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Landuse restrictions and nature conservation assets

Workpackage 7 in RiskCom 2014: Environmental impacts of hydraulic fracturing related to exploration and exploitation of unconventional natural gas, in particular shale gas.

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Summary

The development and extraction of tight and shale gas through fracking and multiple horizontal drilling (high-volume hydrofracturing) does not only differ from conventional gas extraction (with its phases that are temporally and spatially clearly distinct from one another) in that it consumes considerably more resources, but – even more importantly – that it involves multiple overlapping activities in connection with a growing number of different drilling sites across an extended area and of individual drillings. Renaturation is rarely performed during production phases, at least in the U.S., because due to the fast decline in yield, an option to start re-fracking and re-drilling is always to be kept open. Land use competition, environmental impacts and risks of this kind of reservoir development can by no means be assessed merely by looking at isolated drilling sites but can only be grasped in the context of a larger extraction area, in which the individual activities have a cumulative effect. The consequences are direct land use conflicts (e.g. due to loss of area) as well as indirect impacts on land use and the environment (e.g. due to lasting interference in the surrounding area, pollution, the fragmentation of natural spaces, etc.).

Based on a comprehensive examination of the international literature, which starts off Work Package 7, the spatial impacts of the exploration and extraction of natural gas from unconventional reservoirs are assessed and evaluated for potential land use conflicts (inasmuch as this is possible without looking at specific locations). Input parameters for the conflict analyses are three development scenarios with different concentrations of drilling sites in an extraction area of 260 km^2 (approx. 16 x 16 km). The following subject areas were specifically investigated:

Settlement and transport structure

Germany is relatively densely settled. Consequently, the large-scale development and extraction of tight and shale gas is likely to lead to considerable land use conflicts with respect to quality of living conditions, infrastructure, health and material assets. Especially the development phase will see a significant increase in heavy goods vehicle traffic, work noise (primarily caused by the diesel engines of the pumps and delivery vehicles), light emissions as well as increased leakage risks due to the multiple handling and transport of large amounts of environmentally hazardous substances and liquids. Moreover, emissions of air pollutants and particulate matter are to be expected in the direct vicinity of the drilling site as a consequence of mixing activities, machine operation and drilling-related degassing. In areas of high concentration, pollutant emissions may accumulate and lead to a deterioration of the air quality, with a detrimental impact on health. As a protective measure against emissions and accidents, drilling sites are only admissible in a considerable safety distance from residential areas. However, gross land use may have an indirect impact on the quality of living conditions, too, e.g. as a result of increased usage and rerouting of access road as well as pipe systems.

The transport infrastructure of rural communities may be overly taxed due to the considerable increase in heavy goods vehicle traffic.

Agriculture and silviculture

Soil function and plant population losses are to be expected near the drilling sites and access roads as well as the pipes. Regionally, the use of large amounts of water in fracking may result in land use competition, e.g. with agricultural usage and drinking water production. The likelihood of inadvertent contamination by toxic substances in agricultural and silvicultural areas (leakages of fracking fluids, flowback, etc.) increases with the number of drillings, transports and pipelines. Ecologically significant forest biotopes, silvicultural test areas and seed supplies in particular are therefore unsuitable locations. In the U.S., occurrences of contaminated livestock and wild game have been documented in connection with open flowback settling ponds.

Water management / waters protection

The water demand of a drilling site is mainly determined by the fracking cycles during the field development and stimulation phase. Due to the large-scale drilling area development, cumulative effects may include lower groundwater levels, changes in the hydrodynamics of groundwater and surface waters, changes in flow rate, temperature and oxygen rates, with substantial ecological consequences. At the surface, groundwater and surface waters may be contaminated as a result of improper transport, storage and handling of hazardous substances and process water; and underground, as a result of gas migration and hydraulic short circuits. The necessary disposal of large amount of flowback and process water harbours additional risks. Due to the potential environmental risks, using and building access roads and pipelines for the transport of substances that are hazardous to water is not an option in a number of areas. These primarily include drinking water protection areas, medicinal spring protection areas, areas containing mineral springs as well as flood zones. Moreover, a sufficient vertical and horizontal safety distance to areas worthy of protection must be maintained.

Other uses of land mining

Depending on the local and regional geological conditions, the development and extraction of tight and shale gas competes with other mining uses such as raw material production (coal mining, oil and gas production), geothermal energy, energy storage, carbon capture and storage (CCS) and waste disposal. Primary potential risks include leaks and seismic events. The proximity of insufficiently sealed old drill holes, e.g., harbours the risk of substances being released. Hydrogeothermal use, CCS storage sites and energy storage (for instance in salt cavities and lower aquifers) occur in regions which could also be used for tight and shale gas extraction, and hence hold increased risk and conflict potential. Since the underground area is three-dimensional, vertical as well as horizontal safety distances may be required. Germany's Federal Mining Act (BBergG), however, does not contain any provisions that cover different projects involving plans for entire areas and comprehensive underground land use. Yet more and more individual regional development plans of federal states address this issue.

Recreational use, natural scenery and townscapes

Numerous conflicts with recreational use and impairments of the natural scenery are possible for the reasons listed in the section "Settlement and transport structure", specifically on account of the cumulative effects of the drilling field development. This especially concerns areas with therapeutic baths, spa areas as well as camping, weekend and holiday home regions, plus regions with protected natural scenery such as national and nature parks or biosphere reserves. In addition to the direct

impairments mentioned above, indirect effects may be expected, such as fragmentation of the landscape by traffic routes and pipelines. Typically, fracking will not be an option due to a clear conflict with the explicitly defined goals for many recreational areas, in particular national and nature parks as well as biosphere reserves.

Species and biotope protection

The development and operation of drilling sites as well as access roads and pipelines also have an impact on species and biotopes beyond the actual area concerned. Impairments due to noise, activities involving movement and pollution are examples that occur frequently. Indirect impairments of the flora and fauna, for instance due to changes in the water balance, are also possible. Due to the large-scale development of an area, the accumulation of interference radii around drilling sites, access roads and pipelines often leads to a significant loss of habitat functions and thus conflicts with species protection or the goals of protected areas. In addition to protected areas explicitly defined in art. 20 et seq., specific parts of the scenery and landscape listed in art. 30 Federal Nature Conservation Act (BNatSchG) and the habitats of the species which are expressly protected according to art. 44 BNatSchG require special consideration.

The status of different conservation areas, especially that of biosphere reserves, nature reserves, nature parks, national parks and Natura 2000 areas, conflicts with the large-scale development and extraction of tight and shale gas. Consequently, these areas must be excluded from development. Due to the interference radii, safety distances should be considered and maintained. National natural monuments and landmarks, protected parts of the landscape and legally protected biotopes are also worthy of protection. However, here and there impairments may be avoided through an appropriate choice of location. Protected area ordinances often do not even take the possibility of conflicts with mining projects in the potential areas of unconventional natural gas production into account, because this has never been necessary as yet. They should now be legally examined for the sake of protecting rare species and biotopes and those that are sensitive to interference.

Summary assessment

Many different cumulative impacts on environmental factors and other types of use may be expected with respect to the production of natural gas through fracking. Significant environmental and usage conflicts are likely in all scenarios. Obligatory taboo areas and safety distances will strictly limit the potential development areas. Among the most important conflict issues are the frack fluids and the risks of improper transport and handling of environmentally hazardous additives, the large amounts of process water, the risks due to potential mistakes in drilling as well as the handling and disposal of large amounts of highly contaminated wastewater.

The binding mining permission practices are considerably distinct from discretionary or arbitrary decisions regarding other professional spatial planning projects and, in their present form, therefore constitute a highly unsatisfactory solution regarding the regulation of unconventional natural gas production. This is especially true since raw material production is always given the benefit of the doubt and considered a priority when the best public interest is examined under mining law aspects. Another problem is that the Federal Mining Act does not give the competent authorities a separate mandate to act with respect to spatial planning. For example, the mining authorities have no general land use plans. Consequently, when looking at the notoriously chaotic development of shale gas production in the U.S. during the initial boom phase, it remains highly questionable if the otherwise well developed German system of spatial planning will be able to protect against similar imponderables of a chaotic spatial development. If the mining authorities themselves lack general land

use plans, they will not be able to deny cumulative development projects in instances where the spatial development is dubious.

Due to its spatial impact, its spatially significant and supra local character as well as the accumulation of many individual activities, unconventional gas production constitutes a classic case of applied regional planning. Regional planning would be best suited for giving a strategic environmental audit – as recommended by the European Commission for unconventional natural gas production – a general framework for approval procedures by the authorities in accordance with art. 14b Environmental Impact Assessment Act (UVPG). It would, however, be absolutely necessary first to stringently link the spatial planning with the mining code approval.