltic Sea natural gas pipeline from Russia to Germany (Nord Stream 2) is very controversial for political, energy economic, and ecological reasons. The project owner and some European energy companies argue that it is a profitable, private-sector investment project that is necessary to secure natural gas supplies for Germany and Europe. However, DIW Berlin analyses show that the planned pipeline project Nord Stream 2 is not necessary to secure natural gas supplies for Germany and Europe. The energy consumption forecasts on which the project is based, especially the EU Reference Scenario, significantly overestimate natural gas demand in Germany and Europe. On the supply side, there will be no supply gap if Nord Stream 2 is not built. Different profitability studies suggest that high losses up to the billions can be expected from the project. It is also unclear to what extent Nord Stream 2 would lead to higher prices for natural gas customers in Germany.

The idea of supplying Central and Western Europe with natural gas from the former Soviet Union has been dominated by geopolitical considerations since its start in the 1960s and has been a controversial topic in both the European and international discourse. The development of natural gas sources in Western Siberia as well as the construction of a pipeline system towards Western Europe were also driven by the objective of a gradual rapprochement between East and West.¹

The active involvement of German energy supply companies in the Russian gas industry (Ruhrgas and BASF-Wintershall) after the collapse of the Soviet Union was an integral part of German and European foreign policy. In this vein, the reasoning for the ministerial approval of the questionable merger of E.ON and Ruhrgas in 2002 explicitly referred to the positive effects of securing Germany's energy supply with Russian natural gas. However, the monopoly commission responded to this merger with criticism. Conversely, the Russian natural gas sector under state control used these collaborations to enter the Western European energy markets and has been consistently pursuing this strategy ever since.²

After the collapse of the Soviet Union, Ukraine became an important transit country, which further increased the politicization of Russian natural gas exports. The dispute over appropriate transit fees has proved increasingly difficult with the growing political conflicts between Russia and Ukraine since 2006.³ Early on, Russia developed alternative transport corridors to circumvent Ukraine: in 1999, the northern corridor through Belarus and Poland (the Yamal-Europe pipeline) was completed; in 2011, the Nord Stream pipeline, the first direct pipeline connection between Russia and the EU, opened, running from the St. Petersburg area

¹ Cf. Claudia Wörmann, "Osthandel als Problem der atlantischen Allianz: Erfahrungen aus dem Erdgas-Röhren-Geschäft mit der UdSSR," Working Paper for International Politics 38, German Council on Foreign Relations, Bonn, 1986 (in German).

² Cf. Franziska Holz et al., "European Natural Gas Infrastructure: The Role of Gazprom in European Natural Gas Supplies," *DIW Berlin Politikberatung kompakt*, no. 81 (2014) (available online, accessed June 21, 2018; this applies to all other online sources in this report unless stated otherwise).

³ Cf. Christian von Hirschhausen, Berit Meinhard, and Ferdinand Pavel, "Transporting Russian Gas to Western Europe — A Simulation Analysis," *The Energy Journal* 26, no. 2 (2005) as well as Franz Hubert and Svetlana Ikonnikova, "Investment Options and Bargaining Power: Investment Options and the Eurasian Supply Chain for Natural Gas," *The Journal of Industrial Economics* 59, no. 1 (2011): 85–116.

Figure 1

The European natural gas pipeline network



Source: Authors' own depiction based on Kai-Olaf Lang and Kirsten Westphal, "Nord Stream 2 – Versuch einer politischen und wirtschaftlichen Einordnung," SWP Studie S21 (2016); ENTSO-G, Capacity Map (2017).

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The transmission pipeline network in Germany and Western Europe is well established.

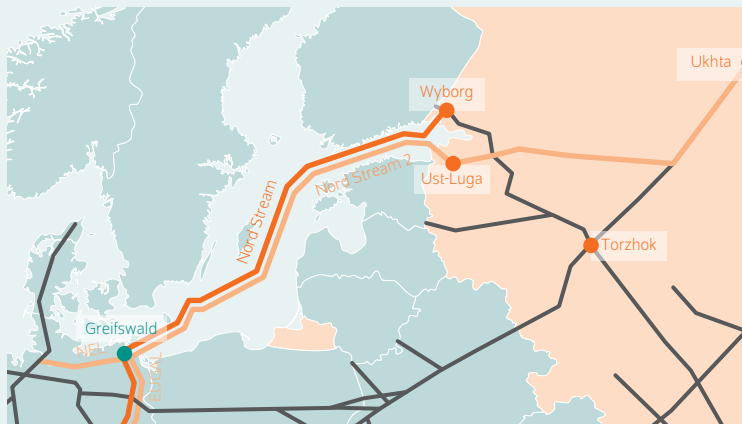
through the Baltic Sea towards Lubmin (in the German state of Mecklenburg-West Pomerania) ([Figure 1](#)).

Since 2014, the disputes over natural gas exports have reached a new quality with the Russian annexation of Crimea and Southeastern Ukraine as well as the subsequent sanctions by the EU and the United States against Russia. Russia is threatening to completely avoid transit through Ukraine after the current transit agreement expires in 2019, thereby further weakening Ukraine's economy. Moreover, with its pipeline projects through the Black Sea towards Turkey and

Southeastern Europe (Turkish Stream) and towards China (Power of Siberia), Russia is driving the diversification of its export routes. The EU has declared itself in favor of Ukraine as the main transit country for Russian natural gas imports and supports Ukraine's efforts to strengthen its independence by facilitating natural gas purchases from Western Europe. The United States also supports efforts to strengthen Ukraine as a transit country; American energy suppliers are now also actively offering their natural gas in Western Europe as an alternative to Russian natural gas imports, as they have considerable export potential due to the shale gas boom.

Figure 2

The Nord Stream project



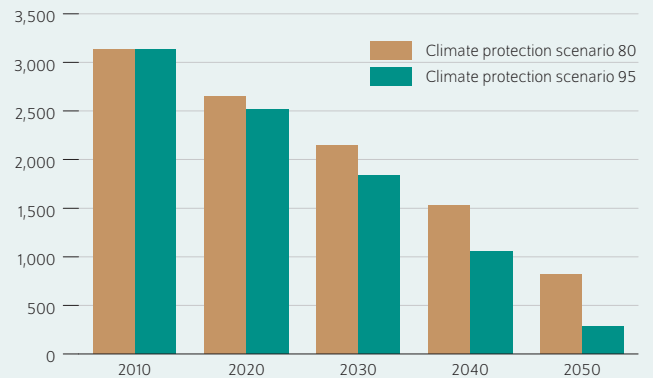
Source: Authors' own depiction.

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Additional connecting pipelines are required in addition to the offshore pipelines.

Figure 3

Share of natural gas in German primary energy consumption In petajoules



Source: Öko Institut (2015): Klimaschutzszenarien 2050. 2. Endbericht, Berlin.

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In the long term, the importance of fossil natural gas will decrease.

State-run Gazprom's political investment project

The planned Nord Stream 2 project consists of the extension and new construction of inlet and outlet natural gas pipelines in Russia and Germany and the main line of two parallel offshore pipelines through the Baltic Sea. On the Russian side, a new pipeline from Ukhta to Gryazovets (970 km) and an extension of the Gryazovets-Volkhov connection to the Slavyanskaya compressor station, the entry point to the Nord Stream 2 offshore pipeline, are required. The offshore pipeline is largely parallel to the Nord Stream pipeline (approx. 1,200 km) (Figure 2). The investment needs for the entire Nord Stream 2 project are estimated at 17 billion USD.⁴

Similar to the first Baltic Sea pipeline, the capacity of Nord Stream 2 will be 55 billion cubic meters (2 x 27.5 billion cubic meters per pipeline); this corresponds to more than half of the current natural gas consumption of approximately 90 billion cubic meters in Germany. The extra natural gas is to be transported from Lubmin via the North European Gas Pipeline (NEL) in the direction of Hamburg; in addition to the underutilized OPAL pipeline, a new pipeline was applied for with the Federal Network Agency, the European Gas Pipeline Link (EUGAL), which would be used to transport natural gas towards Southern Germany, Austria, the Czech Republic, and Poland.

The sole shareholder of this project is the state-controlled Russian natural gas company Gazprom.⁵ Gazprom has con-

siderable financial leeway given the amalgamation with the Russian government's budget and political influence. The state-owned company has been very active in purchasing shares in the EU's natural gas infrastructure over the last three decades and would continue to strengthen this strategy with the construction of Nord Stream 2.⁶ In addition to commercial motivation, Gazprom is obviously also pursuing strategic goals that go beyond purely private sector profitability calculations. While approval is still in progress, the political discussion has rekindled. The project is also controversial within the German government. The project company tried to use the official project launch in May 2018 as a fait accompli. However, not all permits have been obtained and a final investment decision has not yet been reached.

Natural gas demand overestimated

It is necessary to consider the future development of supply and demand when conducting an energy assessment of Nord Stream 2. The planning documents submitted by the project company aim to use the pipeline to strengthen German and European energy security in the long term. This would require there to be a shortfall between the expected future demand and expected supply.⁷ However, alternative calculations suggest that a shortfall is not foreseeable and thus there is no economic need for Nord Stream 2.

Climate policy scenarios for Germany almost unanimously assume that there will be a declining share of fossil natural gas

⁴ Cf. Sberbank Investment Research, *Russian Oil and Gas—Tickling Giants* (Moscow, 2018).

⁵ Although five Western energy suppliers were originally planned as minority shareholders, they were not included in the final ownership structure—unlike in Nord Stream—and are now financial investors, according to the project company.

⁶ Holz et al., "European Natural Gas Infrastructure."

⁷ Prognos, *Status und Perspektiven der europäischen Gasbilanz. Endbericht im Auftrag von Nord Stream 2 AG* (Berlin: 2017) (available online).

in Germany's energy supply. In view of low electricity prices for the foreseeable future, high overcapacities in the conventional power plant sector, and rapid progress in the development of renewable energies and storage technologies, fossil natural gas will no longer have any significance in the electricity industry as a bridge technology; a decline in consumption is also expected in the heating and industry sectors.

The significance of fossil natural gas in Germany's primary energy consumption is dwindling. If the goals for greenhouse gas emissions, renewable energy, and energy efficiency laid out in the federal government's climate policy were achieved (Climate Protection Scenario 80) or if greenhouse gas emissions sank by 95 percent compared to 1990 by 2050 (CPS 95), the demand for natural gas between 2008 and 2050 in the energy, heat, and industrial sectors would decrease by almost 73 percent (CPS 80) or 90 percent (CPS 95) (Figure 3).

EU Reference Scenario overestimates natural gas demand

A significant decline in demand for natural gas is also expected at a European level, taking into account the agreed climate protection goals for 2030 and the long-term goals for 2050. In a target scenario for the EU, calculations made at DIW Berlin also show that the use of natural gas in the energy as well as industrial and heating sectors will decline significantly.⁸

The EU Reference Scenario used to plan Nord Stream 2 postulates a roughly constant demand for natural gas,⁹ but its assumptions and methodology are controversial:

~ The energy system model used for the Reference Scenario calculations, PRIMES,¹⁰ systematically favors fossil fuels, especially coal and natural gas (as well as nuclear power, which is not discussed here), whose significance is structurally overestimated, especially in the energy sector;¹¹

~ The systematic use of a technology that does not exist, CO₂ capture technology (Carbon Capture, Transport, and Storage, CCTS), strengthens the bias in favor of fossil natural gas: the costs for CCTS are erroneously set so low that this technology would be used starting in 2020 for economic reasons

alone;¹² this is not plausible, neither in any EU member state nor worldwide.¹³

~ In contrast, the importance of renewable energies, such as solar and wind power, is systematically underestimated by ignoring technical improvements and by overestimating costs. The rapid developments in storage technology are also ignored in the PRIMES model by using inflated cost values.¹⁴

European Court of Auditors is critical of the EU Reference Scenario

Aside from the broad reception in the scientific community, the structural errors in the EU reference scenario were met with criticism by the European Court of Auditors: they criticize the demand estimates' lack of reliability and stated "that the Commission has persistently overestimated gas demand [...], and needs to restore the credibility of the forecasts it uses"¹⁵ (Figure 4).

Europe's natural gas supply is already crisis-proof and diversified

On the supply side, a large number of technological and regulatory developments have emerged in recent years and made the system crisis-proof both in the short- and long-term. The institutional crisis mechanism and the current Regulation (EU) 2017/1938 in particular require a supply security assessment by the European Transmission System Operators Group, close cooperation across national borders, and for publication of transport obligations under long-term contracts. This should serve the more efficient use of the existing pipeline infrastructure in Europe, the creation of liquid markets for natural gas, and the identification of potential and necessary infrastructure expansions.

The European Network of Transmission System Operators for Gas (ENTSO-G) carried out a Europe-wide analysis of the current state of natural gas supply security. In the unlikely event of an especially cold day or a 14-day cold period (statistically likely to occur once every 20 years), the transmission system operators simulate infrastructure failure in 17 scenarios (for example, a two-month supply interruption via

⁸ Cf. Karlo Hainsch and Konstantin Löffler, "Modeling the low-carbon transformation in Europe and Germany – Developing paths for the European energy system until 2050", *DIW Berlin Diskussionspapier* (2018) (in print).

⁹ European Commission, *EU Reference Scenarios 2016: Energy Transport and GHG Emissions. Trends to 2050*. (Brussels: 2016) (available online).

¹⁰ Pantelis Capros et al., *The PRIMES Energy System Model—Reference Manual* (Athens: University of Athens, 1998); Pantelis Capros, *PRIMES Energy System Model* (Athens: National Technical University of Athens, 2011).

¹¹ Christian von Hirschhausen et al., "European Electricity Generation Post-2020: Renewable Energy not to be underestimated," *DIW Economic Bulletin*, no. 9 (2013): 16-28 (available online); Andreas Schröder et al., "Current and Prospective Costs of Electricity Generation until 2050," *DIW Berlin Data Documentation*, no. 68 (2013) (available online).

¹² Christian von Hirschhausen and Johannes Herold, "Hohe Unsicherheiten bei der CO₂-Abscheidung: Eine Energiebrücke ins Nichts?," *DIW Wochenbericht*, no. 36 (2010): 2-7 (in German; available online); Roman Mendelevitch, "The Role of CO₂-EOR for the Development of a CCTS Infrastructure in the North Sea Region: A Techno-Economic Model and Applications," *International Journal of Greenhouse Gas Control* 20 (2014): 132-59.

¹³ For example, in this Reference Scenario, in Germany in 2045, CO₂ capture technology will be used extensively and will jump from zero gigawatt capacity to 7.9 GW; this corresponds to the construction of around ten large coal and 20 gas power plants. To compare: both the German energy industry and the German government announced the phase-out of CO₂ capture in 2011, which was not considered necessary for the energy transition; see Hirschhausen, "Hohe Unsicherheiten bei der CO₂-Abscheidung."

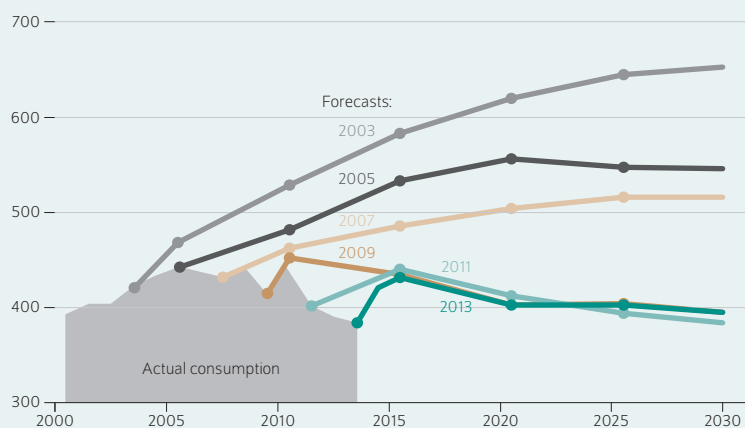
¹⁴ In addition to the EU Reference Scenario's flawed methodology, there is also a lack of transparency: neither the data used nor the model code have been fully disclosed; furthermore, no distinction is made between the assumptions made (exogenous parameters) and the generated (endogenous) results. One example of this is the arbitrary assumption that CO₂ capture technology is available. Thus, the EU Reference Scenario does not meet the requirements for scientific policy advice demanded in Germany by the German Research Foundation (*Deutsche Forschungsgemeinschaft*, DFG) or the Association for Social Policy (*Verein für Socialpolitik*).

¹⁵ European Court of Auditors, "Improving the security of energy supply by developing the internal energy market: more efforts needed," *Special report no. 16* (Luxembourg: 2015) (available online).

Figure 4

Natural gas consumption in the EU 27 and the commission's EU reference forecasts 2000–2013

In millions of tons of crude oil equivalent



Note: All forecasts refer to consumption in the EU 27 at five-year intervals.

Source: European Court of Auditors, "Improving the security of energy supply by developing the internal energy market: more efforts needed," *Special report no. 16* (Luxembourg: 2015), 37 (available online).

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Natural gas consumption is well below the forecasted volumes.

Ukraine or a two-month partial interruption of the existing Nord Stream pipeline). For the majority of the analyses, the European transmission system operators estimate that firstly, the existing system is resilient to such failures and secondly, regional cooperation in Europe is working but should be strengthened, thus ensuring natural gas supply security in Europe in the short and medium term.¹⁶

Germany's prevention plan according to Regulation (EU) No. 994/2010¹⁷ shows in its risk assessment that the infrastructure standard (n-1) as well as the supply standard are more than guaranteed in all cases in the short term and no further measures are required. Thus, in order to determine a possible supply gap, only a risk assessment of long-term development of supply and demand is required.

Europe's natural gas supply will continue to diversify in the future

We conclude that Europe's natural gas supply security has been strong in recent years and will continue to be so in the future, especially in view of the decline in demand mentioned above, independent of the availability of Nord Stream 2. DIW Berlin regularly analyzes Europe's natural gas supply

security using the Global Gas Model.¹⁸ The Global Gas Model (GGM) is a partial equilibrium model for the global gas market which determines the production, demand, and trade flows of natural gas numerically.¹⁹

The supply to Germany and Europe is characterized by well-developed infrastructure and a large diversity of supplier countries, making a further pipeline from Russia unnecessary. Even with declining domestic European production and a slight increase in net imports, the natural gas supply is secure; this is all the more true when demand falls.²⁰ Even a complete supply interruption from Russia could be offset in both Germany and Europe by alternative supply sources and greater efficiency: successfully expanding transport routes and supply structures can compensate for the shortfall.²¹

The composition of German natural gas imports is balanced and diverse for the reference case 2015 and a 2035 case without Nord Stream 2; this applies for the case of a complete loss of Russian supplies (Figure 5). In particular, natural gas deliveries from Norway will remain stable. In addition, Germany can also import liquefied natural gas (LNG) via the Netherlands without its own LNG port, for example from Africa and South America. This is also demonstrated by the almost constant consumption of natural gas in an unrealistic scenario of a complete interruption of Russian natural gas deliveries. The satisfactory supply situation in Germany is even taking into account the recent sharp decline in production in the Netherlands.

The European natural gas supply is also highly diversified without Nord Stream 2 (Figure 5). Thus, Europe could maintain its natural gas use almost at the same level even if Russia completely ended its deliveries. In addition to the regional supply via natural gas pipelines, highly diversified LNG deliveries guarantee long-term supply security. The possibility of landing LNG at numerous import terminals along the European coasts and subsequently implementing efficient distribution through the existing pipeline system strengthens supply security. Currently, the capacity utilization of existing LNG import terminals is very low: in 2016, only 25 percent of existing import capacities in Europe were used.²² This also indicates that there will not be an infrastructure shortage.

Low revenues, very high costs

An accurate investment appraisal of the project is impossible due to the lack of reliable data; however, both economic and

¹⁶ ENTSO-G, *Union-wide simulation of gas supply and infrastructure disruption scenarios* (SoS simulation) (Brussels: 2017).

¹⁷ Regulation (EU) No. 994/2010 of the European Parliament and of the Council of 20 October 2010 concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC.

¹⁸ Franziska Holz, Philipp M. Richter, and Ruud Egging, "The role of natural gas in a low-carbon Europe: Infrastructure and regional supply security in the global gas model," *The Energy Journal* 37 (2016); Franziska Holz et al., "Shaking Dutch Grounds Won't Shatter the European Gas Market," *Energy Economics* 64 (2017): 520–39.

¹⁹ A description of the model can be found in Franziska Holz, Hanna Brauers, and Thorsten Roobeek, "Earthquakes in the Netherlands Cannot Shake the European Natural Gas Market," *DIW Economic Bulletin*, no. 48 (2015): 633–634 (available online).

²⁰ The analysis already takes into account the strong production decline in the Netherlands, where the government is greatly reducing production from the Groningen gas field for technical reasons.

²¹ Holz et al., "Shaking Dutch Grounds," (available online).

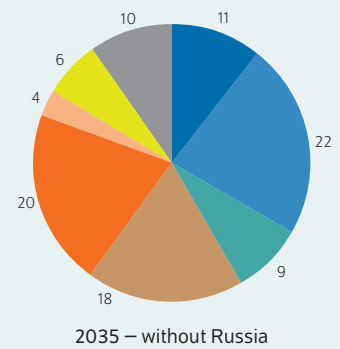
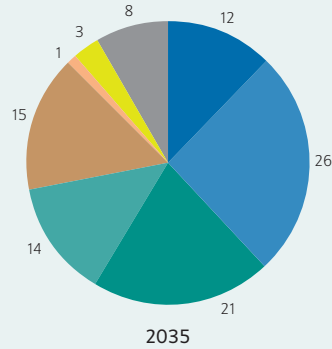
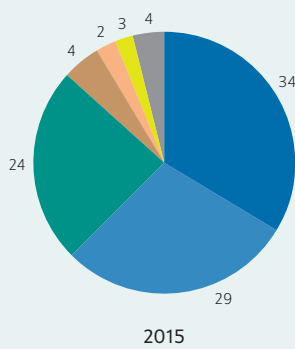
²² IGU, *World LNG Report*, International Gas Union (2017).

Figure 5

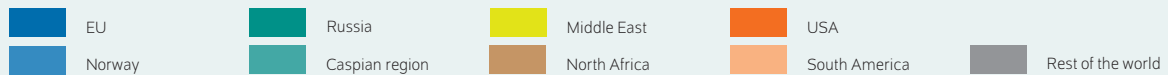
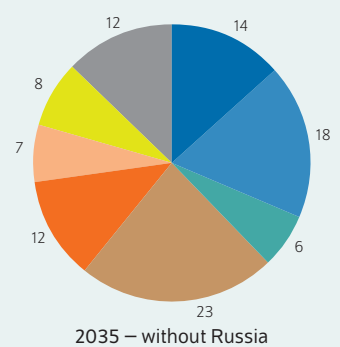
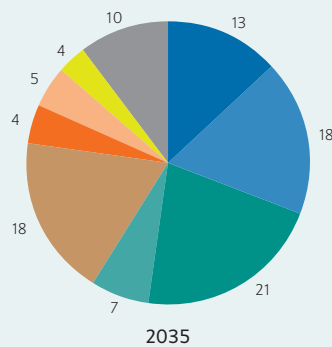
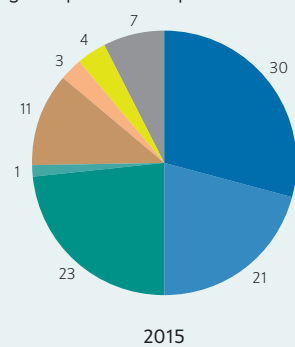
Natural gas imports to Germany and Europe in 2015 and 2035

In percent

Natural gas imports to Germany



Natural gas imports to Europe



Source: DIW Berlin calculations using the Global Gas Model (Holz et al., 2017).

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German and European natural gas imports are already well diversified.

commercial analyses indicate that the pipeline project is far from being profitable. A Norwegian research group showed that Nord Stream 2 cannot be profitable: building the pipeline will not increase Russian natural gas sales in Germany or the EU, and the additional low revenue Nord Stream 2 would bring is offset by very high costs. As a result, no profit can be made from the construction of Nord Stream 2.²³

An analysis from the Russian investment bank Sberbank concludes that Nord Stream 2 destroys rather than creates value.²⁴ The costs of Nord Stream 2 of 17 billion USD, including the supply pipeline from the Russian natural gas network, will be compared with the savings of approximately 700 million USD per year from avoiding transit through Ukraine. Additionally, it is assumed that natural gas sales

in Europe will not increase and that the pipeline is operating at 60 percent capacity. Based on these assumptions, the present value of the investment will be negative at six billion USD (approximately five billion EUR). The authors conjecture that the project will primarily serve geopolitical interests and strengthen the pipeline industry.²⁵

A further indication of the possible lack of economic viability of the project is the high average cost of transporting natural gas. According to an approximate profitability study, the costs for the offshore pipeline would be approximately three to four euros per kilowatt hour (kWh) for natural gas arriving in Germany; the costs of the necessary connecting pipelines in Germany are not even taken into account at all. In the first half of 2018, the average price for natural

²³ Cf. Roar Aune Finn et al., "The Future of Russian Gas Exports," *Economics of Energy & Environmental Policy* 6, no. 2 (available online).

²⁴ Cf. Sberbank Investment Research, *Russian Oil and Gas*.

²⁵ A few days after the study was published by Sberbank, the main author was dismissed without notice, allegedly due to conducting unprofessional analyses. Cf. "Sberbank entlässt Analysten nach kritischem Bericht über Gazprom," *Handelsblatt* online, May 24, 2018 (in German; available online).

gas in Germany was approximately 20 euros per megawatt hour (MWh); overall, it is assumed that it will increase in the coming years only slightly at most. As a result, the transport costs of Nord Stream 2 alone amounted to about 25 percent of the current price; it is not plausible that Gazprom can enforce these additional costs in a predominantly saturated European natural gas market.

Consumers in Germany pay for additional pipelines

A part of the total costs for Nord Stream 2 would most likely be paid for by natural gas consumers in Germany. These costs include the expansion of the NEL's capacities and the construction of the EUGAL. The cost of these additional pipelines is estimated at 500 million euros.²⁶

In Germany, the costs of additional pipelines are passed on to natural gas consumers at a flat-rate basis. Although every natural gas trader can register interest in new pipelines in a market survey, only eight traders did so in the case of the EUGAL. However, this survey is non-binding and without any financial obligation. In connection with a very adequate return on infrastructure investments allowed by the regulator—this amounted to nine percent until 2017 and since then still almost seven percent—this creates a massive incentive for network operators to expand pipelines as extensively as possible at the consumers' expense.

Conclusions

The construction of a second natural gas pipeline between Russia and the EU with landfall in northern Germany (Lubmin/Greifswald) is controversial politically and for the energy industry. Russia is interested in establishing a

stronger presence in the Western European natural gas market and in becoming less dependent on the natural gas transit through Ukraine.

An energy economic analysis shows that Nord Stream 2 is not necessary to strengthen natural gas supply security in Germany and Europe. On the one hand, demand for natural gas is declining in both Germany and Europe; natural gas will no longer be required as a bridge technology for the energy transition, and is inferior to cheaper coal in the short term and to renewable energies in combination with storage technologies in the long term. On the other hand, the natural gas supply is currently already very diversified and can be supplemented by additional liquefied natural gas supplies. Due to the foreseeable decline in European natural gas production, a large, expensive pipeline from Russia with a planned annual capacity of 55 billion cubic meters is not necessary.

Moreover, Nord Stream 2 is not a profitable investment project. Therefore, from a commercial perspective, the project is very questionable. The project owner's profitability calculations are presumably based on implausibly high assumptions for natural gas consumption and market prices. However, due to the calculations' lack of transparency, the evidence is unclear.

What is certain, however, is that the network operators of the connecting pipelines in Germany have strong incentives for excessive expansion due to comfortable, regulated returns. It is likely that natural gas consumers in Germany will have to participate in financing the project.

In sum, the second planned Baltic Sea pipeline is not necessary to secure the German and European natural gas supply. Rather, its construction may hinder the transition to a complete decarbonization of the economic system in Germany and Europe.

²⁶ Cf. Kai-Olaf Lang and Kirsten Westphal, "Nord Stream 2 – Versuch einer politischen und wirtschaftlichen Einordnung," SWP Studie S21 (Berlin: 2016) (in German).

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