

Shale gas in Germany – the current status

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Shale gas exploration and production is a controversial topic in Germany, although activity in this energy sector remains very limited. Estimates on the amount of shale gas reserves in Germany vary and contain great uncertainties. The latest estimate of the amount of technically recoverable shale gas is 25-81 Tcf or 700-2268 billion m³. This is about 2-7 times the German natural gas reserves from conventional reservoirs.

Background

Germany imports around 70 % of its energy resources. Main imports are hard coal* (approx. 81 %), petroleum** (approx. 98 %), natural gas** (approx. 90 %), and uranium* for nuclear energy (100 %). Only one quarter of Germany's energy supply is produced within the country (this includes renewable energy) (*data from 2012, BMWi; **data from 2014, LBEG).

Shortly after the disaster of Fukushima in 2011 (Tohoku-oki earthquake), the Federal Government of Germany initiated an energy transition process [Energiewende] for the entire country. Hence, all nuclear power plants in Germany will be shut down until 2022. This plan has dramatic implications for Germany's energy mix. All electricity generated by nuclear power plants (22% of the entire gross electric energy output) has to be replaced. Natural gas is often regarded as an important transition energy source and could replace part of the energy from nuclear power plants. In the future, natural gas as an energy source will be perceived as more important, because it is available even when the wind isn't blowing and the sun isn't shining, according to the Federal Environment Minister Barbara Hendricks, speaking in Berlin at the ZEIT Conference on Natural Gas and Climate Protection in October, 2014.

Merely 10 % of Germany's natural gas consumption originates from domestic natural gas production. In addition, the annual domestic natural gas production is decreasing due to depletion of conventional reservoirs (conventional and tight gas) (annual report LBEG, 2013). Germany's unconventional gas deposits are mainly made up of shale gas, which may play a central role in improving the security of supply from a domestic energy source.

Public debate of shale gas production

For about 4 years now, the topic of hydraulic fracturing has been present in the media, in public discussions, and among experts. The focus of the public debates is on the possible environmental impact of the fracking-technique such as contamination of groundwater, earthquakes, elevated greenhouse gas emissions, enormous water consumption, and risks due to improper disposal of flowback water.

Several citizens' initiatives against shale gas production were founded, especially in the German States of North Rhine-Westphalia and Lower Saxony. These two states are the most promising regions for shale gas exploration to date. Aside from the citizen's initiatives "Bundesverband Bürgerinitiativen Umweltschutz e.V.", (BBU, Germany's national association of citizens' environmental

protection initiatives) and "No Moor Fracking" the website "Gegen Gasbohren" (against gas drilling) is the joint communication platform of many German citizens' initiatives against shale gas development in Germany. German beer brewers and the environmental protection officers of the Protestant churches in Germany (EKD) also publicly object to the shale gas extraction technique.

In Germany, the hydraulic fracturing technique has been applied for conventional and tight gas reservoirs since the 1950s to increase production rates. Since then, more than 300 frac jobs were successfully conducted in depths of sometimes more than 5000 m (annual report 2010, LBEG). According to the annual LBEG report from 2012 "there has been no known environmental damage during all these years". However, the technique of hydraulic fracturing for shale gas production is still new territory for Germany, as the geological formations with the interesting shale formations are at shallower depths and the frac volumes are considerably greater than with conventional reservoirs (annual report 2012, LBEG). Citizen's initiatives point to the lack of monitoring or systematic investigations of environmental impacts of the hydraulic fracturing activities carried out to date.

To this date, one test drilling using the hydraulic fracturing technology in shale rock was conducted in Germany in 2008 (Damme 3, Lower Saxony). ExxonMobile also published the chemical composition of the frac fluids used in the 3 frac treatments. The test drilling was conducted to achieve an estimate of the production potential of the existing shale rock formations. However, there are no final results as of now (annual report, LBEG, 2012).

There is, however, a general consensus among all parties involved (citizens, public authorities, environmental associations, the science community and also the industry) that intensive research on all aspects of the topic of shale gas is required.

Political context

Following the decision in June, 2013 not to introduce the Bill on regulation of 'fracking technology' within the last parliamentary term, the Federal Environment Ministry and the Federal Economics Ministry presented a combined framework document in July, 2014. The main points (see SHIP News) included the strongest regulations that have ever been seen in this area; the document intended there would be no commercial production for financial purposes in the foreseeable future. Only scientifically supported testing measures were deemed possible. The framework document was as much commended by fracking opponents, who have called for a total ban on the technology, as it was heavily criticised by fracking proponents, who deem it as amounting to a total ban. In September, 2014 ExxonMobil launched an advertising campaign regarding the extraction of shale gas through 'fracking', under the title, „Let's talk about fracking“. In an open letter ExxonMobil claims that it has „succeeded in fulfilling a key political and public demand: our fracking will only use two non-toxic and easily biodegradable additives [Cholinchlorid und Butoxyethoxyethanol].“ Hereby industry has directly addressed a point raised within the framework document [„(...) Test measures to research effects on the environment and sub-surface may be possible, providing the deployed fracking fluid is not hazardous to water.“]. Previously in April, 2014 ExxonMobil published the development of a minimum reduced additive, framed by the 3rd status report on the implementation of the Neutral Expert Group recommendations [see SHIP News]. At the same time Federal Environment Minister Barbara Hendricks was presented with 660,000 signatures from fracking opponents.

In September, 2014, with an open letter (the Copenhagen Declaration), the European Geological Surveys of the North Atlantic Area criticised the lack of utilisation of their specialist authority in research of the geological sub-surface (see SHIP News). The Directors of the Surveys (including BGR-President Prof. Dr. Hans-Joachim Kümpel) are concerned about misleading media reporting, regarding the exploration and exploitation of minerals and energy commodities, in particular the exploitation of shale gas. They feel that often scientific results and conclusions are ignored. „Often

dangers are evoked that simply do not exist. The use of fracking for natural gas production arouses widespread fear amongst the population, fear that from a geological perspective is largely unfounded," claims BGR-President Prof. Dr. Hans-Joachim Kumpel.

Surprisingly in November, 2014 a **revised version** of the original framework document was released. It included the addition that „exceptions can be made following successful test measures and commercial fracking may be permitted, provided an independent expert commission votes positively with respect to environmental impact and earthquake security; the relevant German federal state authorities must additionally approve these activities. The vote of the expert commission is not binding for German federal state authorities.“

On 1st April 2015 the German Bundeskabinett (Germany's government) introduced a bill regulating hydraulic fracturing in Germany (for details see **SHIP News**). The bill will be discussed in the German Bundestag (Germany's parliament) and may experience amendments before final approval.

Scientific reports and positions

ExxonMobil study on the risks of hydraulic fracturing

In early 2011, ExxonMobil Production Deutschland GmbH (EMPG) initiated an **information and dialog process** on the potential risks and environmental impact of unconventional gas production, as a response to widespread public opposition to its exploration activities in North-Western Germany. An extended summary version of the "**Risikostudie Fracking**" (study of fracking risks) was presented during the final conference on April 25, 2012, in Osnabrück, Germany.

At the heart of the information and dialog process was a panel of eight leading experts from German research organizations who worked on a broad spectrum of questions, in particular regarding the environmental risks and health risks of hydraulic fracturing. The experts were selected very carefully; besides excellent scientific expertise, requirements included independence from the natural gas industry and from ExxonMobil.

The main conclusions of the scientists are:

- Compared with conventional gas production, hydraulic fracturing in unconventional reservoirs bears a new range of risks, stemming from an increased number of wells and a related increase in water consumption, the use of chemical substances, and increased traffic. Additionally, many potential gas shales are present at shallower depths than is the case for conventional reservoirs in Germany.
- The assessment of the risks has shown that a slow and cautious development of hydraulic fracturing in unconventional reservoirs should be possible – there is no factual reason for a ban of the technology.

EMPG and the scientists pointed out that the experts did their research without prejudice and were not influenced by EMPG. In this respect, EMPG's willingness to implement all recommendations in future hydraulic fracturing projects in Germany, is remarkable [see **SHIP News**].

Risk study Federal Ministry for the Environment

In August 2012, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Environmental Agency (UBA) presented a **study** on the environmental

impact of shale gas development [see [SHIP News](#)]. An environmental impact assessment is required for any shale gas activity that includes hydraulic fracturing. Another requirement is the availability of a wide range of information and the participation of the public. Shale gas exploration should not be allowed in areas with unfavorable geological conditions and in drinking water protection areas. It is recommended that environment and safety related approvals and monitoring shall be administered by the environmental authorities.

The study recommends that hydraulic fracturing should not be banned, but its application should only be allowed with strict regulation in place and should be accompanied by intensive administrative and scientific supervision.

In July, 2014 the National Environment Agency introduced a second report on the environmental impact of using fracking for the exploration and extraction of natural gas, in particular for shale gas deposits (see [SHIP News](#)). It is recommended in [this study](#) „(...), that scientifically supported tests are carried out, as without such tests, our scientific knowledge of the risks and opportunities of fracking technology will remain limited.“

Risk study by the Ministry of Environment and the Ministry of Economy of North Rhine-Westphalia

In September 2012, the Ministry of Environment and the Ministry of Economy of North Rhine-Westphalia presented a [study](#) about the impact of hydraulic fracturing on the environment. The study emphasizes that the risks related to shale gas development cannot conclusively be evaluated at present and calls for more research. Moreover, it recommends that hydraulic fracturing should be prohibited in drinking water protection areas.

This study recommends suspending shale gas exploration with hydraulic fracturing in North Rhine-Westphalia, until less harmful additives for the fracturing fluids are available and the waste disposal is regulated to an acceptable extent. The state government implemented the recommendations immediately and stopped hydraulic fracturing until further notice, that is until more information on the risks of this technology is available.

Administrative regulation of the State Office for Mining, Energy and Geology (LBEG)

In late October 2012 the LBEG issued a new [circular](#) regarding the "Minimum requirements for operating plans, inspection criteria and approval processes for hydraulic well stimulation in crude oil and natural gas deposits in Lower Saxony". The administrative regulation refers to conventional and tight gas deposits in which hydraulic fracturing is applied. The requirements and processes for hydraulic fracturing in crude oil and natural gas deposits stipulated by the circular are intended to ensure an official assessment and evaluation. The LBEG thus defines a basis for future applications that is comprehensible for both companies and the public. The circular does not apply for geothermal energy and shale gas reservoirs.

Joint statement of the Geological Surveys of the German States (SGD) and the Federal Institute for Geosciences and Natural Resources (BGR)

In March 2013, the BGR and the SGD published a [joint statement on the studies](#) on hydraulic fracturing published in 2012 (studies by the [UBA](#), the state of [North Rhine-Westphalia](#) and the [risk study](#) of the ExxonMobile dialog process). The statement was drawn up on behalf of the federal/state

soil research committee. The examination of these studies resulted in harsh criticism of the presentation and assessment of the geoscientific facts. "The highlighted geoscientific deficits of the studies may result in a one-dimensional perception and accordingly in a general overestimation of the uncertainties when assessing geoscientific-based dangers and risks of hydraulic fracturing technology. (...) It should be emphasized that many of the recommendations with geoscientific relevance are already common practice." The statement also notes that it is not accurate to say that there is not enough data for regional evaluations of the geological underground.

Statement of the German Advisory Council on the Environment (SRU)

The **SRU statement** issued in May 2013 advocates a sober assessment of the chances and risks of hydraulic fracturing. The SRU states that shale gas production in Germany is dispensable under current conditions. In its report, the SRU points out that, in accordance with current scientific knowledge, there are still important questions that remain unanswered with regard to the risks associated with hydraulic fracturing. The committee recommends to clarify these questions one by one and to only issue permits for pilot projects until then.

"Hanover Declaration" of the Institute for Geosciences and Natural Resources (BGR), the Helmholtz Centre Potsdam – German Research Center for Geosciences (GFZ) and the Helmholtz Center for Environmental Research (UFZ)

The three institutes for geology and environment, BGR, GFZ and UFZ, published their **joint statements** on the topic of "Environmentally Compatible Hydraulic Fracturing" for the extraction of shale gas in August 2013. The "**Hanover Declaration**" is the result of a two-day conference with national and international experts on scientific and technical aspects.

The main conclusions are:

1. Natural gas is an indispensable resource for Germany. Recovery of shale gas could contribute to a stabilization of resources caused by dwindling domestic natural gas extraction.
2. If the fracking technology is to be applied for shale gas extraction in Germany, this requires environmentally-friendly procedures (e. g. the use of environmentally-friendly frac fluids). Furthermore, the existing legal framework for the exploration and production of natural gas will need to be developed further. The protection of drinking water must be a top priority.
3. To assess whether fracking can be conducted in an environmentally-friendly manner, proposed procedures should be first checked against local geological conditions in each individual case, and accompanied by appropriate monitoring measures. For this an environmental impact assessment based on the corresponding mining regulations must be carried out. Furthermore, it must be ensured to involve the environmental administration, in particular the water authorities, in the process.
4. The operation and development of technology for shale gas extraction in Germany requires a transparent and step-by-step approach.

Therefore

- first projects should be carried out as demonstration projects and all parties involved (public, industry, scientific community and environmental organizations) should be included from the start;
- individual measures and results should be published and accompanied and evaluated by a comprehensive scientific program;
- the main focus should be on research regarding the possible impact on groundwater quality of hydraulic fracturing measures.

Unique so far in the development of the "Hanover Declaration" was the fact that all parties involved were able to access the [draft online](#) and contribute to its creation.

The German Academy of Technical Science (acatech)

The German Academy of Technical Science, wishes to take a position regarding the basis of technical facts at the end of 2014. It aims to address the theme of hydraulic fracturing with its many facets including the ecological, legal, economic and political implications, as well as communications and community acceptance. It will provide an integrative assessment of all risks and opportunities. In addition to clarifying the technical and scientific aspects, the publication will spread light on the ecological, economic, legal and socio-political dimensions of fracking technology. Focus will be on the distinction of fracking in the context of deep geothermal energy and the extraction of shale gas.

Research on shale gas in Germany

GASH- Gas Shales in Europe

The [GASH project](#) was the first major European shale gas initiative and carried out a broad variety of shale gas research. Nine leading European research organizations are involved in this project, along with national geological services and industry partners.

The companies involved in GASH do not only act as sponsors; both the companies and scientific partners support GASH by delivering access to core data material, and by providing and applying their own analytical facilities.

One of the main problems in European shale gas exploration research is caused by a lack of access to shale gas relevant data from promising stratigraphic horizons crossing national borders. To overcome this issue, a web-serviced GIS database is being developed (European Black Shale Data Base, EBSD).

GeoEn

Basic research on German gas shales was conducted within the [GeoEn](#) project. GeoEn is an interdisciplinary national energy research program funded by the German Ministry for Education and Research. The program concentrates on four core topics of relevance to fossil and renewable geo-resource energy production. These are: shale gas, CO₂ capture, CO₂ storage and geothermal energy. Results will be used to offer safe and environmentally-friendly solutions to the growing energy demand of the future. GeoEn was the sponsor of the Shale Gas Information Platform SHIP.

NiKo

The Federal Institute for Geosciences and Natural Resources (BGR) started the project NiKo in 2011, in close collaboration with the United States Geological Survey USGS. The project will run for four years until 2015. NiKo investigates the shale gas potential for Germany, with a first report published in May 2012 (in German). The report suggests a large German shale gas potential of 700-2268 billion m³.

The conclusion of the study on environmental concerns is this: "From a geoscientific point of view, environmentally-friendly application of the technology is possible, as long as the law is observed, the necessary technical measures are taken and local baseline studies and pilot surveys are carried out. Hydraulic fracturing is compatible with the protection of freshwater reservoirs."

In a second step, the potential of shale oil in Germany will be studied within the NiKo initiative as well.