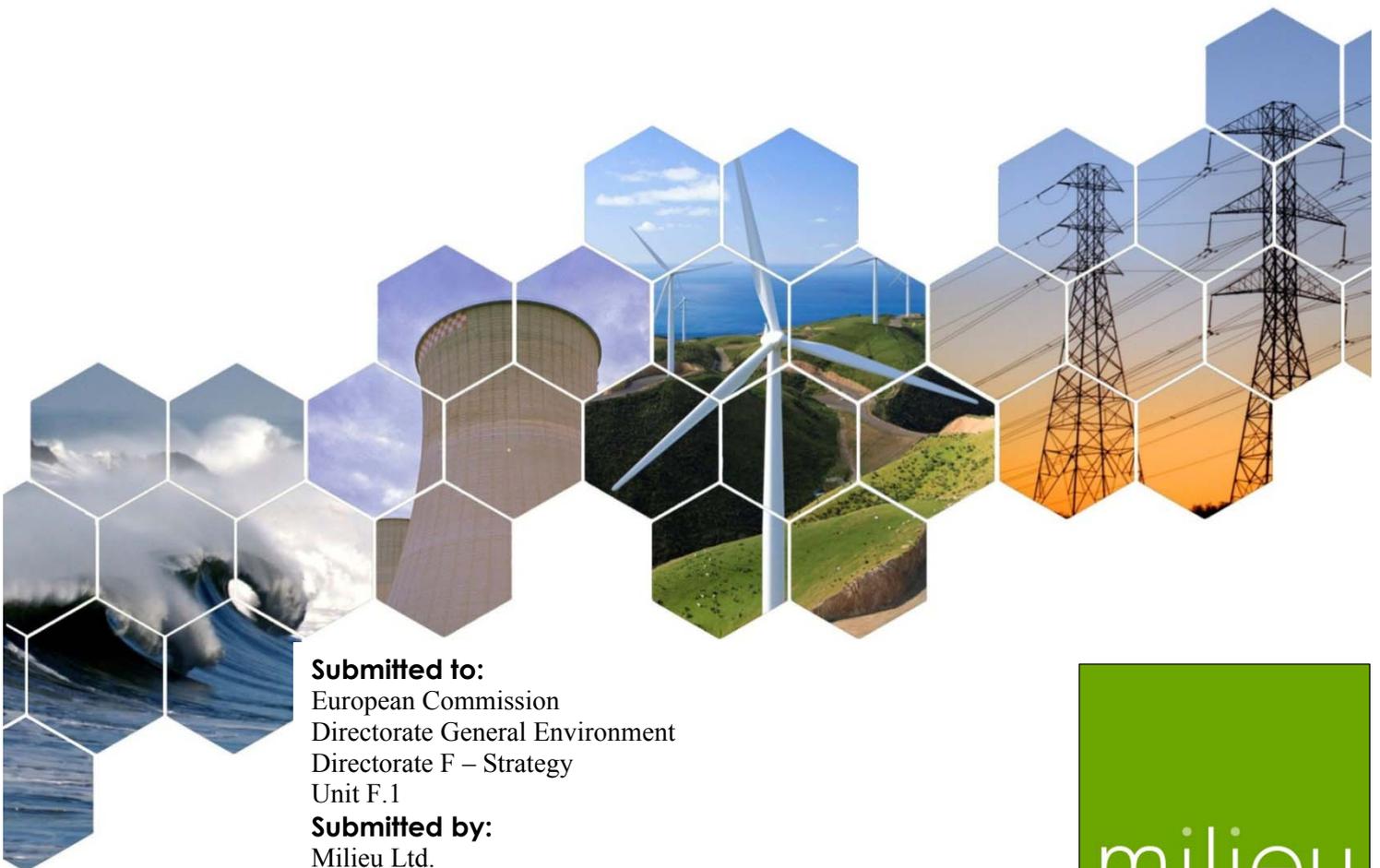


**Regulatory provisions governing key aspects of unconventional gas extraction
in selected Member States**

FINAL REPORT



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The Final Report was prepared by Marta Ballesteros, Florent Pelsy and Leonie Reins and reviewed by Claire Dupont.

Milieu Ltd –Law & Policy Consulting (Belgium), 15 rue Blanche, 1050 Brussels, Tel: 32 2 506 1000, e-mail: marta.ballesteros@milieu.be, web address: www.milieu.be

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TABLE OF ABBREVIATIONS

BSOR Regulations	Borehole Sites and Operations Regulations
BVOT	Tiefbohrverordnungen, deep drilling regulations
CAR	Water Environment (Controlled Activities) (Scotland) Regulations 2011
dB	Decibel
DEA	Danish Environmental Agency
DECC	Department for Energy and Climate Change
DETI	Department of Enterprise, Trade and Investment
DKK	Danish Krone
EA	Environmental Agency
EIA	Environmental Impact Assessment
EIA Directive	Environmental Impact Assessment Directive
EPA	Environmental Protection Act
ETS	Emission Trading System
EU	European Union
GEUS	Danish Geological Surveys
GHG	Greenhouse gas
HSE	Health and Safety Executive
IEA	International Energy Agency
LPG	liquid petroleum gas
NGO	Non-Governmental Organisation
NMRA	National Mineral Resources Agency
NOKE	National Operator of Energy Minerals
PEDL	Petroleum Exploration and Development License
REACH Regulation	Regulation concerning the Registration, Evaluation, Authorisation and Registration of Chemicals
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
US EPA	United States Environmental Protection Agency

1 EXECUTIVE SUMMARY

This Executive Summary presents the key findings of the study on the regulatory provisions governing key aspects of unconventional gas development in Bulgaria, Denmark, Germany, Lithuania, Poland, Romania, Spain and United Kingdom conducted on the basis of information collected between October 2012 and April 2013. These countries were selected as illustrative cases based on their geographical, cultural and legal diversity and their possible interest in extracting unconventional gas and in particular shale gas resources.

The main objective of this study was to identify differences and commonalities in the approaches followed by the selected Member States and examine the potential limitations and useful examples of these regulatory provisions. It should be noted that the study examines national provisions aiming at addressing environmental impacts and risks from unconventional gas extraction, a number of which may have particular transboundary significance (e.g. water and air pollution, impact on biodiversity).

The key findings from this study are based on a desk research as well as stakeholder and expert interviews carried out for the Country Studies. They are complemented by an extensive comparative assessment of the environmental and health related requirements applying to unconventional gas in the eight selected Member States at each relevant stage of this activity (project planning and design, exploration and extraction, as well as closure and post closure).

The comparative analysis of the national legislation has shown that there are a number of potential regulatory gaps and legal uncertainties, but also areas where the current legislation may be deemed sufficient to cover the specific impacts of unconventional gas exploration and exploitation. This analysis identified a few useful examples of regulatory provisions applying specifically to unconventional gas activities in the selected Member States (e.g. management of induced seismicity, page 9). Several Member States are in the process of drafting new legal texts or reviewing existing legislation to address the environmental and health impacts of unconventional gas activities.

1.1 General remarks

- **A complex legal framework**

Unconventional gas such as shale gas activities, generally involve a larger environmental footprint (e.g. in terms of water quantity and quality, waste water, air quality, community disruption such as traffic, fragmentation of natural habitats) compared to conventional gas activities, due to the intensity and scale of the operations, typically requiring the use of high volume hydraulic fracturing combined with horizontal drilling.

At present, the selected Member States rely mainly on the general mining and environmental legislation transposing the EU legislation and related permitting procedures to regulate such activities, as they do for conventional gas extraction. Very few have adopted specific requirements dedicated to unconventional gas practices, although there are on-going reviews of the applicable legislation in five Member States.

Based on the analysis conducted under this project, it appears that there are at present legal uncertainties in the existing Member States legislation (e.g. whether fracturing fluids remaining underground are to be considered as a mining waste or not). This leads to the application of different and sometimes contradictory requirements in Member States. Some competent authorities called for clarification from the European Commission on the applicable legislation.

- **Permitting regime and competent authorities**

None of the selected Member States have set in place a legislation and permitting procedure specific to unconventional gas activities. They all rely on the current mining and/or hydrocarbon legislation.

While there are a lot of similarities in the regime applicable to licensing, defined under Directive 1994/22/EC on the conditions for granting and using authorisations for the prospection, exploration and production of hydrocarbons (Hydrocarbons Licensing Directive)¹, the situation varies from one country to another in terms of approval of operational works, in other words, approval prior to commencing actual exploration and exploitation activities.

The national legislation examined as part of this study does not establish specific requirements, which may or may not be set as permitting conditions by the competent authority. As a consequence, detailed regulatory requirements and criteria applicable to operational works were not identified in this study. For example, requirements on information to be provided as part of the permitting process are often very general. As a consequence, a lot is left to the permitting authorities' discretion. This could raise problems, depending on the level of experience and expertise available to the competent authority, given that a thorough understanding of possible impacts and risk pathways is essential and authorisation conditions may not always be fully effective, appropriate and transparent and may lead to a differentiated treatment of projects across/within Member States. While it is important that competent authorities are able to take into account local specificities of the project, this situation may also result in important differences in the requirements, timing and cost of permits across Europe.

The fact that the national legislation remains general and not specifically targeted at unconventional gas activities may also entail an increased administrative burden for both the authorities and the project proponents. They may be obliged to request several permits under different acts which can create a disincentive for investment in this activity. For example in the UK, at present, any one well pad may require a number of separate permits (e.g. for mining activities, radioactive substances and for groundwater activities, which are the main three).

The competent authorities for issuing the permits also vary from one selected Member State to another, being either an environmental, mining or energy authority, or a mixture thereof. There are also several authorities involved at the local, regional and state level. This diversity reflects the differences in the existing national regimes.

- **Public participation and consultation requirements and access to information**

Member States legislation on granting licenses for hydrocarbon projects essentially transposes the requirements of the Hydrocarbons Licensing Directive 94/22/EC (which focuses on ensuring non-discriminatory awarding of licenses) and the information disclosed or accessible to the public is the general one linked to the licensing process (e.g. geographical areas which have been opened for prospecting, exploration and production and the composition thereof and the estimated reserves contained in its territory). In addition, national authorities must disclose information related to environmental matters under the transposing legislation of Directive 2003/4/EC on public access to environmental information² (Directive 2003/4/EC). However, Directive 2003/4/EC requires balancing the commercial confidentiality interest with the public interest for disclosure. The exemption of commercial confidentiality is only waived in cases of information related to emissions into the

¹ Directive 94/22/EC of the European Parliament and of the Council of 30 May 1994 on the conditions for granting and using authorisations for the prospection, exploration and production of hydrocarbons, *OJ L 164*, 30.06.1994, p. 3-8

² Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC, *OJ L 41*, 14.2.2003, p. 26-32.

environment.

Public participation requirements in the selected Member States mainly derive from the transposing legislation of Directive 2011/92/EU of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment³ (EIA Directive) and Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (SEA Directive). However it is not entirely clear to competent authorities whether unconventional gas activities (either exploration or exploitation) always fall under the scope of the national requirements transposing these Directives (see below under point 2, sub-section on EIA and SEA). Furthermore, the public is only allowed to consult and comment on the EIA and not on the final authorisations.

Public participation requirements are also imposed by the rules governing the permitting procedure under the legislation transposing Directive 2010/75/EU on industrial emissions (Industrial Emissions Directive)⁴ and Directive 2006/21/EC on the management of waste from extractive industries (Mining Waste Directive)⁵. However, the applicability of these different permitting procedures is still uncertain in all the Member States considered under this study.

1.2 Project planning and design

- **Financial guarantee**

Most selected Member States require a financial guarantee from the operator prior to the start of the hydrocarbon mining activities, although the details of this requirement e.g. the form, the damage covered, calculation methods, the evaluation procedure and the timeframe vary greatly across countries.

- **Environmental impact assessment prior to exploration/extraction and strategic environmental assessment**

The status of EIA requirement for exploration and/or extraction differs amongst the individual Member States selected, as it depends on how the EIA Directive requirements are transposed and applied.

In Bulgaria, the drilling for exploration and extraction of unconventional gas is subject to a mandatory EIA since April 2012. In Denmark, since July 2012, a drilling project that involves hydraulic fracturing (be it at the exploration or at the production phase) is subject to a full EIA. Lithuania requires a mandatory EIA for exploitation of hydrocarbons (for both conventional and unconventional without reference to the use of hydraulic fracturing), but not for the exploration phase.

The other selected Member States transposed the EIA Directive without a specific reference to unconventional gas activities or hydraulic fracturing. It is therefore uncertain whether exploration and extraction projects will be subject either to an EIA screening procedure or a compulsory EIA or none of the two, depending of the criteria or thresholds set by the Member States.

Recent draft legislation proposed in certain Member States show also varying approaches: for example

³ OJ L 26/1 [28.1.2012].

⁴ Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), *OJ L 334, 17.12.2010, p. 17–119*.

⁵ Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC, *OJ L 102, 11.4.2006, p. 15–34*.

in Poland, the draft legislation (as per the public notice released on 15/02/2013) sets a criterion of 5,000 meters for deep drilling projects to be subject to EIA provisions. This would imply that shale gas exploration projects that would typically take place above 5,000 meters would not be subject to screening under the national EIA provisions.⁶ In some countries (Germany, Spain), recent draft legislation foresees the specific inclusion of shale gas projects or hydraulic fracturing under the mandatory EIA regime. It has to be noted that all these recent proposals may be adapted in the coming months, as they are still under discussion at national level at the time of drafting this report.

The selected Member States did not set up specific environmental and health and safety requirements within the EIA process for unconventional gas activities (e.g. specific information on geology, measures to limit the risks of hydraulic fracturing to water).

In two countries (the UK and Lithuania), a strategic environmental assessment (SEA) is carried out before the invitation for the application for a licence. Environmental impacts will therefore be assessed before the issue of licences. On the one hand, impacts are only assessed at a generic level. On the other hand, cumulative and synergistic effects are covered by the SEA.

With regard to assessments of risk and impacts pursuant to the EIA legislation, there is no common understanding amongst the selected Member States as to the scope of the EIA and when it is required, in particular, whether or not it covers the whole unconventional gas development area, the well pad or wells individually. In the latter case, cumulative impacts may not be covered adequately.

- **Requirements for geological characterisation**

In the selected Member States, general requirements for geological characterisation designed for the extraction of conventional hydrocarbons apply. However, these do not appear specific enough and adequate to deal with the characteristics of unconventional gas extraction as they often do not focus on potential underground risks in the context of hydraulic fracturing (e.g. identification of existing faults and fractures; hydrogeology; existing abandoned wells). In particular, none of the legislation reviewed address specifically the identification of existing faults and fractures, which are directly relevant to the risk of contaminants migration to groundwater. Such requirements may be set within the EIA/permitting process by the competent authorities on a case-by-case basis, although there is no explicit legal guarantee foreseen.

A specific regulatory practice, considered as a useful example, has been identified in the UK where operators seeking consent under the licences for any hydraulic fracturing operations for shale gas will have to conduct a prior review of information on seismic risks and the existence of faults in the area; submit a ‘fracking’ plan showing how any seismic risks are to be addressed; carry out seismic monitoring before, during and after the ‘fracking’. In practice, requirements for monitoring seismicity from hydraulic fracturing are also in place in Denmark.

- **Setback and zoning**

In all selected Member States, setback, zoning and minimum well spacing requirements are derived from general mining operations and are not specific to unconventional hydraulic fracturing activities. They might also arise from local planning permission. The actual requirements on setback and zoning

⁶ According to a report from the Polish Oil and Gas Institute, shale gas deposits in Poland are typically situated at the depth of 1200 to 2500 m in the north, to the depth of 2500 to 4500 m in the south. Halina Jędrzejowska-Tyczkowska, Polish Shale Gas, Oil and Gas Institute, Krakow, May 2011 available April 2013 at: <http://www.inig.pl/inst/nafta-gaz/nafta-gaz/Nafta-Gaz-2011-05-01.pdf>. According to the Polish Geological survey report of March 2012, in the Podlasie Depression, the eastern part of formation may be located approximately 5000 m. deep underground. https://www.pgi.gov.pl/en/dokumenty-in/doc_view/769-raport-en.html

vary, for example the minimum distance from populated areas. Finally, in all selected Member States, the water legislation transposing EU directives regulates, controls or prohibits activities in specific protection zones.

- **Requirements on baseline monitoring prior to drilling or fracturing**

No specific requirements on baseline monitoring prior to drilling or fracturing have been identified. The requirements are set under the EIA procedure or permit conditions on an ad-hoc basis. In this sense, they would differ amongst countries although it is not possible to identify clearly these differences in the absence of detailed information on requirements set in the limited number of existing EIA or permits. In several of the selected Member States, data on establishment of more specific conditions on an ad-hoc basis directly in permits (e.g. Denmark, UK) or in administrative decisions on EIA (e.g. Spain) have been described. For example, in Spain, the decisions adopted by the Ministry of Environment subjecting unconventional gas exploration projects to EIA, request a monitoring programme to detect impacts on aquifers, surface water as part of the EIA. In Denmark, under one of the permits granted for exploration, water quality baseline monitoring includes a permit for the drilling of two water wells for the purpose of gathering data to analyse and control the ground water quality before, during and after the drilling has taken place. In these three countries, the monitoring requirements relate to surface and groundwater quality and cover baseline monitoring but also monitoring during operational works.

No specific requirement on air and soil baseline monitoring has been identified. This may be part of the EIA/planning permission or permits on a case-by-case basis, although there is no explicit legal guarantee foreseen.

1.3 Project operation: exploration and extraction phases

- **Health and safety**

Most occupational health and safety legal acts in the selected Member States derive from the transposition of EU health and safety directives applicable in the mining and/or hydrocarbon sector such as Directive 92/91/EEC.⁷ They set in place health and safety standards on the use of substances, equipment and conditions at the working place and accident reporting.

The use of chemicals for hydraulic fracturing might require the handling and storage of hazardous substances in the site of the installation. The risks from the chemical substances handling by workers are regulated by the national legislation transposing Directive 98/24/EC⁸ on risks related to chemical agents at work and Directive 2004/37/EC⁹ specifically regulating carcinogens or mutagens at work, both aiming at ensuring the protection of the health and safety of workers.

Furthermore, the risks to human health (and environment) in case of major accidents would potentially be regulated by the legislation transposing at national level Directive 2012/18/EU¹⁰ on the control of

⁷Council Directive 92/91/EEC of 3 November 1992 concerning the minimum requirements for improving the safety and health protection of workers in the mineral-extracting industries through drilling (eleventh individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)

⁸ Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work, OJ L 131/11 [5. 5. 98].

⁹ Directive 2004/37/EC of 29 April 2004 on the protection of workers from the risks related to exposure to carcinogens or mutagens at work (Sixth individual Directive within the meaning of Article 16(1) of Council Directive 89/391/EEC), OJ L 158/50 [30.4.2004].

¹⁰ Directive 2012/18/EU of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC, OJ L 197/1 [24.7.2012].

major-accident hazards (Seveso III). However, if Seveso III scope is transposed as such¹¹, it would apply only to the chemical and thermal processing operations and storage related to those operations which involve listed dangerous substances in the Directive (e.g. natural gas).¹² Indeed the Directive exempts from its scope the exploitation, namely the exploration, extraction and processing, of minerals in mines and quarries, including by means of boreholes.

In addition, Seveso requirements would only be applicable on a case by case basis if the relevant thresholds are reached in relation to the storage/processing of natural gas on site or to other listed dangerous substances that may be used for instance for hydraulic fracturing. This legislation might not be applicable for the exploration phase given the low percentage of chemicals used in the fracking fluid and the fact that natural gas is unlikely to be stored on-site and processed at this stage. In relation to exploitation, applicability would depend on the characteristics of the substances used for hydraulic fracturing, the volume of dangerous substances and gas stored and processed on site.¹³

- **Gas leakage and air pollution incl. from methane (e.g. via venting, flaring)**

There appears to be no legislation in the selected Member States that explicitly addresses venting and flaring in the context of hydrocarbon projects. Venting and flaring of methane and other emissions are expected to be addressed through permitting conditions.

In all selected Member States, there are no requirements on gas leakage and air pollution specific to unconventional gas developments. Only prevention and remediation of gas leakages is foreseen under conventional gas legislation and/or in practice. In the absence of specific requirements on flaring and venting, the competent authorities retain a large discretion on deciding whether or not flaring and venting can be allowed.

In some selected Member States, a differentiation is made between flaring and venting. As part of the consenting process in the UK, an applicant must demonstrate that flaring or venting will be kept to the minimum that is technically and economically justified. Consent to venting would not normally be given unless flaring is not technically possible. In Denmark, a prohibition of venting is not set in legislation but would be applied in practice. Flaring is only accepted to a limited extent (e.g. for safety reasons). In Romania, one operator mentioned that, in practice, flaring can be authorised only for limited time while venting would be allowed only in case of emergency.

In the UK, storage of wastewater in open ponds is prohibited. Storage has to be done in closed metal tanks before being treated. This is the only country where such a requirement has been identified. However, the national studies did not look specifically at the existence of such requirement.

- **Well design, construction integrity and casing**

There are no specific legal requirements relating to casing and cementing for unconventional gas wells. However, the hydraulic fracturing process places additional stresses on the well casing and

¹¹ An analysis of the transposition of EU legislation by Member States was not within the scope of this study.

¹²The Seveso Directive exempts from its scope the exploitation, namely the exploration, extraction and processing, of minerals in mines and quarries, including by means of boreholes, but covers chemical and thermal processing operations and storage related to those operations which involve dangerous substances, as well as operational tailings disposal facilities, including tailing ponds or dams, containing dangerous substances.

¹³It is common practice that even if some of the gas processing can be accomplished at or near the wellhead (field processing), the complete processing of natural gas usually takes place at a processing plant, located in a natural gas producing region. The extracted natural gas is transported to these processing plants through a network of gathering pipelines, which are small-diameter, low pressure pipes. Information retrieved from the website [naturalGas.org](http://www.naturalgas.org/naturalgas/processing_ng.asp) available May 2013 at: http://www.naturalgas.org/naturalgas/processing_ng.asp

specific requirements may be needed for unconventional gas wells. In two of the selected Member States, detailed requirements on the design, construction and integrity for conventional gas wells have been identified. Six of the selected Member States require well integrity tests under conventional gas legislation.

- **Hydraulic fracturing**

The study has reviewed some key requirements associated to the carrying out of the fracturing activity.

- *Obligation on the operator to monitor the effects of fracturing operations (e.g. induced seismicity)*
None of the countries assessed have set in place measures to control and monitor the effects of the hydraulic fracturing process, with the exception for induced seismicity in the UK.
- *Injection of fracturing fluids in the ground*
There is no common understanding amongst the selected Member States as to which sectoral legislation regulates the hydraulic fracturing operation (injection of fracturing fluids in the ground). Five of the selected Member States consider that this operation falls under the water legislation. The remaining Member States have various approaches – no specific requirement to regulate the injection of fracturing fluids in the ground, issue addressed through the EIA process or no official position on the applicable legislation.
- *Waste management requirements*
There are major differences between Member States and uncertainties as to the legislation and requirements applicable to the management of wastewater resulting from hydraulic fracturing, as underlined in the paragraphs below.
- *Injection of wastewater resulting from hydraulic fracturing for underground disposal ; re-use in fracturing operations*
The selected Member States do not have a common understanding of the application of the transposing provisions of Article 11(3)(j)¹⁴ of the Water Framework Directive with regard to the injection of wastewaters resulting from hydraulic fracturing activities, for underground disposal or with regard to re-use in subsequent fracturing operations. Some Member States consider that the derogation under Article 11(3)(j) of the Water Framework Directive (first alinea) does not apply to the injection of wastewaters from hydraulic fracturing, without differentiation between disposal or re-use into subsequent fracturing operations. Other Member States however consider that re-use in subsequent fracturing operations falls under the derogation under Article 11(3)(j) of the Water Framework Directive (first alinea) and can thus be authorised, while it is not the case for the underground injection for disposal that would then be prohibited. Other Member States consider that treated flowback water suitable for use in re-fracturing should not be treated as waste. Finally, some consider that it would be possible to inject wastewater underground for disposal, while others do not share this view.
- *Treatment and discharge to surface waters*
None of the selected Member States provide specific requirements for the treatment and discharge to surface waters of wastewater from unconventional gas operations. They rely on the water legislation transposing the Water Framework Directive and the Urban Waste Water

¹⁴ Art. 11. 3 (j) of the Water Framework Directive provides for a prohibition of direct discharges of pollutants into groundwater subject to certain provisions. The first alinea is interpreted differently by Member States (“ injection of water containing substances resulting from the operations for exploration and extraction of hydrocarbons or mining activities, and injection of water for technical reasons, into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which for natural reasons are permanently unsuitable for other purposes . Such injections shall not contain substances other than those resulting from the above operations”).

Directive. The discharge to surface water would only be allowed if it meets the standards of effluent to protect receiving waters.

○ *Surface storage*

None of the selected Member States have set specific requirements with regard to the surface storage of wastewater from unconventional gas activities. Some Member States consider that surface storage of wastewater falls under the mining waste legislation. In the UK, authorities in England consider that this storage is subject to planning conditions for surface water storage. Storage of wastewater in open ponds is prohibited in the UK. Storage has to be done in closed metal tanks before being treated. This is the only country where such a requirement has been identified. However, the country studies did not look specifically at the existence of such requirement.

○ *Legal status of hydraulic fluids remaining in the ground*

Among the four Member States that replied to the questionnaire of the Commission,¹⁵ the requirements applying to hydraulic fracturing fluids remaining in the ground diverge. Germany provides that the general provisions from the Federal Water Act (WHG) are applicable (uses of water, permits and protection from harmful changes of water quality). Poland considers that flowback water which has not been treated or has no further use, should be treated as mining waste, however the fracturing fluids remaining underground would not qualify as waste. In the UK, authorities in England would consider it as a mining waste, authorities in Northern Ireland do not have an established position but would require a licence under the Waste Management Licensing Regulations for such situation, while the authorities in Scotland provide that if such discharge is allowed under the Controlled Activities Regulations (in compliance with the Water Framework Directive), then the fluids will be an allowable entry of pollutants into groundwater.

○ *Water abstraction*

The general water legislation transposing EU directives on water applies, pursuant to which a permit would typically be required for water abstraction. None of the selected Member States have set specific requirements relating to the authorisation, monitoring, reporting and verification of water abstraction and use during hydraulic fracturing, beyond these general provisions.

○ *Movements of trucks*

The analysis in the selected Member States showed that there are no specific requirements regulating the movement of trucks in the national legislation. Local regulations on truck movements and restrictions are applicable and might contain traffic limitations or speed restrictions between certain hours for the transport of heavy materials by trucks.

○ *Obligation on the operator to disclose information on the chemicals contained in the fracturing fluids and requirements (including possible prohibition) regarding use or non-use of certain chemicals*

In the Member States assessed, operators of unconventional gas activities are not explicitly obliged by national legislation to disclose information to public authorities and the general public on the substances they are planning to use during the fracturing phase. They have not adopted legislation that would complement the REACH Regulation. The disclosure requirement can however be set during the permitting procedure by national authorities on a case-by case

¹⁵ Within the framework of this study, the Commission sent a questionnaire to the national authorities of the selected Member States concerning the legislation applicable to the management of waste from hydraulic fracturing on the surface (e.g. surface storage, treatment, discharge to surface water) and in the ground (e.g. injection of waste water for disposal) or re-use in other fracturing activities. Out of the eight Member States consulted, four responded (Germany, Poland, the UK and Spain). Spain indicated that “these issues are still under consideration since there are no projects approved so far”.

basis or following guidelines. In the UK, when assessing whether a permit will be required for groundwater activities, or whether any discharge to groundwater is to be prohibited, the authorities will require information on any chemicals contained in the fracturing fluids. In Bulgaria, national authorities can request operators on a case-by-case basis to provide information on the chemical substances used within the mandatory EIA procedure for drilling of exploration or exploitation activities. In Spain, the Ministry's decision requiring EIA for all applications of projects of unconventional gas involving hydraulic fracturing submitted to the Ministry requires information on the chemicals used and their expected environmental impact.

- *Permanent monitoring of the impacts of hydraulic pressure on the well or ground and adoption of measures (stopping or resuming activity)*
None of the selected Member States have established requirements relating to monitoring of the hydraulic pressure during fracturing activities, except in the UK with a traffic light system to identify unusual seismic activity, and Germany, with a requirement to constantly monitor the pressure in the well and to shut off the well in cases that the pressure exceeds the standard pressure in the line as a general requirement. In other Member States, specific requirements may be set during the permitting procedure, although there is no explicit legal guarantee foreseen.

1.4 Project cessation and closure phase/post closure phase

No specific requirements apply to the closure and post closure phase of unconventional gas extraction wells beyond those applicable to conventional wells. For the latter, most Member States require a well abandonment plan and set post closure measures to be taken by the operator to maintain the integrity of the well. This would include requirements such as filling up the well with the material with the same characteristics, as previously extracted, setting-up monitoring equipment and equipment to facilitate any required interventions. Moreover, the legislation in selected Member States sets requirements for the dismantling of installations and the restoration of the land.

1.5 Enforcement regime

- **Requirement on liability**

Most Member States do not go beyond the Directive 2004/35/EC of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage¹⁶ (Environmental Liability Directive). Strict liability¹⁷ applies to damages or imminent threats caused by activities listed in Annex III of the Directive (e.g. management of waste from extractive industries, water abstraction and impoundment under the Water Framework Directive). Most of the activities of unconventional gas exploration and exploitation would fall under this list and be subject to the corresponding strict liability system. However, the national authorities interviewed have expressed divergent views on the applicability of strict liability to unconventional gas activities. For example, some interviewees consider that unconventional gas exploration and exploitation would not fall under the Mining Waste Directive. If to consider that these activities do not fall under Annex III, liability will be only fault-based and limited to damage or threat of damage to protected species and natural habitats.

One exception is Spain, which is the only Member State going beyond the Environmental Liability

¹⁶ Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage

¹⁷ Under strict liability regime, there is no need to proof intent or negligence when the operators cause environmental damage or an imminent threat of such damage.

Directive. Spanish law covers all damages for activities outside Annex III¹⁸ (if there is fault or negligence). Furthermore for activities outside Annex III, operators are required to adopt prevention and avoidance measures even if they acted without fault or negligence. The lack of adoption of these measures is considered as a serious infringement leading to sanctions (i.e. fines).

In addition, several of the selected Member States have set up liability regimes specific to mining operations (e.g. Germany and UK). However, Milieu has not assessed whether these specific liability regimes take properly into account the characteristics of unconventional gas activities.

- **Sanction regime**

The sanction regime applicable to all hydrocarbon exploration/extraction varies as to the nature and the level of sanctions or the definition of offences amongst the selected Member States. It is generally covered by sanctions either under mining, hydrocarbons, water or other environmental legislation. The sanctions can be of financial nature but include also other measures such as closure of the installations.

¹⁸ The Directive limits environmental liability with fault or negligence outside activities in Annex III to damages to protected species and natural habitats.

2 INTRODUCTION TO THE PROJECT

The extraction of unconventional gas in the European Union is at a very early stage of development compared to the United States which is already well advanced in the commercial production. Prospecting and explorations are however underway or foreseen in several EU Member States. On the one hand, there is a strong political interest in the development of this industry and technology that could further diversify Member States energy supply through local production while reducing imports from countries outside the EU (e.g. the reliance of Poland, Lithuania and Romania on Russian gas). On the other hand, there are general public and public authorities' concerns over the environmental, climate and health impacts and risks induced by the extraction of unconventional gas. At national level, Member States have followed very different approaches. For example, Bulgaria imposed a ban on the exploration and exploitation of hydrocarbons using hydraulic fracturing.¹⁹ At the same time, Poland is designing new legislation to facilitate the development of unconventional gas.²⁰

The Commission has already started assessing the EU environmental 'acquis' in view of its application to unconventional gas practices,²¹ and for example, it has produced a guidance note on the application of the Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment²² (EIA Directive) to projects related to the exploration and exploitation of unconventional hydrocarbons.²³ The Commission acknowledges the need to ensure that health and environmental risks that may arise from individual projects and cumulative developments are managed adequately. This objective is in line with the European Council mandate calling for an assessment of Europe's potential for sustainable extraction and use of conventional and unconventional fossil fuels resources in order to further enhance Europe's security of supply.²⁴

The aim of this project is to assess both the differences and commonalities in the regulatory approaches to unconventional gas extraction and health and environmental protection in eight selected Member States, and to identify useful regulatory practices in the context of unconventional hydrocarbons extraction as well as possible aspects for which increased clarification could be useful. The assessment included rules specific to unconventional gas (e.g. shale gas) and any other applicable measure such as legislation on mining and hydrocarbons, water and air quality, impact assessment (non-exhaustive).

The result of this analysis regarding the potential useful practices and/or uncertainties/limitations found in the national legislation may be used by the Commission to feed into on-going work on a framework for safe and secure unconventional hydrocarbons (e.g. shale gas) extraction, subject to an impact assessment.

Unconventional gas extraction is a complex industrial activity that is developed through different phases. The structure of this report and the national studies is based on these phases in order to assess the regulatory requirements that are currently in place to address the potential risks and impacts of this activity. The main phases of unconventional gas developments are as follows:

¹⁹ Decision of the Parliament 14 July 2012 <http://www.parliament.bg/bg/desision/ID/14031>

²⁰ Information on the new draft law is available on the website of the Ministry of Environment: http://www.mos.gov.pl/kategoria/250_prawo/

²¹ See relevant 2011 Commission note available at: http://ec.europa.eu/environment/integration/energy/pdf/legal_assessment.pdf

²² Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment, *OJ L 26, 28.1.2012, p. 1–21*

²³ See relevant study available September 2012 at: http://ec.europa.eu/environment/integration/energy/pdf/guidance_note.pdf

²⁴ Conclusions of the European Council of 4 February 2011, <http://register.consilium.europa.eu/pdf/en/11/st00/st00002-re01.en11.pdf>

Stage 1: Site identification and preparation

The site selection stage can have an important influence on the potential environmental and health impacts in later stages. Site preparation activities consist primarily of clearing and levelling an area of adequate size and preparing the surface to support movement of heavy equipment (New York State DEC 2011 PR p5-10). Site access routes need to be designed and constructed.

Stage 2: Well design; drilling; casing; cementing; perforation

The first drilling stage is to drill, case, and cement the conductor hole at the ground surface. A vertical pipe is set into the hole and grouted into place. The second drilling stage is to drill the remainder of the vertical hole. Surface and intermediate casings are constructed, cemented and horizontal bores drilled. The pipework and cement is then perforated, and the wellhead constructed.

Stage 3: Technical hydraulic fracturing

Water with proppant (typically sand) and chemicals is pumped into the well at high pressure.

Stage 4: Well completion and management of wastewater

During the well completion phase, operators need to process flowback and produced water.

Stage 5: Production

Stage 6: Decommissioning/abandonment

3 OBJECTIVE OF THE PROJECT: METHODOLOGY & CHALLENGES

3.1 Objective and Methodology

The objective of this study is to provide the Commission with an assessment of the regulatory provisions governing key aspects of unconventional gas extraction in Bulgaria, Denmark, Germany, Lithuania, Poland, Romania, Spain and United Kingdom in order to identify differences and commonalities in the approaches followed by these Member States and identify potential limitations and useful practices.

The methodology has been constructed around the three main tasks identified in the Technical Specifications:

- Task 1: Literature review and template preparation;
- Task 2: Completion of the Country Studies:
 - First phase: desk-study and legal analysis;
 - Second phase: stakeholder interviews;
- Task 3: Horizontal analysis (assessment of the different/common approaches in Member States and identification of potential limitations and useful practices).

The Country Studies (available as Annexes to this report) were prepared by a team of national lawyers. It was considered crucial to cross-check the information gathered through desk research by interviewing stakeholders from various fields. To that end, our national experts carried out interviews with relevant stakeholders representing:

- NGOs (environmental associations, civil society movements)
- Industry (mining or energy companies)
- Labour unions on occupational health and safety issues
- National competent authorities (permitting and enforcement)
- Scientific community (e.g. geologists, universities, research centres)

3.2 Main challenges encountered

- Unconventional gas extraction is at the early stages of development in the European Union. There is a lot of debate on the potential risks and impacts of such projects, whether to regulate specifically such developments or not, whether unconventional gas projects should be encouraged or stopped. As a result, the legal framework tends to evolve rapidly at national level, with new legal developments being proposed as this report was being drafted. Information on applicable legal requirements at national level was collected between October 2012 and April 2013. The Final Report endeavoured to reflect all major developments in the legislation even at the stage of proposal or draft laws.
- In most Member States, the existing legal framework to regulate unconventional gas consists of a complex array of overlapping sectoral and cross-sectoral laws. The challenge of the report was to identify the relevant requirements and legislation that would apply specifically to unconventional gas since almost none of the selected Member States have designed particular requirements to cover the potential health and environmental impacts specific to unconventional gas extraction.

4 GENERAL BACKGROUND INFORMATION ABOUT UNCONVENTIONAL GAS DEVELOPMENT IN THE MEMBER STATES

This section lays down the general background on unconventional gas extraction in the Member States and is based principally on the Country Studies (see Annexes). It includes background information on the potential resources for unconventional gas extraction, on the political context and the stage of development (prospection, exploration or exploitation) including whether there has been any drilling or hydraulic fracturing and the companies requesting permits in each Member State. It further explains the general legislative context (adoption of specific legislation or reliance on current legislation, moratorium, proposed/foreseen legislation).

Bulgaria

Potential resources for unconventional gas extraction

It is estimated that Bulgaria may have potential shale gas reserves of between 300 million and 1 billion cubic meters.²⁵

Political context and stage of development

Bulgaria is highly dependent on natural gas imports. According to information provided by the National Statistical Institute in 2008, Bulgaria imported more than 90 percent of its gas demands.²⁶ Shale gas became a very controversial issue in Bulgaria in 2011, when the Government granted a prospection and exploration permit for shale gas (*разрешение за търсене и проучване*) to Chevron-Bulgaria Exploration and Production Ltd for the Northern part of the country.²⁷ This led to a wide public campaign against shale gas exploration highlighting the potential risks of hydraulic fracturing. As a result the Government withdrew the prospection and exploration permit. Moreover, following the strong pressure from civil society groups and environmental associations, the Parliament imposed a moratorium on shale gas exploration by prohibiting drilling with a pressure above 20 atmospheres resulting in practice in a ban of drillings below 200 meters.²⁸ The text of the decision was so restrictive, that it effectively blocked all the prospecting and exploitation of oil and natural gas in the country. Following the reaction of the industry and research societies, on 14 July 2012, the Parliament adopted amendments to the text of the moratorium²⁹ removing the prohibition of drilling with a pressure above 20 atmospheres but clearly prohibiting the use of hydraulic fracturing technology.

General legislative context

To date, Bulgarian legislation makes no distinction between conventional and unconventional gas extraction. The key act for prospecting, exploration and extraction of natural gas applicable to the territory of the Republic of Bulgaria (including the continental shelf and in the exclusive economic zone in the Black Sea) is the Underground Resources Act.³⁰ The Underground Resources Act covers

²⁵ This information was widely spread in the media, but no official data confirming that estimations could be identified. - http://3e-news.net/show/17897_hristo%20kazandjiev%20bylgariya%20moje%20da%20dokaje%20zapasi%20ot%20shistov%20gaz_b

²⁶ Energy Strategy of Republic of Bulgaria until 2020, page 7

http://www.mi.government.bg/files/useruploads/files/epsp/22_energy_strategy2020_.pdf

²⁷ http://pris.government.bg/prin/document_view.aspx?DocumentID=/8xztzZTEo/tahpq0R3Jzg==

²⁸ Decision of the Parliament, dated 18 January 2012 - <http://www.parliament.bg/bg/desision/ID/13824>

²⁹ <http://www.parliament.bg/bg/desision/ID/14031>

³⁰ Закон за подземните богатства – Underground Resources Act (URA), promulgated in State Gazette, issue 23/12 March 1999, last amended State Gazette, issue 45/15 June 2012- <http://lex.bg/laws/ldoc/2134650880>

all aspects of prospecting and/or exploration and extraction of underground resources, protection and rational use of the underground resources, and mining waste management.

The legislation differentiates between the prospecting and exploration phase (*търсене и проучване*) and the extraction phase (*добив*)³¹ of mineral resources. The prospecting and exploration phase of natural gas is subject to a permit issued by the Council of Ministers (*Министерски съвет*), following a proposal by the Minister of Economy, Energy and Tourism – (*Разрешение за търсене и проучване или проучване*) and the extraction phase can be carried out upon the award of a concession (*концесия*) by the Council of Ministers, following a proposal by the Minister of Economy, Energy and Tourism (*Министър на икономиката, енергетиката и туризма*). The permits for prospecting and/or exploration are limited to a maximum of five years but can be prolonged twice for a period of two years, while the concessions for extraction are granted for 35 years but can be prolonged for 15 more years.

Denmark

Potential resources for unconventional gas extraction

The US Energy Information Administration has assessed the potential Danish shale gas reserves to about 617 billion recoverable cubic meters gas which is equivalent to two to three times the size of Danish gas production during 1972-2011.³² Concurrently, the Danish Geological Surveys (GEUS) has started work on an independent evaluation of the potential of Danish shale gas resources. This is being carried out in cooperation with other European geological survey entities in the Baltic Sea area. However, it is not expected to be completed before spring 2014.³³

Political context and stage of development

Since 1995, Denmark has had a large trade surplus in oil and gas. In 2010 the State received about 61 percent of the surplus from production of oil and gas, corresponding to DKK 24 billion (3.2 billion EUR).³⁴ Even though the Danish Government's target is a 100 per cent transition to renewable energy by 2050, it is considered by the energy sector and industry that fossil fuels will remain an important resource in energy supply in the decades to come.

The exploration of shale gas lived a silent life till the spring of 2012 when the political opposition put forward some parliamentary questions to the Minister of Climate, Energy and Buildings on the environmental risks, and the approval of activities connected to shale gas exploration, and the division of responsibilities between the local and state level in this respect. The Minister has announced that no further licences (*tilladelser*) will be approved until the results of the test drilling, under the licences that were granted under the previous government in 2010, are available. At the same time however, the Minister declared that if shale gas may be produced in a commercial and uncomplicated manner with no environmental harm, he would be (in favour of production if the gas at the same time would assist in the planned green energy transformation).

The local municipalities are responsible for planning, including the EIA procedure and the granting of various permits (water, waste, buildings etc). On 4 December 2012, the municipality of Frederikshavn approved the carrying on of the activities connected to shale gas subject to a hearing process of the neighbours to the project. Moreover, a small majority of the council members decided that the

³¹ For an exact definition of the terms see Additional Provisions, para 1, item 4 and 32 of the URA

³² Information provided by the Danish Energy Agency during interviews

³³ Danish Geological Survey, 4 January 2013.

³⁴ Danish Energy Policy Report 2011, p. 16

Minister should be approached to ask him to re-consider shale gas activities.³⁵ Following the completion of the EIA screening procedure, and a public information meeting held on 10 January 2013, the municipal Committee for Planning and Environment decided on 5 February 2013 to recommend to the Council that a rural zone permit be granted to allow initiating drilling activities which do not include hydraulic fracturing and that no full EIA was required.³⁶ The Council did not follow the recommendation from the administrative committee but decided that a full EIA should be prepared.³⁷

The Danish Minister for Climate, Energy and Buildings has so far granted three licences in total for exploration and production of shale gas from the Alum Shale formation³⁸ but two more applications have been submitted to the Ministry.³⁹ The first licence (*tilladelse*) issued in 2009 to Schuepbach Energy LLC (80 percent) and the Danish state-owned North Sea Fund (20percent) was however abandoned the following year. On 5 June 2010, Devon Energy Netherlands BV and the Danish North Sea Fund were awarded two new licences in an Open Door procedure: licences 1/10 and 2/10 situated respectively in Northern Jutland and Northern Zealand. Later that year, Devon handed over its licence shares to Total E&P Denmark B.V. (with an 80 percent share and appointed as operator) in partnership with the Danish state-owned North Sea Fund (20 percent).

For the 1/10 licence in Northern Jutland, the exploration period is divided into three phases from 2010 to 2016. Exploratory drilling is planned to take place at Dybvad 20 kilometres from the town Frederikshavn in May/June 2013 to investigate whether shale is present at the location. Cores of the shale will be taken, and by investigations of the cores in the laboratory it will be evaluated whether natural gas is present in the shale. The drilling is expected to last about three months. If the results are positive, further activities in the drilled exploration well will be performed such as fracturing in the shale formation drilled (and cased off) and a short production test to see whether natural gas can be produced at all. However, the Danish Energy Agency has not issued yet the necessary drilling permit pursuant to general mining legislation.⁴⁰

General legislative context

To date, there is no specific legislation applicable to shale gas. The Danish mining legislation is composed of one key act the Subsoil Act⁴¹ that is applicable to both offshore and onshore activities and does not distinguish between different hydrocarbons. However, in terms of environmental and safety issues, the Subsoil Act is supplemented with important legislation. Whereas special legislation has been adopted for the offshore areas, it is the general rules applicable to all onshore activities that are relevant also for exploitation of shale gas like the Planning Act⁴², the Environmental Protection Act⁴³ and the Working Environment Act.⁴⁴ Moreover, secondary legislation and the licence conditions based on a Model Licence (*Modeltilladelse*) provide the details within the framework set out by the primary acts. An amendment to the Executive Order on Environmental assessment of certain public and private projects (*Bekendtgørelse om vurdering af visse offentlige og private anlægs virkninger på miljøet*

³⁵ DR P4 Nordjylland, 04. dec. 2012 09.02 Nyheder (News) and <http://frederikshavn.dk/Sider/Skiferogas.aspx>
<http://www.dr.dk/P4/Nord/Nyheder/Frederikshavn/2012/12/04/074826.htm>

³⁶ Minutes of the meeting 5/2 2013:

<http://frederikshavn.instant.cohaesio.net/Plan-percent20ogpercent20MiljpercentC3percentB8udvalget/05-02-2013percent20Referatpercent20afpercent20Referat.aspx#10>

³⁷ <http://frederikshavn.dk/Sider/Skiferogas.aspx>

³⁸ It is a combined licence although with an exploration period of normally six years and a possible prolongation for 30 years for production

³⁹ Danish North Sea Fund, Annual Report for 2010, p. 8.

⁴⁰ Danish Energy Agency, 7 December 2012.

⁴¹ Consolidated Act No 960 of 13/09/2011, cf. <https://www.retsinformation.dk/Forms/R0710.aspx?id=138657>

⁴² Consolidated Act No 937 of 24/09/2009 as amended, cf. <https://www.retsinformation.dk/Forms/R0710.aspx?id=127131>

⁴³ Consolidated Act No 879 of 26/06/2010 as amended, cf. <https://www.retsinformation.dk/Forms/R0710.aspx?id=132218>

⁴⁴ Consolidated Act No. 1072 of 07/09/2010 as amended, cf. <https://www.retsinformation.dk/Forms/R0710.aspx?id=133159>

(VVM) was introduced on 1 July 2012. This now includes shale gas projects within the requirement to notify the municipality in writing, and obliges the municipality to require a full EIA both at the exploration and production phase if a drilling operation includes hydraulic fracturing.⁴⁵

Germany

Potential resources for unconventional gas extraction

It is estimated that Germany contains shale gas resources of 13 trillion cubic meters, whereof 10 percent or 1.3 trillion cubic meters are technically recoverable. This is more than eight times higher than the amount of existing conventional gas resources.⁴⁶ However, a considerable amount of these resources lies in nature and drinking water protection areas (14 percent of the overall areas where shale gas resources are situated are water protection areas) where exploration and extraction is prohibited according to the draft legislation.

Political context and stage of development

Shale gas extraction is a very controversial issue in Germany. In 2010, Germany imported 87 percent of its gas demand. Companies like ExxonMobil, BNK Petroleum and Wintershall are the key players in Germany. The first and to date only hydraulic fracturing activity to test the resources was undertaken by Exxon Mobil on a site “Damme Z3” Lower- Saxony in 2008⁴⁷. Meanwhile, North Rhine Westphalia has granted 23 exploration licences covering 20.000 km² which represents 60% of the area of this Länder.⁴⁸

The method of ‘fracturing’ has been discussed by the different Länder (16 federal states of Germany), political parties, NGOs and local initiatives, due to the controversy surrounding its potential environmental and health impacts. For example, North-Rhine Westphalia (the most highly populated of the 16 Länder) has passed a moratorium on ‘fracturing’ operations.⁴⁹

General legislative context

To date, there is no specific legislation applicable to shale gas beyond the legislation applicable to conventional hydrocarbons. The German mining legislation is composed of one key act, the Federal Mining Act of 1980⁵⁰ and several Mining Ordinances like the Ordinance on the Environmental Impact Assessment of Mining Projects of 1990⁵¹, the Health and Safety Mining Ordinance of 1991⁵² and the Federal General Mining Ordinance of 1995.⁵³ The ordinances lay down technical or procedural issues, whereas the Mining Act covers all aspects of mining including licences, health and safety, environmental matters and compliance and monitoring requirements in a comprehensive manner,

⁴⁵ Order No 1510 of 15/12/2010, cf. <https://www.retsinformation.dk/Forms/R0710.aspx?id=134469> as amended by Order No 744 of 28/06/2012, cf. <https://www.retsinformation.dk/Forms/R0710.aspx?id=142559>

⁴⁶ Bundesanstalt fuer Geowissenschaften und Rohstoffe, "Abschaetzung des Erdgaspotenzials aus dichtem Tongesteinen (Schiefergas) in Deutschland," (2012), 6.

⁴⁷ Exxon Mobil Germany, "Erdgassuche in Deutschland", available at <http://www.erdgassuche-in-deutschland.de/erdgas/explorationsgebiet/index.html>.

⁴⁸ http://www.bezreg-arnsberg.nrw.de/themen/e/erdgas_rechtlicher_rahmen/index.php

⁴⁹ Joint decree of the Ministries of Economics and Environment, 18. 11. 2011 (V B 1 – 47-03/IV-5-3052-37727).

⁵⁰ Federal Mining Act (Bundesberggesetz), as of 13 August 1980 (BGBl. I p. 1310), last amended by article 15a of the Act as of 31st July 2009 (BGBl. I p. 2585); in force since 1st January 1982.

⁵¹ Ordinance on the Environmental Impact Assessment of Mining Projects from 1990 (BGBl. I p. 1420), last amended by article 8 of the Regulation as of 3rd September 2010 (BGBl. I p. 1261), "UVP-V Bergbau".

⁵² Ordinance of 31 July 1991 on the health protection of mineworkers. Health and Safety Mining Ordinance of 1991 (BGBl. I, p. 1751)

⁵³ Allgemeine Bundesbergverordnung as of 23 October 1995 (BGBl. I S. 1466), last amended by article 5 para. 5 of the Act as of 24th February 2012 (BGBl. I p. 212), "Allgemeine Bundesbergverordnung (ABBV)".

supervised by one single administration. It is further supplemented by the deep drilling regulations (Tiefbohrverordnungen (BVOT)) of the individual Länder.

The Federal Mining Act as the key legislation has several functions: besides regulating and advancing exploration, production and preparation of mineral resources it also contains provisions aimed at guaranteeing the safety of operations and of the people employed in mining activities.

The legislation differentiates between exploration (*Aufsuchung*) and extraction (*Gewinnung*)⁵⁴ of mineral resources. There are four different types of licences (“Bergbauberechtigung”): the exploration licences (“Erlaubnis”⁵⁵) for exploration only, the production licences (“Bewilligung”⁵⁶) and the mining proprietorship (“Bergwerkseigentum”⁵⁷) for exploration and extraction and old rights (“alte Rechte”) which are old authorisations from the old law which are still valid. To date, several Länder have granted licences for exploration (*Erlaubnisse*) of shale gas: Baden-Württemberg, Hesse, Lower Saxony, North-Rhine Westphalia, Saxony-Anhalt and Thuringia. Licences for continuous exploration and extraction (*Bewilligungen, Bergwerkseigentum*) on the contrary have not been awarded yet.⁵⁸

Starting of an activity is subject to two legal requirements. Firstly, the granting of a licence (*Bergbauberechtigung*) that entitles operators the right to explore and/or exploit and secondly the approval of mining activities (*Betriebsgenehmigung*) by means of an operational plan (*Betriebsplan*).⁵⁹ The licences for exploration granted pursuant to the Federal Mining Law are limited for a scope of maximum five years. The time scope for a licence for exploration is not restricted by law and determined on a case by case basis. However fifty years may only be exceeded if this is necessary with regard to the investment and the recovery thereof.

The mining authorities (*Bergbehörden*) of the individual Länder where the gas reservoirs are situated (e.g. the Regional Government of Arnsberg, a regional authority of North-Rhine Westphalia) are in charge of the enforcement of the mining laws.

It is noteworthy that on 1 February 2013, the upper house of parliament (*Bundesrat*) decided on a legislative proposal on unconventional gas introduced by the States of North Rhine-Westphalia, Schleswig –Holstein, Baden-Württemberg, Bremen and Rhineland-Palatinate. The upper house recommended the federal government to analyse systematically the chemical substances used in hydraulic fracturing in particular their impacts on water quality. Furthermore it asked for a mandatory Environmental Impact Assessment for shale gas activities, in cases where there were three or more drilling sites. Finally on 26 February 2013, the Minister of the Environment together with the Minister of Economic Affairs introduced a proposal of law on hydraulic fracturing which includes a mandatory EIA and a general prohibition of fracturing activities in drinking water protection areas, through the amendment of the Federal Water Act.

Lithuania

Potential resources for unconventional gas extraction

The exact amount of Lithuanian shale gas resources is still uncertain. The Lithuanian Geological Survey under the Ministry of Environment estimates in 2011 that the country can hold 480 billion

⁵⁴for an exact definition of the terms see article 4 para 1 and 2 of the Federal Mining Act.

⁵⁵ Article 7 of the Federal Mining Act.

⁵⁶ Article 8 of the Federal Mining Act.

⁵⁷ Article 9 of the Federal Mining Act.

⁵⁸Umweltbundesamt, assessment of shale gas extraction, December 2011; available at: http://www.umweltbundesamt.de/chemikalien/publikationen/stellungnahme_fracking.pdf.

⁵⁹Till Elgeti and Lars Dietrich, "Unkonventionelles Erdgas: Berg- und Wasserrecht.(Report)," *Natur und Recht* 34, no. 4: 234.

cubic meters of shale gas reserves⁶⁰.

Political context and stage of development

The National Energy (Independence) Strategy of Lithuania published in October 2010 indicates that shale gas exploitation is one of the five energy priorities of the country due to its potentially significant reserves and favourable investment environment.

The National Energy Strategy indicates that Lithuania's natural gas consumption is expected to increase from 3.07 to 4.71 billion cubic meters by 2030 mainly because of the country's continued economic growth.

Currently Lithuania is fully dependent on Russian natural gas with imports covering 100 percent of domestic consumption.⁶¹ Gas imports are subject to agreements with the largest gas supplier, Gazprom.

Shale gas is under exploration in Lithuania. Companies interested in extracting shale gas and other hydrocarbons in Lithuania include MinijosNafta, a local oil production company, as well as LotosGeonafta, Lithuania's biggest oil production and exploration company, as well as the US energy company Chevron which bought a 50 percent stake in LL Investicijos, a local company that has an oil field in Western Lithuania. The US company Chevron's arrival in Lithuania shows the interest of large international players in Lithuania's shale gas reserves. The Lithuanian Geological Survey undertook an international tender for licences for hydrocarbons exploration, including shale gas. On 14 September 2012, the Official Journal of the European Union published Lithuanian Government's notice concerning this tender (2012/C 278/02).⁶²

General legislative context

With the purpose of creating a clearer and more secure environment for potential investors, Lithuania made a number of amendments to the existing legislation relating to the protection of the environment and human health when carrying out hydrocarbons exploration and exploitation.

Law No. I-1034 of the Republic of Lithuania on Underground⁶³, as last amended by the Law No. XI-972 of 30 June 2010 (hereinafter – Underground Law), provides environmental protection requirements for exploration and exploitation of underground resources, and defines the basic rights and obligations of the public institutions as well as of legal and natural persons involved in exploration, exploitation and protection of the underground resources.

The Lithuanian legislation differentiates between underground exploration (*žemės gelmių tyrimas*) and exploitation, which is defined as the 'use of the underground resources and its cavities' (*žemės gelmių išteklių ir ertmių naudojimas*).⁶⁴ Government Resolution No. 365 of 4 April 2005 contains the rules on the issue of licences to explore the underground resources (*Leidimų tirti žemės gelmestaisyklės*).⁶⁵ It

⁶⁰ Source: Natural Gas Europe, Lithuania looks to accelerate shale gas development, May 26, 2011 <http://www.naturalgaseurope.com/lithuania-to-accelerate-shale-development>; and Lithuanian Geological Survey at <http://www.lgt.lt/index.php?lang=lt>

⁶¹ Source: National Control Commission for Prices and Energy, Annual Report on Electricity and Natural Gas Markets of the Republic of Lithuania to the European Commission, 2011, http://www.regula.lt/en/publications/report-to-the-european-commission/Report_2010_Lithuania.pdf.

⁶² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2012:278:0002:0003:EN:PDF>

⁶³ Lietuvos Respublikos žemės gelmių įstatymas, http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=378634

⁶⁴ *ibid*

⁶⁵ *Leidimų tirti žemės gelmes taisyklės*,

http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=253362&p_query=&p_tr2=2

provides for procedures on the issue, update and withdrawal of underground exploration licences. Currently exploration licences for hydrocarbons have been granted to six companies: MinijosNafta, LotosGeonafta, Manifoldas, LL Investicijos, Geobaltic, and GenciuNafta.⁶⁶ Government Resolution No. 1151 of 28 October 2005 sets out the procedures on issue of licences to exploit hydrocarbon resources together with the requirements for their update and withdrawal.⁶⁷

Rules on exploration and exploitation of hydrocarbon resources, approved by Order D1-578 of 30 November 2005 of the Ministry of Environment⁶⁸, establish requirements exploration and exploitation of hydrocarbons, including obligations to develop an Exploration work plan before starting the exploration process, and the Exploitation 'project' before starting exploitation works.

The Underground Law requires that economic activities shall be regulated in the manner prescribed by the Law on Environmental Protection⁶⁹, the Law on Territorial Planning⁷⁰, the Law on Environmental Impact Assessment⁷¹, the Law on Monitoring⁷² and other legislation.

The Ministry of Environment has prepared new legislation on the design, drilling, integrity and closure of both conventional and unconventional hydrocarbons exploration/exploitation wells that also covers the related environmental and health impacts. The draft requires that drilling projects include:

- A description of geological and hydrogeological conditions of the exploration site;
- A description of the proposed works, meaning a technical description of the proposed activities including measures against gas leakage and measures ensuring environmental protection and safety at work;
- A description of measures on the management of waste generated during planned exploration/exploitation of hydrocarbons; and
- Inspection measures regarding the technical condition of wells.

Under the draft, technological conditions and design must ensure protection of the underground including groundwater from contamination. Hazardous substances may only be used in accordance with procedures established by the EU and/or Lithuanian legislation.

It was planned that the new law would enter into force in the very beginning of 2013. However, at the time of writing of the report, such legislation has not yet been introduced. The latest information (obtained on 19 March 2013) shows that the draft of this legislation is still under preparation. New revision of this draft aims at specifying requirements for exploration/extraction of shale gas and making clear distinction between them and requirements applicable for other hydrocarbons.⁷³

In addition, a working group is currently preparing amendments to the Underground Law with the purpose of establishing statutory requirements specifying the conditions for exploration/exploitation of shale gas. The law should be adopted in September 2013.⁷⁴

⁶⁶Source: KPGM study 'Central and Eastern European Shale Gas Outlook', 2012, page 62

⁶⁷Leidimų naudoti angliavandenilių išteklius išdavimo tvarkos aprašas,

http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=378234

⁶⁸Angliavandenilių išteklių paieškos, žvalgybos ir naudojimo (gavybos) Lietuvos Respublikoje taisyklės,

http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=267689&p_query=&p_tr2=2

⁶⁹Lietuvos Respublikos aplinkos apsaugos įstatymas, http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=404415

⁷⁰Lietuvos Respublikos teritorijų planavimo įstatymas, http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=437953

⁷¹Lietuvos Respublikos planuojamos ūkinės veiklos poveikio aplinkai įstatymas,

http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=402750

⁷²Lietuvos Respublikos monitoringo įstatymas, http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=276158

⁷³ Lithuanian Ministry of Environment

⁷⁴ Lithuanian Geological Survey

Poland

Potential resources for unconventional gas extraction

According to a report of the Polish Geological Institute released in June 2012 shale gas reserves could be up to 1.9 trillion cubic meters, with the most likely amount set between 346 billion and 768 billion cubic meters. Shale gas deposits are located in a zone stretching from the north-west to the south-east of Poland. According to the Ministry of Environment, these are found in the areas of the Baltic basin, Podlaska depression and Lubelszczyzna.⁷⁵

Political context and stage of development

Poland is highly dependent on Russian's carriers (mostly from crude oil and natural gas) and has experienced problems with energy supply in the past. Therefore the development of shale gas is considered by the Polish authorities as a key component of their strategy to diversify Poland energy mix and to improve its energy security.

As of 1st May 2013, 108 concessions for prospecting and exploration of hydrocarbons from shale gas formation were granted. The total acreage of these concessions represents approximately 87 000 km² (around 27 % of the Polish territory). As of 6th May 2013, 44 shale gas exploration wells were completed, three wells were in the process of being drilled, ten wells with vertical section were hydraulically fractured; four wells with horizontal or directional section were hydraulically fractured, five wells were subject to diagnostic fracture injection test or were micro- hydraulically fractured. Another 333 wells are planned to be drilled by 2021 (123 obligatory wells and 210 optional ones)⁷⁶.

General legislative context

Currently shale gas extraction is regulated by the general Geological and Mining Law Act. The Polish government has proposed in February 2013 a new legislation amending the Geological and Mining Law Act. At the time of writing, the draft law is being under public scrutiny until 18th March 2013. The draft law proposes the following changes:

- Mainstreaming of concession (instead of two concessions, only one joint concession for exploration and extraction activities will be required);
- Environmental NGOs to be part of an Environmental Impact Assessment (EIA) procedure must be registered at least 12 months before the start of the project;
- The EIA procedure will cover an area of 500 meters from the outer border of the project;
- In case of certain changes in the concession (e.g. changes to the depth of the borehole or changes to the timeframe and schedule of the exploration and exploitation activities) a new EIA will not be needed;
- Exploratory drilling wells not deeper than 5,000 meters are not subject to an EIA (nor to a screening)

It should be noted that the 5,000 meters threshold would imply that most shale gas exploration projects would not be subject to screening under the EIA legislation, since according to the Polish Oil and Gas Institute, the Polish shale gas resources typically lie at the depth of 1,200 to 2,500 m in the north, to the depth of 2,500 to 4,500 m in the south.⁷⁷ It has to be noted however that this proposal may be

⁷⁵ Website of the Ministry of Environment, last access on 27.09.2012
http://www.mos.gov.pl/artykul/3327_najczesciej_zadawane_pytnia_odpowiedzi/12471_4_gdzie_na_terenie_polski_moze_wystepowac_gaz_lupkowy.html

⁷⁶ Information from Polish authorities

⁷⁷ Halina Jędrzejowska-Tyczkowska, Oil and Gas Institute, Polish shale gas (may 2011). Accessed 25 March 2013 at:

adapted in the coming months, as the draft law is still under discussion at national level at the time of drafting this report.

Romania

Potential resources for unconventional gas extraction

The unconventional gas potential of Romania is currently being explored as part of a National Geological Programme. Whilst certain areas of Romania (e.g. Moldova and Black Sea coast) are believed to have an important shale gas potential, prospection studies are still on-going.

Political context and stage of development

Several companies (Chevron, Midia Resources, Mol, Romgaz) are involved in different stages of obtaining rights for exploring/exploiting shale gas on the Romanian territory. Public consultation for shale gas operations (exploration phase – ‘seismic bi-dimensional prospection’) for the purpose of granting environmental endorsements for prospection operations to Chevron (i.e. activities that do not imply construction of drills at this stage), were advertised by Constanta Environment Agency and Chevron on their websites in mid-October 2012 for the land located in Constanta County conceded to Chevron.⁷⁸ The request was submitted to the authorities by Prospectiuni S.A. (a company which mainly undertakes prospection and exploration activities) on behalf of Chevron.

The concessions received by Chevron (four in total) are the most debated ones. Midway through the year, a group of NGOs, which includes Greenpeace Romania, initiated three lawsuits for annulling these acts, claiming alleged adverse effects on the environment and violation of environmental norms. Two of the three initial files are currently pending with the Bucharest Court of Appeal, with hearings scheduled for the end of February 2013 (for the joining of files). One of them was dismissed by the Court. According to the interview conducted by the national expert with a Greenpeace Romania representative, the decision has been appealed.

In May 2012 the Government made public its official Governance Programme that provided an ‘*immediate establishment of a moratorium on shale gas operations until the completion of the ongoing studies at the European level on the environmental impacts of hydraulic fracturing*’. However following the Parliamentary elections of December, the Prime Minister Victor Ponta (Member of the Social Democratic Party) stated in several interviews that the Government was in favour of unconventional gas exploration and exploitation in compliance with all necessary environmental protection requirements activities.⁷⁹ The Government programme for 2013-2016 now specifically states that ‘*exploration activities for the identification of exploitable unconventional resources*’ is a priority activity.⁸⁰

<http://www.inig.pl/inst/nafta-gaz/nafta-gaz/Nafta-Gaz-2011-05-01.pdf>; According to the Polish Geological survey report of March 2012, in the Podlasie Depression, the eastern part of the formation may equal to approximately 5000 m. https://www.pgi.gov.pl/en/dokumenty-in/doc_view/769-raport-en.html

⁷⁸ The perimeters for which an environmental endorsement was requested are all located in Constanta in the areas of (a) Almălău (Ostrov) — Aliman — Urluia (Adamclisi) — Zorile (Adamclisi) — Șipotele (Deleni) and the Bulgarian border up to Almălău (Ostrov) (the first perimeter); (b) Adamclisi — Pietreni (Deleni) — Potârnichea (Topraisar) — Vânători (Pecineaga) — Tufani (Independența) — Șipotele (Deleni) (the second perimeter); (c) Tufani (Independența) — Vânători (Pecineaga) — Vama Veche and the Bulgarian border up to Furnica (Dumbrăveni) (the third perimeter). Information available at <http://www.chevron.ro/news/announcements.aspx> (accessed on 5 February 2013)

⁷⁹ <http://economie.hotnews.ro/stiri-energie-14079073-victor-ponta-sustin-explorarea-gazelor-sist.htm> (accessed on 5 February 2013)

⁸⁰ The Government Programme for 2013-2016 available at <http://www.gov.ro/upload/articles/117322/program-de-guvernare-2013-2016.pdf> (accessed on 19 March 2013).

General legislative context

The Romanian legislation does not distinguish between underground conventional and unconventional resources and their exploitation and exploration regime. Both types of resources fall under the broad definition of ‘petroleum’ provided in Article 1 of Romanian Petroleum Law no. 238/2004. The definition sets forth that petroleum is any ‘*mineral combustion substance from mixes of natural hydrocarbons accumulated in the terrestrial shell that after being extracted to the surface is either in gaseous form, as natural gas or in liquid form, as crude oil or condensate*’ and that it is exclusively owned by the Romanian State (irrespective of the owner of the land above).

The competent regulatory authority in the field of natural resources is the National Mineral Resources Agency (NMRA). This authority organises public procedures and concludes concession agreements (called ‘petroleum agreements’) for the exploration and exploitation of petroleum with the investors, which are subsequently approved by Government decisions.⁸¹

A petroleum agreement has multiple stages of execution: exploration (after the finalisation of geologic and seismic prospection), development and exploitation and can be concluded for all such stages or for particular ones. Exploration works can also be performed separately (i.e., no petroleum agreement is necessary), based on prospection permits.

Spain

Potential resources for unconventional gas extraction

Although reserves of unconventional gas in Spain have been found mainly in the Basque Country and Cantabria, the level of resources and their location for unconventional gas in Spain have not been fully determined yet. According to the Council of Mining Engineers, the estimated reserves of natural gas trapped in shale rock are about 1.4 trillion cubic meters which correspond to 39 years of domestic demand⁸². Prospecting for unconventional gas resources has increased due to high oil prices also favored by an attractive gas tax in Spain. Currently requests for investigation permits and exploratory drilling works have been submitted in Cantabria and the Basque Country but also in Aragón, Andalucía, Asturias, Castilla-León, Cantabria, Cataluña and Navarra.

Political context and stage of development

The development of unconventional gas activities in Spain is at a preliminary stage, investigating the potential of resources. No drilling has been carried out yet which does not make it possible to talk about commercial exploitation in the short term. Specialized companies based in America or Canada are looking to expand their markets in Spain and current investigation permits that have been awarded involved both national and international companies such as Repsol, Trofagas Hydrocarbons, a wholly owned subsidiary of BNK Petroleum, and the Hydrocarbon Society of Euskadi, Petroleum Oil & Gas España, S.A. Northern Petroleum Exploration Limited, Montero Energy and Frontera Energy. For example a consortium has been formed by Cambria Europe 20% (Spanish branch of True Oil LLC), and US HEYCO’s Energy Spain (Petrichor Euskadi) 36% as part of a joint venture with the Hydrocarbon Society of Euskadi “SHESA” to explore the potential of the Valmaseda Formation (Cantabrian basin) up to 4,000 meters thick.

The Spanish Minister of Energy has stated recently that Spain will continue granting investigation

⁸¹Roundtable discussion organized by the Bucharest Faculty of Geography and Geophysics regarding the shale gas potential of Romania on 26 May 2012.

⁸² Information retrieved from Bloomberg website available March 2013 at:

<http://www.bloomberg.com/news/2013-03-11/spain-shale-gas-reserves-estimated-to-equal-39-years-of-demand.html>

permits provided that the conditions and environmental safeguards established under law are complied with. However, not a single authorisation for individual well drilling or fracturing has been granted yet. The legal framework that would be applicable to unconventional hydrocarbon is not clear and the Minister acknowledged the need for new legislative proposals.

General legislative context

To date, Spain does not have specific legislation to regulate unconventional gas operations but existing legislation for conventional sources of energy has the potential to cover different aspects of unconventional gas extraction. However, the lack of precise reference to unconventional gas in the existing legislation leads to legal uncertainty and a discretionary application of environmental and health protection measures.

The Law 6/2010 of 24 March on Environmental Impact Assessment for projects does not refer specifically to unconventional gas activities and follows literally the Directive requiring screening for deep drillings and an EIA for exploitation for commercial purposes referring to the same production threshold of 500,000 cubic meters/day. Under this legal framework it is not clear whether an environmental impact assessment will be always carried out for unconventional gas activities as deep drilling is not defined and the result of the screening might not require an EIA and the production threshold for EIA might not be reached by a unconventional gas exploitation. It is not clear whether the EIA is required for the individual well or for a whole installation covering a site with several wells. In this situation, a decision taken by the Ministry of Environment in 2011 on one of the projects for drilling unconventional gas did not require full impact assessment.

In January 2012, the House of Representatives urged the Spanish Government to put on hold any projects for drilling and prospecting hydrocarbon and to make them subject to environmental impact assessment in pursuance of the Law on Environmental Impact Assessment⁸³. Between October 2012 and January 2013 the Ministry of Environment communicated to the energy companies that all the wells (both conventional and unconventional) involving hydraulic fracturing will be subject to full Environmental Impact Assessment. The requirement of commercial purpose which in principle excludes EIA for exploration permits, has been interpreted by the Ministry of Environment to request an EIA for all projects involving hydraulic fracturing as it was considered that the high level of investment in these projects indicated their commercial purpose. A new draft bill has been adopted by the Council of Ministers on 15th of March 2013 amending the Law on Environmental Impact Assessment and introducing unconventional hydrocarbon activities involving hydraulic fracturing in Annex I listing the activities requiring a mandatory EIA⁸⁴.

At present, the Law 34/1998, on the hydrocarbon sector and the Regulation on the exploration and exploitation of hydrocarbons approved by Royal Decree 2362/1976 set up the rules for the permitting procedures and differentiates between investigation (exploration) and exploitation activities. However the legal basis for the authorisation of individual works for drilling is not clear, the requirements are not explicitly set up in the legislation and there is no reference to hydraulic fracturing. The draft bill adopted on 15th of March introduces unconventional gas extraction involving hydraulic fracturing within the scope of the current legal framework regulating hydrocarbons in Spain. The current proposal has not been published yet and therefore, the implications of the introduction of hydraulic fracturing in the scope of the legislation cannot be defined.

It is worth mentioning that Spain has a very convenient tax regime in order to render the investments in this field more profitable and secure energy supply for a country with a net energy import

⁸³ Idem, footnote 18: http://www.congreso.es/public_oficiales/L10/CONG/BOCG/D/D_021.PDF

⁸⁴ http://www.lamoncloa.gob.es/ConsejodeMinistros/Referencias/_2013/refc20130315.htm

dependency (over consumption) of about 75%, 100% over oil and gas.⁸⁵ The tax system for the hydrocarbon sector establishes a reduction in the general 35% taxable income applicable to corporate entities by applying a depletion factor.

Concerns in Spain are coming from different stakeholders mainly at the regional level and had led to the development of proposals for the adoption of a moratorium in Aragón⁸⁶ which was rejected in February 2013. Similarly the government of Cantabria has published on 27 October 2012 a proposal for the adoption of a law prohibiting hydraulic fracturing⁸⁷. The proposal has not been adopted yet.

United Kingdom

Potential resources for unconventional gas extraction

Shale gas exploration in the UK is still in its infancy. Official estimates published by the Department of Energy and Climate Change (DECC) in 2010 indicated that up to 150 billion cubic meters of shale gas could be potentially recoverable in the UK.⁸⁸ No official estimates have been made of the fraction of potentially recoverable resources that would be commercially recoverable.⁸⁹ However, industry estimates indicate that over 5,000 billion cubic meters of gas could lie in the Bowland shale under Lancashire in the North of England alone.⁹⁰ DECC has commissioned a study by the British Geological Society (BGS) of the total resources of the Bowland Shale, the results of which should be published during 2013.

Political context and stage of development

While five companies expressed an interest in shale gas during the last licensing round, only one well has been hydraulically fractured to date. However, following seismic events experienced in Spring 2011 following exploratory drilling at the site at Preese Hall, near Blackpool in the north of England, the company, Cuadrilla, halted fracking operations. The Government temporarily suspended all fracking for shale gas until a better understanding of the seismic events could be gained and an assessment made of the scope for mitigation of seismic risks in future fracking operations. A geomechanical study was therefore submitted to DECC for consideration, which recommended that a detailed seismic monitoring system be put in place. The Government commissioned independent experts to review that report, and subsequently invited views from the public on findings and recommendations of the independent experts.⁹¹ Although there are no long term plans to introduce a moratorium on shale gas activities in the UK, the operations carried out by Cuadrilla in the North of England resulted in a temporary suspension of fracking for shale gas. However, on 13 December 2012, the Secretary of State for Energy and Climate Change announced that exploratory hydraulic fracturing for shale gas could resume in the UK, subject to new controls to mitigate the risks of seismic activity.⁹² The new controls require the operator to submit a fracking plan prior to the grant of well consent by DECC, that background monitoring of seismicity is carried out before operations start,

⁸⁵ http://ec.europa.eu/energy/policy/doc/factsheets/mix/mix_es_en.pdf and http://www.energiaycambioclimatico.com/export/sites/foro/recursos/pdf/programa_investigacion/investigacion/SET_EE_Energy_Dependence_2010.pdf

⁸⁶ Trade Union: http://www.ccoo.com/comunes/recursos/1/doc88246_Informe_fractura_hidraulica.pdf; IU Party: <http://www.iuaragon.com/wp-content/uploads/2012/11/Proposici%C3%B3n-de-Ley-contra-el-fracking.pdf>

⁸⁷ http://cantabria.es/web/gobierno/detalle/-/journal_content/56_INSTANCE_DETALLE/16323/1782904

<http://www.fracturahidraulicano.info/noticia/anteproyecto-ley-fracking-gobierno-cantabria.html>

⁸⁸ DECC, 2010, *The Unconventional Hydrocarbon Resources of Britain's Onshore Basins – Shale Gas*

⁸⁹ Houses of Parliament, 'UK Shale Gas Potential', January 2013, available at http://www.parliament.uk/documents/post/postpb005_UK-shale-gas-potential.pdf (last accessed 19 March 2013).

⁹⁰ Information retrieved from the following website: <http://www.cuadrillaresources.com/benefits/jobs-and-investment>

⁹¹ www.parliament.uk/briefing-papers/SN06073.pdf

⁹² <https://www.gov.uk/government/news/written-ministerial-statement-by-edward-davey-exploration-for-shale-gas> (website last accessed 25 February 2013)

and that on-going monitoring of seismicity is carried out during operations. Under the new controls, DECC will not consent a well until it has seen and is satisfied with the fracking plan submitted by the operator.

While a motion calling for a moratorium on shale gas activities was passed by the Northern Ireland Assembly in December 2011, this has not been endorsed by the Executive. Tamboran Resources Pty Ltd, the company exploring for shale gas in Northern Ireland, has a ‘drill or drop’ work programme whereby it must make a decision by the end of Year 3 to drill an exploration well before the end of the initial five year term of the licence, or it must relinquish or ‘drop’ the licence. No drilling of any type can take place on the licence without the consent of DETI and the permission of the Department of Environment (DoE) may also be required, depending on the nature and location of the drilling operations.

Legislative context

In the UK, there is no specific legislative provision made for shale gas and therefore shale gas activities are covered by the general provisions for conventional oil and gas exploration and development. There are also local controls through land use planning. In addition, there are a number of legislative variations in the regulation of unconventional gas within England and Wales, Scotland and Northern Ireland. Oil and gas licensing in England, Wales and Scotland is governed by the Petroleum Act 1998, the Petroleum (Production) (Landward Areas) Regulations 1995, and the Hydrocarbon Licensing Directive Regulations 1995. The 1998 Act vests all rights and ownership of petroleum resources (oil and gas) in the UK government, which then grants a Petroleum Exploration and Development licence (PEDL) in competitive offering (licensing rounds) for the exclusive exploration, development, production and abandonment of hydrocarbon in the licence area. Licences are not specific therefore to shale gas, as grant exclusivity in the defined area of the licence for both conventional and unconventional gas extraction. However, during the 13th Round of Onshore Licensing, five companies which were granted consent to drill for hydrocarbons expressed an interest in shale gas.

Oil and gas licensing in Northern Ireland is governed by the Petroleum (Production) Act (Northern Ireland) 1964, the Petroleum Production Regulations (Northern Ireland) 1987, the Petroleum Production (Amendment) Regulations (Northern Ireland) 2010 and the Hydrocarbon Licensing Directive Regulations (Northern Ireland) 2010. The 1964 Act vests all rights and ownership of petroleum resources in Northern Ireland in the Department of Commerce and the Department of Enterprise, Trade and Investment (DETI) is its successor department. DETI operates an open licensing system (i.e. no licensing rounds) whereby applications for petroleum licences may be submitted at any time for any unlicensed acreage. As in the rest of the UK, Northern Ireland petroleum licences grant exclusivity within the licence area for oil and gas exploration and production, and no distinction is made between conventional and unconventional oil and gas. There are four current petroleum licences in Northern Ireland and in one of these the Licensee is focussing on shale gas targets. The Northern Ireland petroleum licences operate in a similar manner to PEDLs in England, Scotland and Wales, in that exploration and production activities are subject to a range of drilling / development consents, planning permissions, health and safety and environmental requirements. DETI assesses the technical competence, environmental awareness, financial viability and capacity of licence applicants before making a decision on granting a licence, and will reassess these when a Licensee makes a firm decision to drill on a ‘drill or drop’ work programme.

5 COMPARATIVE ANALYSIS

The comparative analysis provided below draws on the Country Studies. The section is structured around the main phases of an unconventional gas development project:

- Project planning and design: this phase groups activities taking place before any exploration and exploitation. After an overview of the general permitting regime and procedure, it covers requirements specific to the following aspects:
 - Impacts towards public and local communities affected by the activity
 - Financial guarantees
 - Environmental and health information
 - Strategies to avoid/minimise disruptions to land use, biodiversity, community and water stress
 - Setbacks, zoning restrictions and minimum well spacing
 - Vehicles and mobile working machines during levelling phase
 - Geological characterisation
 - Baseline monitoring prior to drilling/fracturing
 - Risk assessment
- Project operation: this sub-section focuses on exploration and extraction activities. It presents key requirements, differentiating between:
 - Cross-cutting requirements, covering general health and safety rules and third party evaluation
 - Surface requirements, including noise and emergency measures linked to drilling, and, in relation to well operation, construction of linked infrastructure, gas leakage and air pollution.
 - Sub-surface requirements, which group measures to protect groundwater during drilling, rules ensuring well integrity (for both casing and cementing), requirements specify to hydraulic fracturing
- Project cessation and closure phase, including well abandonment, dismantling of the installation, restoration of land.

Finally, the last sub-section analyses enforcement practices across the selected Member States.

5.1 Project planning and design (prior to operation)

It is important to distinguish up-front between licensing and so-called operational (work) authorisation. While there is a lot of similarities in the regime applicable to licensing (defined pursuant to the Directive 1994/22/EC on the conditions for granting and using authorisations for the prospecting, exploration and production of hydrocarbons⁹³ (Hydrocarbons Licensing Directive) as *the exclusive right to prospect or explore for or produce hydrocarbons in a geographical area*), the situation varies from one country to another in terms of approval of operational works, that is approval prior to commencing actual exploration and exploitation activities e.g. drilling, well construction, etc.

For example, in Spain, the Hydrocarbons legislation regulating the approval of exploration permits do not include an express reference to the authorisation for each work referred to in the program. Conducting exploratory drilling requires individual authorisation, so throughout the duration of the exploration licence (five or six years) the drilling of each well will be subject to a specific permitting

⁹³ Directive 94/22/EC of the European Parliament and of the Council of 30 May 1994 on the conditions for granting and using authorisations for the prospecting, exploration and production of hydrocarbons, *OJ L 164, 30.06.1994, p. 3-8*

procedure including an authorisation of works (*autorización de trabajos o de sondeos*). This is based on a general provision referred to “other authorisations” without specifying the requirements for its granting⁹⁴. Under the Hydrocarbons Regulation⁹⁵ when the permit holder wishes to exercise a right to drill a well, the operator shall inform in writing to the competent authorities, sending at least one month prior to starting the works, the implementation report describing the well, location, depth for drilling, equipment to be used, casing foreseen, objectives and budget. These legal provisions do not explicitly refer to the documents and information to be submitted by the operator to the authorities, for example in relation to the assessment of the environmental impacts. Similarly, for exploitation, the Spanish Hydrocarbon Law requires operators to hold an exploitation concession and to submit to the national authority, three months prior to the start of the calendar year, an annual work plan and an implementation report one month prior to the starting of the works. It is not clear whether further authorisations for works assessing its impact need to be requested.

In national legislation, even if the permitting regime/procedure under which will fall operational works for both exploration and exploitation is clear, as a rule, the legislation does not set specific requirements. As a consequence, the national experts could not identify detailed requirements and criteria applicable to operational works. For example, requirements on information to be provided as part of the permitting process are often very general. Therefore, it appears that a lot is left to the permitting authorities’ discretion. This could raise problems as, given that impacts from unconventional gas projects are not fully known in terms of extent, seriousness, paths or long-term impacts, authorisation conditions may not always be fully effective, appropriate and transparent. This lack of harmonisation may also result in important differences in the requirements, timing and cost of permits across Europe.

Comparative key findings throughout the country studies:

- In all selected Member States, the permitting system for exploration and extraction of unconventional gas does not differ from the one for conventional gas activities.
- In all selected Member States, there are no public participation requirements under general mining legislation, other than consultation with local authorities. A public participation and consultation procedure is required only if unconventional gas projects are subject to an EIA or if considered as a mining waste facility, as per the interpretation of the Commission, and pursuant to the public participation requirements set in Article 8 of the Mining Waste Directive.
- Most selected countries require a financial guarantee from the operator prior to the start of the hydrocarbon mining activities but its scope differs between countries.
- Bulgaria amended its EIA legislation to subject unconventional gas activities to compulsory EIA while Denmark requires a compulsory EIA when exploration or exploitation involve hydraulic fracturing.
- The selected Member States did not set up environmental and health and safety requirements or guidance relating to EIA specific to unconventional gas activities.
- In the UK and Lithuania, a SEA is carried out before the invitation for the application for a licence. In the UK, licences are offered for 10km by 10km blocks that are previously unlicensed. During the 13th Round of Onshore Licensing, 93 Petroleum Exploration and Development Licences were awarded in the UK. The areas available for licensing in each licensing round are subject to a SEA. In Lithuania the concession area is of 1800 km².
- There are no direct requirements on strategies to avoid/minimise disruptions to land use, biodiversity, community and water stress, apart from the general strategies in the EIA procedure. However general requirements under national nature protection and planning

⁹⁴ Article 6 Law 34/98 on Hydrocarbon Sector and according to interviews with Energy authorities.

⁹⁵ Article 28 and 35 of Royal Decree 2362/1976

legislation apply.

- No specific requirements on baseline monitoring prior to drilling or fracturing have been identified. The requirements may be set under the EIA procedure or permit conditions on an ad-hoc basis.
- All selected Member States require operators to carry out geological surveys but few of them set specific geological assessment for hydraulic fracturing future operations. In the UK, for example, operators seeking consent under the licences for any hydraulic fracturing operations for shale gas will have to conduct a prior review of information on seismic risks and the existence of faults in the area; submit to DECC a 'fracking' plan showing how any seismic risks are to be addressed; carry out seismic monitoring before, during and after the 'fracking'.

5.1.1 Permitting regime/procedure

None of the selected Member States have set in place a legislation and permitting procedure specific to unconventional gas activities. They all rely on the current mining and/or hydrocarbon legislation. Most of the countries require first the granting of an exploration licence and for the exploitation phase the granting of an exploitation licence. In the UK, however, only one licence (the 'Petroleum Exploration and Development Licence' (PEDL)) covers both the exploration and exploitation phase. Under the terms of the PEDL, the licensee is thereafter required to obtain specific consent for drilling or production. By this stage, all other consents such as planning permission and environmental permits must be in place. As a general rule, the start of operational works (e.g. drillings, extraction phase and closure) must be authorised. In some Member States such as Bulgaria, Denmark, Germany, Lithuania and Spain, the operators must provide operational plans that detail how mining works will be carried out to the national authorities for approval. In Spain, further to the exploration permit or exploitation concession, every well requires a specific authorisation for works. The legal basis for that authorisation and the requirements for the application are not clear generating legal uncertainty as well as a wide margin for interpretation for the authorities to adapt to each case. Unlike the other Member States assessed, the UK and Lithuania have conducted a SEA prior to the opening of the last oil and gas licensing round and prior to the invitations to tender for exploration/exploitation of hydrocarbons.

With regard to the number of permits necessary for unconventional gas authorities, the UK authorities mention that in the UK, at present, any one well pad may require a number of permits (e.g. mining activities, radioactive substances and for groundwater activities, which are the main three), which raises the question of the need for possible streamlining of permitting requirements, notably for the production phase.

Exploration work programme for unconventional gas licence 1/10 according to Total E&P Denmark B.V website

The exploration phase (2010-2016) will be followed by a development phase and a production phase if the results from the exploration phase are satisfactory. The exploration period is divided into three phases from 2010 to 2016 as follows:

Phase 1 (2010-2012):

During the first two years, preliminary geological investigations have been performed on the basis of existing information and data collected by geologists from surface outcrops. Phase 1 also included initial environmental and social investigations and will describe the general environmental conditions in the exploration permit area.

Phase 2 (2012-2014):

The current Phase 2 is devoted to investigating technical feasibility. A few vertical wells will be drilled to gather information on the subsurface, particularly on rock characteristics (natural gas

content and mineralogical composition), and, if relevant, some production tests performed. If necessary, seismic data will be acquired as well. The community and environmental investigations conducted in Phase 1 will continue. For instance, factors such as biodiversity, soil quality, hydrography, hydrogeology, landscape and land use will be assessed. Studies will be performed by external consultants to ensure unbiased survey data. Further investigations may be done to determine the best locations for operations (seismic surveys or exploration wells) so as to cause the least possible environmental impact.

Phase 3 (2014-2016):

If the Phase 2 results prove positive, Phase 3 will be devoted to investigating the financial feasibility of production. This will include drilling and production testing a few horizontal wells to obtain information about production rates and costs. The hydraulic fracturing technique is used for production testing. Further environmental, community and safety investigations will be performed and/or supplemented as the investigation area grows and new operations are initiated.

The requirements under the phases 1 to 3 were agreed between the authorities and the operator during the adoption of the work programme for exploration. It is decided on a case by case basis then and these exploration requirements and procedures may change for another licensee.

- **Competent authorities in charge of issuing the permits/licences**

The competent authorities for issuing the permits also vary from one selected Member State to another, being either an environmental, mining or energy authority, or a mixture thereof. There are also several authorities involved at the local, regional and state level. In the UK and Denmark, only one main authority⁹⁶ is in charge of issuing the relevant licences. In Germany, the (state) mining authority is responsible, also regarding e.g. the issuance of water permits. In Spain, the complexity of the permitting process is increased with the distribution of competences between the Autonomous Communities and the State. The State for example, is responsible for granting hydrocarbon exploration permits affecting the territory of more than one Autonomous Community or exploitation concessions. This diversity simply reflects the differences in the existing national regimes.

5.1.2 Requirements regulating impacts towards public and local communities affected by the activity

- **Public participation and consultation requirements and access to information**

Access to information on hydrocarbon activities is limited. Unconventional gas activities are commonly regulated by national hydrocarbon legislation which imposes an obligation on the operators to provide information to the authorities on the characteristics of the exploration or exploitation activities to be carried out or while being carried out.

Member States legislation on licensing hydrocarbon projects does not go beyond the requirements of the Hydrocarbons Licensing Directive 94/22/EC (which focuses on ensuring non-discriminatory awarding of licenses) and the information disclosed or accessible to the public is limited to the general one linked to the licensing process (i.e. geographical areas which have been opened for prospecting, exploration and production, authorisations granted, entities holding authorisations and the composition thereof and the estimated reserves contained in its territory). In addition, national authorities must disclose information related to environmental matters under the transposing legislation of Directive

⁹⁶ In Denmark the Danish Energy Agency is responsible to issue licences. In England, Wales and Scotland the Department of Energy and Climate Change (DECC) is responsible for issuing PEDL's. In Northern Ireland, petroleum licences are granted by the Energy Division of the Department of Enterprise, Trade and Investment (DETI).

2003/4/EC on public access to environmental information⁹⁷. However, Directive 2003/4/EC requires balancing the commercial confidentiality interest with the public interest for disclosure. The exemption of commercial confidentiality is only waived in cases of information related to emissions.

Public participation requirements in the selected Member States mainly derive from the transposing legislation of the EIA Directive. However it is not entirely clear whether unconventional gas activities (either exploration or extraction) always fall under the scope of the national requirements transposing this Directive (see section 6.2.1.4 below). Furthermore, the public is only allowed to consult and comment on the EIA and not on the final authorisations. In general a shorter public participation procedure is also foreseen for projects under screening. In England, Wales and Scotland, as well as in Lithuania, the landward areas that are available for concessions have been the subject to a prior SEA, which involved public consultation. It is worth noting that in the UK irrespective of whether an EIA is required or not, the planning process will also provide the public with an opportunity to express their views generally on the development.

Public participation requirements are also imposed by the rules governing the permitting procedure under the legislation transposing the Industrial Emissions Directive and the Mining Waste Directive. However, the applicability of these different permitting procedures is still uncertain in all the Member States considered under this study.

In Spain, the granting of concessions both under the Law 34/98 on Hydrocarbon sector and under the Water Act adopted through Royal Decree 1/2001 are subject to the principles of publicity and requests as well as decisions are published in the official journal (BOE).

Article 6 of the Royal Decree 975/2009 on mining waste management, refers to the public participation requirements for investigation or exploitation projects whose permitting procedure requires an impact assessment and should also cover the permit for the restoration plan. In the cases where the adoption of the permit for the investigation or the exploitation of geological-mining resources does not require environmental impact assessment, the project should still be subject to public participation in relation to the waste management plan and the document on the prevention policy for serious accidents. For Category A installations⁹⁸, the public information/participation procedure is mandatory with regards to the development of the installation external emergency plan.

5.1.3 Financial guarantee (coverage, time scope, when is it required in the procedure)

Most selected Member States require a financial guarantee from the operator prior to the start of the hydrocarbon mining activities, although the details of this requirement e.g. the form, the damage covered, calculation methods, the evaluation procedure, the timeframe vary greatly across countries.

In Spain, the amount of the guarantee must cover all the obligations under the permit regarding the investments, fiscal, social security and restoration obligations, as well as environmental or other requirements established in the permit conditions. The guarantee is updated regularly to cover new permits or conditions granted. In the case of non-fulfilment of the investment commitment or any other obligation, the guarantee will be executed. Further, prior to the start of the work for exploration and investigation of exploitation activities, the operator is required to have in place civil liability insurance to cover any damages to people or goods as a consequence of its activities. In Lithuania, a financial guarantee is only required for exploration and not for extraction activities and further does not cover health and environmental damages derived from the mining operations.

⁹⁷ Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC, *OJ L 41, 14.2.2003, p. 26–32*.

⁹⁸ Defined under Annex II of the Mining Waste Royal Decree 975/2009.

In Romania, the operator must make provision (deducted when calculating the annual income tax) for the restoration of the environment and re-instatement of the petroleum site as agricultural land. The Romanian Fiscal Code from 2003 provides that the value of this provision is a maximum 1percent of the difference between the income from the sale of resources and the expenses for their extraction, processing and delivery.

In Poland, the operator who obtained a permit/authorisation for the mining activity must create a fund to be used where necessary to cover the cost of closure of the mining facility. The fund has to contain the equivalent of not less than 3percent of the depreciation in the value of the fixed assets of a small mining plant, calculated in accordance with the provisions on income tax.

In Germany, the competent authority *can* make the authorisation of mining activity subject to a financial security guarantee, covering damages to the environment and people but it is not a compulsory requirement. The geoscience expert interviewed in the framework of this study is of the opinion that such an instrument is missing and suggests to differentiate between the different risk levels in more and less likely risks with regard to fracturing.

In England, Wales and Scotland, applicants must have the necessary financial capacity before a licence is granted. However, the financial capacity of an applicant will be considered in greater detail upon making an application for well consent under the licence. Companies are required to hold insurance to cover exploration activities. In Northern Ireland, applicants must also have the necessary financial capacity before a licence is granted. The authority would review the level of insurance in place where a company is to proceed to the drilling phase, and possibly increase the level of insurance required. The level of insurance would also be reviewed again at the development phase. To date, bonds have not been required in relation to a petroleum license; however the Northern Irish authorities have indicated that it may consider these in relation to shale gas in the future.

In Denmark, operators have to demonstrate that they have bank guarantee or insurance cover in place for all existing and future obligations and liabilities arising in relation to the licensed activities.

5.1.4 Environmental and health information requirements prior to operation (e.g. EIA for exploration and/or extraction)

The status of the EIA for exploration and/or extraction differs amongst the individual Member States selected, as it depends on how is implemented the EIA Directive. Pursuant to the EIA Directive:

- Extraction of petroleum and natural gas for commercial purposes where the amount extracted exceeds 500 tonnes/day in the case of petroleum and 500 000 cubic metres/day in the case of gas is subject to compulsory EIA.
- Deep drilling is included in Annex II and therefore subject to a screening process on the basis of a case-by-case examination or thresholds or criteria set by the Member States, or both procedures to decide if an EIA is necessary.

It is likely that exploitation of unconventional gas does not reach the thresholds of Annex I, or at least not during the whole production period, and therefore there is no guarantee that an EIA would be legally required for unconventional gas development. There is also some uncertainty surrounding the results of Member States screening of Annex II projects to unconventional gas development, both exploration and exploitation. The screening process might consider that there is no need for full EIA of the project.

In Bulgaria, the drilling for exploration and extraction of unconventional hydrocarbons are subject to mandatory EIA since April 2012. In Denmark, since July 2012, a drilling project that involves hydraulic fracturing is subject to a full EIA. Lithuania requires a mandatory EIA for exploitation of

hydrocarbons projects, but not for the exploration phase.

The other selected Member States transposed the EIA Directive without reference to unconventional gas activities. It is therefore uncertain that all exploration and extraction projects will be subject either to an EIA screening procedure or a compulsory EIA or none of the two, depending of the criteria or thresholds set by the Member States. A striking example is Poland where the draft legislation sets a criterion of 5,000 meters for deep drilling projects to be subject to EIA. This de facto excludes shale gas exploration projects. In some countries (Germany, Spain as described in the table below), the current draft legislation foresees the specific inclusion of shale gas projects under a mandatory EIA regime.

The following table provides an overview on the application of the EIA legislation to unconventional gas activities in the selected Member States.

Member State	EIA requirements
Bulgaria	With the amendment of the Environmental Protection Act (EPA) in April 2012, the drilling for exploration and extraction of unconventional hydrocarbons are subject to mandatory EIA and listed as activities under Annex I of the Environmental Protection Act (EPA).
Denmark	Planned drilling that involves hydraulic fracturing at both exploration or exploitation phase is subject to a full EIA pursuant to the amendment to the EIA Order of the 1st July 2012.
Germany	The German Ordinance on the Environmental Impact Assessment of Mining Projects does not go beyond the EIA Directive. Germany did not prescribe a case-by-case examination or thresholds/criteria applying to unconventional gas activities. There are currently several initiatives and legislative proposals at both federal and state levels requesting a change to these regulations to include hydraulic fracturing activities within the scope of the Ordinance in order that they are subject to a mandatory EIA.
Lithuania	EIA procedures must be carried out before exploitation of hydrocarbons i.e. before preparation of the exploitation. Further the Ministry of Environment is preparing amendments to the legislation requiring an EIA procedure for the exploration.
Poland	<p>Under the current legislation, an EIA is compulsory for the following hydrocarbon projects:</p> <ul style="list-style-type: none"> - Exploitation of the deposits of the natural gas of more than 500,000 m³ per day; - Exploitation taking place in the marine areas of Poland. <p>Under the current legislation the following projects are subject to screening by the administrative authorities, in order to conclude whether there is a need for a full EIA, or not:</p> <ul style="list-style-type: none"> - geological works and the use of explosives; - performance of activity by underground method; - performance of activity by drilling holes at more than 1000 meters depth; - operation in the sea territory of Poland. <p>The draft amendment to the EIA Regulation of February 2013 proposes to change the threshold for drilling holes to a depth of 5,000 meters, which would imply that shale gas exploratory projects located at less than 5 kms deep underground would not be subject to a screening nor an EIA. This proposal is currently under discussion at national level.</p>

Member State	EIA requirements
Romania	The Romanian Government Decision no. 445/2009 does not go beyond the EIA Directive and does not set specific thresholds applying to unconventional gas activities.
Spain	The Spanish Royal Legislative Decree 1/2008 of 11 January adopting the Spanish Law on the Impact Assessment for projects does not go further than the EIA Directive. However, since October 2012, the Ministry of Environment took the position that all the wells involving hydraulic fracturing will be subject to a full EIA. On 15 March 2013, the Council of Ministers adopted a new draft bill, which proposes to amend the Law on Environmental Impact Assessment and includes unconventional hydrocarbon activities involving hydraulic fracturing in Annex I listing the activities requiring a mandatory EIA ⁹⁹ .
United Kingdom	<p>The Town & Country Planning (Environmental Impact Assessment) Regulations 2011 do not go beyond the EIA Directive with regard to Annex I projects. It is most likely that shale gas drilling operations for exploration would fall within the Schedule 2 (projects subject to screening), which includes the following relevant categories:</p> <ul style="list-style-type: none"> • Deep drilling where the area of the works exceeds 1 hectare; • Surface industrial installations for the extraction of coal, petroleum, natural gas and ores, as well as bituminous shale, where the area of the development exceeds 0.5 hectare; • Industrial installations for carrying gas where the area of the works exceeds 1 hectare; • Surface storage of natural gas where the area of any new building, deposit or structure exceeds 500 square metres or a new building, deposit or structure is to be sited within 100 metres of any controlled waters. <p>However, it has been recommended that an EIA be made mandatory, and DECC are taking steps to improve the existing requirements in this respect, by requiring licensees to undertake a full assessment of environmental risks over the full life-cycle of the proposed operations.</p>

It is noteworthy that the selected Member States did not set up specific environmental and health and safety requirements within the EIA process for unconventional gas activities (e.g. specific information on geology, measures to limit the impact of hydraulic fracturing on water). For example, Denmark and Bulgaria where EIA is mandatory do not go beyond the environmental and health requirements as set forth in the EIA Directive.

In one country, the UK, additional information on environmental impacts is requested as part of the application for an exclusive right licence. In addition to the analysis of the geology of the area, applicants are required to demonstrate awareness of environmental issues and regulatory requirements in the form of an 'Environmental Awareness Statement' including information on the applicant's understanding of the UK's onshore environmental legislation relevant to the exploration, development and production stages of the project and on particular sensitivities associated with operational planning (e.g. Special Areas of Conservation, Special Protection Areas, Marine Conservation Zone, Marine Protected Areas). Further the statement includes details of the applicant's pollution liability arrangements and its commitment to environmental policy and management and details of any previous failure to comply with environmental standards or requirements within the previous five years (e.g. any civil or criminal action against the operator, or any convictions for breaches of environmental legislation). In Northern Ireland, a similar environmental awareness statement is

⁹⁹ http://www.lamoncloa.gob.es/ConsejodeMinistros/Referencias/_2013/refc20130315.htm

needed.

5.1.5 Requirements on strategies to avoid/minimise disruptions to land use, biodiversity, community and water stress (in particular for cumulative developments)

Under the national mining laws assessed, there are no particular obligations on the operators to provide strategies to avoid/minimise disruptions to land use, biodiversity, community and water stress prior to the start of the mining activities apart from the general strategies included in the EIA process where required. However operators will have to comply with general requirements under the national nature protection, planning and environmental permitting legislation and the EU legislation on nature conservation, and specific conditions set out in the permits. It may however be difficult for the competent authorities to set the adequate operational conditions for these activities if they do not have comprehensive information from the operators on the overall potential environmental impacts and strategies to avoid them.

Land use example from Romania

Under certain conditions, Land Law no. 18/1991 requires that fertile soil on the petroleum sites be removed before the start of the drilling activities and deposited on low productive land. The Rompetrol Approval provided for the removal of 20 cm soil from the surface afferent to the construction site before starting the works, while the land was levelled to obtain a 98 percent compacting level for the mounting of the drill.

Applicability of land use conditions in Spain

In Spain, under the Law on the hydrocarbon sector, restrictions derived from land use planning or infrastructure planning can be imposed to exploration and exploitation activities but only if they do not have a generic character and are motivated. This provision opens the possibility to restrict hydrocarbon activities on the basis of environmental aspects linked to land use and infrastructure planning, including the protection of Natura 2000 sites or the existence of a water stream that could be polluted from the activities.

Land use planning in the UK, Annas Road, Westby, Blackpool

The planning permission granted in relation to operations at land at Annas Road, Westby, Blackpool, in the North of England¹⁰⁰, sets out a number of planning conditions relating to ecology and the safeguarding of watercourses and drainage. For example, planning condition 22 states that no development shall commence until the planning authority has approved measures to mitigate the impacts of the development on ecological interests (overwintering birds), which shall include seasonal restrictions on site development works and measures to avoid impacts on ground nesting birds. The conditions relating to safeguarding watercourses and drainage require measures to be taken to protect ground water resources, prevent the transfer of fluids between different geological formations, and the uncontrolled discharge of groundwater to surface during the drilling and construction of the borehole. The planning conditions also refer to the need to obtain a water abstraction permit or environmental permit from the Environmental Agency where required

Conservation of Habitats and Species Regulations in the UK

A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which (a) is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and (b) is not directly connected with or necessary to the management of that site, must make an appropriate

¹⁰⁰ Planning Permission Application No.05/10/0634, granted to Cuadrilla Resources Ltd for temporary change of use from agriculture to site for drilling an exploratory borehole and testing for hydrocarbons including construction of a drilling platform and highway access point.

assessment of the implications for that site in view of that site's conservation objectives. The competent authority must consult the appropriate nature conservation body and have regard to any representations made within such reasonable time as the authority specify. It must also, if considered appropriate, take the opinion of the general public.

In two countries (the UK and Lithuania), a SEA is carried out before the invitation for the application for a licence. Land use environmental impacts will therefore be assessed before the issue of licences. On one hand, impacts are only assessed at a generic level. On the other hand, cumulative and synergistic effects are covered by the SEA.

With regard to assessments of risk and impacts pursuant to the EIA legislation, there is no common understanding amongst the selected Member States as to the scope of the EIA when it is required, in particular, whether or not it covers the whole unconventional gas development area or wells individually. In the latter case, cumulative impacts may not be covered adequately.

In Lithuania, an SEA is required before announcement of invitations to tenders for exploration/exploitation of hydrocarbons. The SEA assesses possible impacts on the environment and the public from planned exploration/exploitation activities by taking into consideration location, infrastructure and other factors related to the plans for exploration/extraction of hydrocarbons. In the UK, the SEA should include the preparation of an environmental report.

Information requirements under the SEA in the UK:

- An outline of the content and main objectives of the plan or programme, and its relationship with other relevant plans and programmes;
- The relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme;
- The environmental characteristics of areas likely to be significantly affected;
- Any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to the Birds and Habitats Directives;
- The environmental protection objectives, established at international, Community or Member State level, which are relevant to the plan or programme and the way those objectives and any environmental considerations have been taken into account during its preparation;
- The likely significant effects on the environment, including short, medium and long-term effects, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects, on issues such as biodiversity, human health, flora and fauna, air, climatic conditions, measures to prevent, reduce and as fully as possible offset any significant adverse effects on the environment.

5.1.6 Setbacks, zoning restrictions and minimum well spacing requirements

The legislation of several selected Member States such as Romania, Germany and Bulgaria contain requirements on setback and zoning. The actual requirements vary, for example the minimum distance from populated areas under German law is 200 meters, and in the UK the minimum distance is 125 metres from any of the boundaries of the licensed area. In Poland, a well must be located at a minimum distance of 50 metres from open fire items. Further, a minimum distance of 1.5 times the height of the rig has to be kept between the drilling rig and any railway tracks, water streams, water bodies, rivers, public roads and buildings. In Bulgaria zone restrictions are evaluated on a case-by-case basis during the environmental impact assessment and procedures for coordination of development schemes and plans under the Law on Spatial Planning.

In all selected Member States, setback, zoning and minimum well spacing requirements are derived from general mining operations and are not specific to unconventional hydraulic fracturing activities. They might also arise from local planning permission.

In all selected Member States, the water legislation transposing EU directives regulates controls or prohibits activities in specific protection zones.

5.1.7 Rules on vehicles and mobile working machines during levelling phase.

The study did not identify specific rules on vehicles and mobile working machines that apply to the levelling phase of unconventional gas developments.

In six countries, general mining and planning legislation applies e.g. through general rules on vehicles and mobile working machines used in the mining sector. Further, it is most likely that, in the selected Member States, local authorities are responsible for setting rules on traffic generated by the construction phase. For example, in the UK, local authorities are entitled to specify the hours of operation of the site, conditions regarding the construction of access roads and dust control as part of the planning permission.

Rules on vehicles the UK, Annas Road, Westby, Blackpool

For example, under planning permission for Annas Road, condition 8 sets out working hours, planning condition 9 requires that improvements to the roads are approved prior to the commencement of development, and planning condition 10 requires measures to be taken at all times during the site construction, operational and restoration phases of the development to ensure that no mud, dust or other deleterious material is tracked onto the public highway by vehicles leaving the site.

5.1.8 Requirements for geological characterisation including risks of geological faults, manmade structures (e.g. abandoned wells, characteristics of the cap rock)

In the selected Member States, general requirements for geological characterisation designed for the extraction of conventional hydrocarbons apply (see below for some examples). However, these may not be specific enough and adequate to deal with the characteristics of unconventional gas extraction as they rarely focus on potential underground risks due to hydraulic fracturing (e.g. identification of existing faults and fractures; hydrogeology; existing abandoned wells). In particular, none of the legislation reviewed address specifically the identification of existing faults and fractures, which are directly relevant to the risk of chemical migration to groundwater. However, it should be noted that such requirements may be set within the EIA/permitting process by the competent authorities on a case-by-case basis.

In the UK, an analysis of the geology of the area is part of the licensing process. In particular, this should identify the petroleum prospects, as well as the technical data on which the analysis is based. A work programme for evaluating the potential petroleum production from the area to which the application relates should also be provided and an explanation of the way in which the work programme takes account of the analysis of the geology. Further, operators are required to carry out with due diligence the scheme of prospecting including any geological survey by any physical or chemical means and such programme of test drilling, during the initial term of this licence. Also, new controls to mitigate the risks of seismic activity were announced in the Ministerial Statement on the Exploration for Shale Gas, made on 13 December 2012.¹⁰¹ The new controls require the operator to

¹⁰¹ <https://www.gov.uk/government/news/written-ministerial-statement-by-edward-davey-exploration-for-shale-gas> (website)

carry out prior geological analysis to identify relevant faulting, submit a fracking plan and carry out background monitoring of seismicity before operations start, and that on-going monitoring of seismicity is carried out during operations. Under the new controls, DECC will not consent a well until it has seen and is satisfied with the fracking plan submitted by the operator

In Spain, under the Hydrocarbons Sector Law, the operator should submit the technical report and the exploitation plan with information regarding the geological characterisation, including seismicity of the area. There is no express reference to assessing the risks of geological faults even if they might be considered under the geological characterisation analysis. The requirements under the Royal Decree 975/2009 on Mining Waste could be applicable to monitor the situation prior to hydraulic fracturing. The permit for operating the mining waste facilities requires the submission of a geological-geotechnical study of the site, a hydro-geological study and a hydrological study of the site, including seismological and earthquake resistance studies. This legislation could be applicable if the well is considered as a facility for the hydraulic fracturing fluid that remains underground. This study should include the characterisation of coating materials, with the determination of the parameters of strength and drainage, characterisation of the rock mass substrate, defining its lithology, degree of weathering, permeability and bearing capacity, the erosion of soils and the elements needed for planning the final rehabilitation of the land. The geotechnical stability study should include an analysis of seismic effects in order to assess their potential effects on the stability of the tailings facility. The seismic geological calculations are based on Seismic Resistant Construction Standard. To note that applicants for authorisation of works within exploration permits for shale gas have been requested to provide a detailed geological study identifying potential faults; geotechnical study of the structure and resistance of the rocks to be crossed; study of the hydrodynamic of the aquifers affected directly or indirectly by the projects. They were also requested to do injection tests with micro-seismic monitoring prior to fracturing

In Poland, a specific working plan for geological work is needed within the permit application procedure. The plan consists of a text and a graphical part. Requirements are laid down in a regulation of the Minister of the Environment.¹⁰²

Geological work plans in Poland

The text part consists of:

- 1) information on the intended location of geological works, including the location in the three-level division of the country, and a description of the land on which the applicant intends to carry out the works, including buildings and protected areas;
- 2) a description of the results of earlier geological works and geophysical, geological and geochemical studies conducted on the desired area and the list of geological archived materials used and their interpretation and presentation on the geological map, on an appropriate scale, area or place of work and performance testing;
- 3) a description of the geological and hydrogeological conditions in the area of the intended works together with the expected geological profiles of proposed excavation;
- 4) a presentation of the main features of geological work, including in particular:
 - a) a description and justification of the number, location and type of proposed excavations,
 - b) the expected construction of wells or excavation,
 - c) information on the closing of water-bearing horizons,
 - d) the method and date of eradication of wells or excavation and land reclamation;

last accessed 25 February 2013)

¹⁰² Regulation of the Minister of the Environment of 20 December 2011 on the detailed requirements for plan of geological works, including the works, for which the permit is required - Rozporządzenie Ministra Środowiska z dnia 20 grudnia 2011 r. w sprawie szczegółowych wymagań dotyczących projektów robót geologicznych, w tym robót, których wykonywanie wymaga uzyskania koncesji (Dz.U.2011.288.1696).

- e) a description of and justification for the scope and methods of desired geophysical and geochemical works and their locations,
 - f) a description of the sampling of excavations,
 - g) the range of observations and field studies, in particular:
 - Observation levels and measurements of water flows,
 - Pumping test,
 - Measurement of temperature and pressure in the event of the occurrence of natural gas, oil or water
 - Specific tests and measurements,
 - h) identification of the necessary geodetic works,
 - i) the scope of the laboratory tests,
 - j) the estimated size of the inflow of water into the excavation or into the different levels of extraction,
 - k) the expected quality of the water pumped out of the excavation,
 - l) the flow of drainage and method of pumping water out of the excavation;
- 5) determination of:
- a) geological samples to be transferred to the geological authority, indicating the manner and date of the transfer,
 - b) the intended schedule of geological works, including the timing of their start and end
 - c) the impact of intended geological works for protected areas, including Natura 2000 sites
 - d) the nature of the geological documentation to be established as a result of geological works

The graphic part consists of:

- 1) topographical map on a scale of at least 1:100,000, indicating the desired area or areas of geological exploration and the position of these in relation to the limits of the village in which there is a seat of the municipality or geodetic points, and depending on the purpose of these works - maps: geological, hydrogeological, geological -engineering, geophysical and geological cross-sections, where such documents have been drawn up;
- 2) the location of the area or areas of intended geological works on:
 - a) the situation and altitude map drawn in an appropriately selected scale of not less than 1:50,000,
 - b) geological map showing the components of the economic environment to be protected, done in an appropriately selected scale of not less than 1:50,000,
 - c) geological cross-sections.

5.1.9 Requirements on baseline monitoring prior to drilling or fracturing (water quality, air quality, seismicity)

No specific requirements on baseline monitoring prior to drilling or fracturing have been identified. The requirements are set under the EIA procedure or permit conditions on an ad-hoc basis. In this sense, they would differ amongst countries although it is not possible to identify clearly these differences in the absence of detailed information on requirements set in the limited number of existing EIA or permits. In several of the selected Member States, data on establishment of more specific conditions on an ad hoc basis directly in permits (e.g. Denmark, UK) or in administrative decisions on EIA (e.g. Spain) have been described. For example, in Spain, the decisions adopted by the Ministry of Environment subjecting unconventional gas exploration projects to EIA request monitoring programme to detect impacts on aquifers, surface water as part of the EIA. In Denmark, under one of the permit granted for exploration, water quality baseline monitoring includes a permit for the drilling of two water wells for the purpose of gathering data to analyse and control the ground water quality before, during and after the drilling has taken place.

In the UK, the DECC announced that operators seeking consent under the licences for any hydraulic fracturing operations for shale gas will have to conduct a prior review of information on seismic risks and the existence of faults in the area; submit to DECC a ‘frac’ plan showing how any seismic risks are to be addressed; and carry out seismic monitoring before, during and after the ‘frac’.¹⁰³ It is also noteworthy that in Scotland from 1 April 2013, boreholes of over 200m depth require a complex licence under the Water Environment (Controlled Activities) (Scotland) Regulations 2011. Such a licence may include conditions for baseline monitoring of water quality prior to drilling, and monitoring after drilling.

In response to the recent report on shale gas extraction in the UK¹⁰⁴, the Government stated that the British Geological Survey (BGS) is working with the Environment Agency (EA) to establish a national baseline survey of methane and other contaminants (the scope of which is to be determined by DECC in consultation with the EA and the Scottish Environment Protection Agency (SEPA) in groundwater.¹⁰⁵ Monitoring of methane and other contaminants in groundwater is already considered to be “good oilfield practice” and therefore operators will be required to carry out appropriate site specific monitoring, as well as to publish the results on their website. Where the EA or SEPA identifies a risk to groundwater, groundwater monitoring will be required before, during and after shale gas operations.

Finally, in German mining legislation, the competent authority *can* ask the operator to conduct surface measurements in areas where damage to the surface by mining operations *are expected to happen* or in the case the measurements are important for the prevention of damage to life, health or substantial material goods. Thus, the provision leaves a lot of discretion to the competent authority to decide whether or not these measurements are to be carried out and does not establish coherent baseline monitoring prior to fracturing or drilling. However, the academic expert and the expert from the NGO call for an amendment of the mining legislation to include for example an accompanying monitoring and control of the activity, however the extent and the specific requirements should not be regulated by the mining legislation but through administrative orders as this would be too technical and detailed to be set in general legislation.

It is noteworthy that no specific requirement on air and soil baseline monitoring has been identified. It may be part of the EIA/planning permission or permits, although there is no guarantee it will be.

Water quality baseline monitoring in Denmark:

Under the actual licence for shale gas exploration, a permit for the drilling of two water wells have been issued for the purpose of gathering data to analyse and control the ground water quality before, during and after the drilling has taken place.

Seismic measurements requirements in Denmark:

- Digital seismic field data in SEG Y or another standard format shall be sent to GEUS on

¹⁰³ Information retrieved from DECC website (December 2012):

http://www.decc.gov.uk/en/content/cms/meeting_energy/oil_gas/shale_gas/shale_gas.aspx

¹⁰⁴ Shale gas extraction in the UK: a Review of Hydraulic Fracturing, June 2012, the Royal Society and the Royal Academy of Engineering (available at http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/projects/shale-gas/2012-06-28-Shale-gas.pdf)

¹⁰⁵ Government response to Royal Academy of Engineering and Royal Society report on “Shale gas Extraction in the UK: a review of hydraulic fracturing”, Final A04 – 10th Dec 2012, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/49541/7269-government-response-sg-report-.pdf (last accessed 21 March 2013)

IBM3590 tapes or another medium agreed with the Geological Survey of Denmark and Greenland (GEUS).¹⁰⁶ Unless GEUS requests the field data to be submitted at another time the data shall be submitted at the time of expiry of the confidentiality period for the data in question, cf. the provisions in the permit according to which the data has been acquired, however data acquired according to an exclusive licence shall be submitted not later than at the time of expiry of the licence.

- Processed digital navigation data in UKOOA format with exact format specifications and indication of the central meridian shall be submitted to GEUS on IBM3590 or Exabyte tapes or another medium agreed with GEUS.
- A hard copy shotpoint map showing the location of the acquired data shall be submitted to GEUS.
- Acquisition report containing the necessary information for reprocessing purposes. Observers log as digital data in tif format on CDrom or another media agreed with GEUS.
- Processed and stacked seismic data with raw stack, stack and final migration shall if produced be submitted to GEUS in SEG Y format on IBM3590 or Exabyte tapes or another medium agreed with GEUS. If data is scaled to a Landmark workstation such data shall be submitted on Exabyte tapes to the Danish Energy Authority and on IBM3590 or Exabyte tapes to GEUS. Data scaled to other seismic workstations shall be submitted to GEUS. If the licensee produces hard-copy versions of stacked and migrated seismic lines, corresponding versions shall be submitted to GEUS. If the licensee produces hard-copy versions of migrated seismic lines, a folded copy shall likewise be submitted to DEA.
- Stacking and migration velocities in Esso V2 format shall be submitted to GEUS on IBM3480, IBM3590 or Exabyte tapes or another medium agreed with GEUS.
- Processing reports shall be submitted to GEUS.
- If other special processing or reprocessing is carried out, such data shall be submitted in accordance with the provisions contained in paragraph I, 1, e-g, above.
- Interpretation reports.

5.1.10 Assessment requirements covering individual and/or cumulative impacts and risks

There are no assessment requirements covering individual and/or cumulative impacts and risks applicable in the selected Member States other than as part of the EIA and/or feasibility study or the technical construction documentation (as for example in Romania) or within the planning permission (as in the UK). It should be noted in relation to the assessment of cumulative impacts that, as explained in section 5.1.5, these are partly covered in a generic way in case of SEA. However, an SEA is requested only in two countries, Lithuania and the UK.

As a result, the definition of assessment requirements covering individual and/or cumulative impacts and risks is mainly left at the discretion of the individual permitting authorities.

With regard to assessment of risk, in the UK DECC is planning to require licensees to undertake an assessment of environmental risks over the full life-cycle of the proposed operations, including the disposal of waste and well abandonment. As part of this, the licensee will be required to consult with stakeholders, including local communities, as early as practicable. In the UK, risk assessment is also central to the procedures followed by Health and Safety Executive (HSE). Information on safety risk assessments is required to be included in the health and safety information for the site and details of well operations is to be notified to HSE, who will be assessing the well design prior to construction.

¹⁰⁶ Geological Survey of Denmark and Greenland

5.2 Project operation: exploration and extraction phase

Comparative key findings throughout the country studies:

- Most occupational health and safety legal acts in the selected Member States derive from the transposition of EU health and safety directives applicable in the mining and/or hydrocarbon sector.
- General third party evaluation and verification does to a large extent exist for drilling operations in the consulted countries; however they relate to technical requirements rather than to health and environmental performance.
- There appears to be no legislation in the selected Member States that explicitly addresses venting and flaring in the context of hydrocarbon projects. Venting and flaring of methane and other emissions are expected to be addressed through permitting conditions. In all selected Member States, there are no requirements on gas leakage and air pollution specific to unconventional gas developments. Only prevention and remediation of gas leakages is foreseen under conventional gas legislation and/or in practice. In the absence of specific requirements on flaring and venting, the competent authorities retain a large discretion on deciding whether or not flaring and venting can be allowed.
- There are no legal requirements relating to casing and cementing specific for unconventional gas wells. Two of the selected Member States have set detailed rules on the design, construction and integrity of gas wells that apply to conventional gas activities.
- Six of the selected Member States require well integrity tests for conventional wells. However, the hydraulic fracturing process places additional stresses on the well casing and specific requirements may be needed for unconventional wells.
- The Member States' legislation assessed do not contain monitoring obligations applicable to hydraulic fracturing, with the exception of the UK that requires operators to implement a 'traffic light' system which will be used to identify unusual seismic activity requiring reassessment, or halting, of operation due to hydraulic fracturing.
- None of the selected Member States set specific requirements relating to the fracturing activity for unconventional gas except the UK which requires a fracking plan.
- None of the countries assessed provide specific requirements for the management of waste derived from hydraulic fracturing. They mainly rely on the national legislation transposing the EU waste legislation. However the selected Member States do not have a common view on the applicability of the Mining Waste Directive to this type of waste.
- There are no specific requirements relating to the authorisation, monitoring, reporting and verification of water abstraction and use during hydraulic fracturing apart from the general water legislation transposing EU water-related directives.
- In the selected Member States, there are no obligations on operators prior to carry out fracturing to disclose information on the chemicals they will use (e.g. type and quantity). In some of the selected Member States, national authorities are entitled under water/permitting legislation to demand the disclosure of the composition of the fracturing fluids.
- In some of the selected Member States, there are measures relating to monitoring of the hydraulic pressure during fracturing activities.

5.2.1 Cross-cutting requirements

- **Health and Safety measures and reporting of occupational incidents/accidents**

In most of the selected Member States, health and safety requirements and reporting of occupational incidents/accidents within mining activities are laid down in various mining laws, safety industrial

rules and ordinances. No specific measures are included regarding unconventional gas activities. Most occupational health and safety legal acts in the selected Member States derive from the transposition of EU health and safety directives applicable in the mining and/or hydrocarbon sector such as Directive 92/91/EEC concerning the minimum requirements for improving the safety and health protection of workers in the mineral- extracting industries through drilling¹⁰⁷. They set in place strict health and safety standards on the use of substances, equipment and conditions at the working place and accident reporting.

The use of chemicals for hydraulic fracturing might require the handling and storage of hazardous substances in the site of the installation. The risks from the chemical substances handling by workers are regulated by the national legislation transposing Directive 98/24/EC¹⁰⁸ on risks related to chemical agents at work and Directive 2004/37/EC¹⁰⁹ specifically regulating carcinogens or mutagens at work, both aiming at ensuring the protection of the health and safety of workers.

Furthermore, the risks to human health (and environment) in case of major accidents would be regulated by the legislation transposing Directive 2012/18/EU¹¹⁰ on the control of major-accident hazards (Seveso III). However, if Seveso III scope is transposed as such, it would apply only to the chemical and thermal processing operations and storage of dangerous substances (e.g. natural gas) as the Directive exempts from its scope the exploitation, namely the exploration, extraction and processing, of minerals in mines and quarries, including by means of boreholes, but covers chemical and thermal processing operations and storage related to those operations which involve dangerous substances listed in the Directive (e.g. natural gas), as well as operational tailings disposal facilities, including tailing ponds or dams, containing these substances.¹¹¹

In addition, this legislation might not be applicable for the exploration phase given the low percentage of chemicals used in the fracking fluids and that natural gas is unlikely to be stored and processed at this stage. In relation to exploitation, the applicability would depend on the characteristics of the substances used for hydraulic fracturing, the volume of dangerous substances and natural gas stored and processed onsite.¹¹²

In all selected Member States, health and safety requirements applicable to conventional gas projects are deemed to be sufficient to cover adequately occupational incidents and accidents in unconventional gas projects.

Plan for Health & Safety (approval of workplace design) in Denmark

Before drilling work can commence, a Workplace Evaluation (*Arbejdspladsvurdering*) and a nomination from a certified safety coordinator must be forwarded to the Danish Working Environment

¹⁰⁷ Council Directive 92/91/EEC of 3 November 1992 concerning the minimum requirements for improving the safety and health protection of workers in the mineral- extracting industries through drilling (eleventh individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC), *OJ L 348, 28.11.1992, p. 9–24*.

¹⁰⁸ Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work, *OJ L 131/11 [5. 5. 98]*.

¹⁰⁹ Directive 2004/37/EC of 29 April 2004 on the protection of workers from the risks related to exposure to carcinogens or mutagens at work (Sixth individual Directive within the meaning of Article 16(1) of Council Directive 89/391/EEC), *OJ L 158/50 [30.4.2004]*.

¹¹⁰ Directive 2012/18/EU of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC, *OJ L 197/1 [24.7.2012]*.

¹¹¹ See Article 2(2)(e) and Article 2(2) last paragraph of Directive 2012/18/EU

¹¹² It is common practice that even if some of the gas processing can be accomplished at or near the wellhead (field processing), the complete processing of natural gas usually takes place at a processing plant, located in a natural gas producing region. The extracted natural gas is transported to these processing plants through a network of gathering pipelines, which are small-diameter, low pressure pipes. Information retrieved from the website [naturalGas.org](http://www.naturalgas.org) available May 2013 at: http://www.naturalgas.org/naturalgas/processing_ng.asp

¹¹³ Information retrieved from Total E&P Denmark B.V. website: <http://www.skifergas.dk/en/technical-guide/regulations->

Authority. Subsequently, the Danish Working Environment Authority has the right to make inspections without prior notice to the employer¹¹³

Applicability of general industrial legislation

Spanish Law 21/92 on Industry establishes industrial safety rules that are applicable the exploration and exploitation of mineral or geological resources. It covers not only general aspects related to health and safety, but also certain environmental matters. In case where inspections would identify deficiencies, which cause a risk of serious and imminent damage to people or the environment, the competent authority can request the temporary suspension (total or partial) of the activity until these deficiencies are corrected.

- **Third party evaluation and verification of health and environmental performance**

The analysis shows that in five selected Member States, third party evaluation and verification does to a large extent exist for drilling operations; however they are not always related to health and environmental performance but more to technical requirements, as for example in Germany.

The Romanian legislation goes further, requiring that a technical expert must be present on-site to assess compliance with the essential quality requirements of the executed works linked to the approved projects. He must specifically monitor the compliance with health and safety and environmental obligations that are included in the approved projects.

In the UK, the well operator has to set up a well examination scheme and appoint an independent well examiner. The well examination scheme and involvement of the well examiner is for the complete lifecycle of the well from design through to abandonment. The legislation requires that well examination takes place at the design stage of the well to comply with the regulations. The examiner can ask for results of well integrity tests if carried out by the operator, such as pressure tests and cement bond logs when they are available, but they are not always required to demonstrate well integrity, and report any health and safety concerns. The well examiner does not have the power to give consent to, or prohibit, activities. The examiner can inform the health and safety regulator if he is unsatisfied that the operator has addressed his concerns and the regulator will monitor that the issues raised by the independent well examiners were addressed by the operator. The UK authorities acknowledge that at present the well examination scheme is purely safety specific but consider that this may in practice also serve to prevent the release of harmful material into the environment. The requirement for the operator to submit weekly reports, so called well notification schemes is considered essential by UK authorities in order to verify the safety of the well since on-site inspections are limited.

Following the Memorandum of Understanding entered into between HSE and the EA¹¹⁴, joint inspections are to be carried out by HSE and the EA (in England and Wales). . At present, HSE and the EA have developed a joint approach to inspecting new exploratory shale gas operations, and HSE will also work together with the EA to regulate onshore unconventional oil and gas developments under the Environmental Permitting (England and Wales) Regulations 2010.¹¹⁵

5.2.2 Surface requirements during the exploration and production phase

and-approvals.aspx

¹¹⁴<http://www.hse.gov.uk/aboutus/howwework/framework/aa/hse-ea-oil-gas-nov12.pdf> (last accessed 25 February 2013)

¹¹⁵<http://www.hse.gov.uk/aboutus/howwework/framework/aa/hse-ea-nov12.pdf> (last accessed 25 February 2013)

5.2.2.1 Drilling requirements

- **Noise from engines used for the drilling**

In the examined Member States, noise from engines used for the drilling phase are either regulated under general legislation applying to noise and the transposing legislation from the Directive 2000/14/EC on the noise emission in the environment by equipment for use outdoors (Outdoor Machinery Noise Directive)¹¹⁶, as well as part of the permitting process setting requirements for the individual machine engines.

Noise regulation in Romania

In Romania, for any new economic activity a limit value of 50 dB (A) and a 45 noise curve, measured at 3 m from the outer walls of housings and 1.5 m height from the ground must be respected. At night (from 22.00 to 6.00 hours), the noise level must be reduced by 10 dB (A). The noise limits for nearby apartments, schools or libraries measured inside (with the windows closed) must not exceed 35 Db by day and 25 Db by night. These values must be specified within the environmental permit for the construction phase and exploration / exploitation phase.

Noise regulation in the United Kingdom, Annas Road, Westby, Blackpool

For example, the Annas Road planning permission includes the following planning conditions:

14. Noise emitted from the site shall not exceed 55 dB Laeq (1 hour) (free field) as defined in this permission when measured at either of the following properties at a point closest to the noise source [...]

15. Notwithstanding condition 13, outside the hours of 07.30 to 18.30 hours Monday to Friday, 07.30 to 13.00 on Saturdays and at any time on Sundays and Public Holidays, noise emitted from the site shall not exceed 42 dB Laeq (1 hour) (free field) [...]

16. All plant, equipment and machinery used in connection with the operation and maintenance of the site shall be equipped with effective silencing equipment or sound proofing equipment to the standard of design set out in the manufacturers specification and shall be maintained in accordance with that specification at all times throughout the development and restoration.

Noise requirements in Denmark

When deciding whether a drilling rig can be placed on a desired location a noise prediction must be performed and evaluated prior to approval. This will be done by the local community administration when evaluating a permit to perform activities.

- **Emergency measures (including safety plans) and reporting of incidents/accidents**

There is no differentiation between above and below ground emergency measures and requirements in the selected Member States. Safety or emergency plans and measures have to be prepared under the general mining legislation or the transposing provisions of the Directive 2006/21/EC on the management of waste from extractive industries¹¹⁷ (Mining Waste Directive) if applicable (see Section 5.2.3.3 on hydraulic fracturing - waste management) or the Seveso Directive depending on type and quantities of substances used. Member States did not adopt any emergency requirements covering specifically unconventional gas risks.

With regard to reporting, the UK has a specific set of Wells Dangerous Occurrences that the Well

¹¹⁶ Directive 2000/14/EC of the European Parliament and of the Council of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors, *OJ L 162, 3.7.2000, p. 1–78*.

¹¹⁷ Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC, *OJ L 102, 11.4.2006, p. 15–34*.

Operator has to report to authorities. These include a blowout i.e. an uncontrolled flow of well fluids, the unplanned use of blow out prevention equipment; the unexpected detection of hydrogen sulphide, the failure to maintain minimum separation distance between wells and mechanical failure of any safety critical element of a well.

In Spain when drilling, the operator is required to take into account all safety standards and measures necessary to prevent discharges or spills of brine, oil or other environmental pollutants. The operators are obliged to notify any normal or exceptional incidences, including the leakage of hydrocarbons to the competent authority (Article 28 Regulation on Hydrocarbons, Royal Decree 2362/1976). According to article 35 of the same law, operators have to make sure that the drilling equipment and installations are up to date and follow internationally accepted oil standards.

Examples of health and safety information to be provided in drilling programmes in Denmark:

Blow-out preventers:

- A list of the blow-out prevention equipment available onboard the drilling platform, specifying manufacturer, size, working pressure, and arrangement. Information regarding the control system operating the blow-out preventer stack. A list of the blow-out prevention equipment available on the drill floor ready for mounting on the drill pipe.
- Procedure for kick control, stating i.a., the data and calculations which by routine are updated to ensure the necessary background for handling emergency situations. Information on how blow-out preventers, measuring equipment, drilling fluid circulation and mixing equipment are expected to be used under such conditions.

Abnormal pressures:

- An evaluation of the possibilities of encountering over pressured zones with the well in question. This should be based on seismic data and/or experience from neighbouring wells.
- A description of methods and procedures to be used for detecting any overpressure in the well.

5.2.2.2 Well requirements

- **Requirements for the construction of linked infrastructures (e.g. pipelines)**

The selected Member States set requirements for the construction of linked infrastructure derived from other regulations. Germany for example has specific requirements for the construction of linked infrastructure for deep drilling activities. The German regulations include provisions on the material to be used, pressure control and shut-off mechanisms. In the UK, requirements arise from the methods and practice customarily used in good oilfield practice. Romanian regulations on linked infrastructure are covered through the general health and safety, environmental protection and permitting requirements and fall under the general electricity and gas law. Similarly, Bulgaria does not have any specific requirements, other than general rules.

- **Gas leakage and air pollution including from methane (e.g. venting, flaring)**

There appears to be no legislation in the selected Member States that explicitly addresses venting and flaring in the context of hydrocarbon projects.¹¹⁸ Venting and flaring of methane and other emissions

¹¹⁸ To note that in Spain the hydrocarbon legislation requires that associated gas to the hydrocarbon extraction should be used. If it cannot be used, economically exploited or returned to the ground it will be destroyed always on the basis of a permit where the security measures will be set up. The hydrocarbon legislation requires that any destruction of the gas should

are expected to be addressed through EIA/planning permission or permitting conditions. In all selected Member States, there are no requirements on gas leakage and air pollution specific to unconventional gas developments. Only prevention and remediation of gas leakages is foreseen under conventional gas legislation and/or in practice. In the absence of specific requirements on flaring and venting, the competent authorities retain a large discretion on deciding whether or not flaring and venting can be allowed.

In some selected Member States, a differentiation is made between flaring and venting. As part of the consenting process in the UK, an applicant must demonstrate that flaring or venting will be kept to the minimum that is technically and economically justified. Consent to venting would not normally be given unless flaring is not technically possible. In Denmark, a prohibition of venting is not set in legislation but would be applied in practice. Flaring is only accepted to a limited extent (e.g. for safety reasons). In Romania, one operator mentioned that, in practice, flaring can be authorised only for limited time while venting would be allowed only in case of emergency.

The box below describes in more details the relevant regulatory framework and practice.

Venting and Flaring in the selected Member States

Bulgaria

Resulting from the analysis of the legal framework, there are no special regulations on gas leakage and air pollution connected with the well requirements. The operator is obliged to undertake measures to prevent gas leakage and air pollution under the requirements of the general environmental legislation (Environmental Protection Act, Clean Air Act) as well as under the measures provided in the EIA decision.

Denmark

Venting is not allowed in Denmark and flaring only accepted to a limited extent (e.g. for safety reasons- the conditions on flaring are included in the drilling permit and as a part of the development plan and thus both during the exploration phase and production).

Germany

Provisions directly applicable to venting and flaring can be found in the voluntary technical regulations and standards of the German Industry Association Oil and Gas Extraction (Wirtschaftsverband Erdöl- und Erdgasgewinnung)¹¹⁹, as well as in the voluntary Technical Instructions on Air Quality Control ('Technische Anleitung Luft, Technische Anleitung zur Reinhaltung der Luft'). The provisions are specific and detailed enough to also deal with the venting and flaring of gases evolving from fracturing activities according to an academic expert on geosciences. However, it should be noted that these technical regulations are all voluntary and not binding.

Lithuania

The Rules on preparation of projects for exploitation of hydrocarbon resources¹²⁰ requires that the project document includes measures against hydrocarbon spills in the environment and open blow-out. The Rules do not prescribe any specific measures, as they depend on the techniques and technologies used. However, under Article 14(1) of the Underground Law, relevant authorities may

follow the rules under legislation on air quality. However the law does not include any definition of the term "destruction of the gas" which would enable defining the scope of activities allowed for the destruction (e.g. venting or flaring)

¹¹⁹ For an overview of the technical regulations and standards see WEG, "TechnischeRegeln- Ueberblick", available at: <http://www.erdoel-erdgas.de/article/articleview/130/1/93/>.

¹²⁰ Angliavandenilių išteklių naudojimo projekto rengimo taisyklės, http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=269183&p_query=&p_tr2=2

require submission of additional information on the technology as well as strengthen the environmental protection and safety measures.

The new draft law requires drilling projects to include technical description of the proposed activities including measures against leakage of gas and measures ensuring environmental protection and safety at work.

Poland

According to the representative of the State Mining Authority, in the extraction phase, all gas leakages are remediated. If it is impossible, the entire well is to be closed. Moreover, the general requirements of the Environmental Protection Act regarding air protection apply. Furthermore, where required, the EIA decision sets the environmental requirements to be applied during the operational phase of the projects. It may include conditions on air pollution. However, in the absence of specific requirements on flaring and venting, the competent authorities retain a large discretion on deciding whether or not flaring and venting can be allowed.

Romania

According to the Petroleum Law Norms, an investor cannot start exploitation until all the legal requirements regarding the flaring of associated gases that are not subject to exploitation are duly in place. Similar provisions are regulated through environmental and other applicable permits for exploration activities. The exploration activities can only start after the investor proves that all the drilling fluids (*lichide de sonda*) are captured and all the necessary measures for preventing gas venting and flaring are in place

Through pilot exploitation (i.e. between exploration and full exploitation), the beneficiary of a Petroleum Agreement is required to collect gas samples for flaring and has the obligation to present a report to NMRA regarding the obtained results.¹²¹

No gas leakages are allowed for the petroleum installations, including gas extraction sites. The beneficiary must ensure that all equipment is checked according to the standards elaborated by the State Inspection authority and any leakage must be notified to NMRA.

According to an interviewed operator, while flaring could be required for temporary management of gases during preliminary tests, in practice, the NMRA does not allow flaring of gas for unlimited duration in order to avoid emissions and the waste of resources. The company explains that during the environmental authorisation process, the potential gas emissions are assessed and venting the natural gas would only be allowed for emergency situations, while the gas should be normally used or burned to reduce its greenhouse impact. Companies in the sector may also apply internal safety rules to reduce the incidence and consequences of such issues.

Spain

The decisions by the Ministry of environment requiring an EIA prior to granting authorisation of works within exploration permits do not refer to specific legislation regarding requirements for air pollution or avoidance of gas leakage. However, they request an evaluation of the potential emissions to the atmosphere from motors, flaring, venting, fugitive or diffuse emissions as well as the evaluation of emissions from methane or other greenhouse gases.

Annex IV of the Law 34/2007 of air quality and protection of the atmosphere recognises that fossil fuel extraction and hydrocarbon production as well as the torches of oil and gas extraction plants can be considered as air polluting activities. Those activities are subject to permits establishing the emission limit values, provisions to reduce long distance pollution, systems for emissions control, measurement methodology, frequency and procedures for evaluating measurements; the measures

¹²¹ Technical instructions issued by NMRA in 2006 regarding experimental exploration.

¹²² The equivalent provisions for Northern Ireland are set out in paragraph 16 of Schedule 2 of the Petroleum Production Regulations (Northern Ireland) 1987, as amended.

relating to the operating conditions in situations other than normal which may affect the environment, such as commissioning, leaks, malfunctions, temporary stoppages or decommissioning and the period for which the authorisation is granted.

In the event of leakage Article 35 of RD 2362/1976 on hydrocarbons requires the holder of permit or concession to report the leakage to the competent authorities in the Ministry of Industry, Energy and Tourism informing of the causes, the measures taken to control it and an estimate of the gas lost, destroyed or allowed to escape. Similarly any major leaks that may occur in the well head, discharge pipes or tanks shall be reported detailing the location, causes of the incident, measures taken to remedy and amount of gas lost, destroyed or allowed to escape. Under this provision, any associated gas to the hydrocarbon extraction should be used. If it cannot be used, economically exploited or returned to the ground it should be flared or vented on the basis of a permit by the DG of Energy where the security measures will be set up. The hydrocarbon legislation requires that any destruction (both flaring and venting) of the gas should follow the rules under legislation on air quality.

Under the current terms of the national law a requirement for an IPPC permit for the methane emissions from an unconventional gas installation in Spain is not clear and has not been clarified during the interviews with the authorities.

If considered applicable, the Royal Decree 975/2009 on Mining Waste requires the operator to apply the necessary measures in the design and construction of the tailings facility to prevent or reduce dust and gas emissions. However the applicability of this legislation to unconventional gas extraction involving hydraulic fracturing has not been confirmed.

United Kingdom

Schedule 6, paragraph 18 of the 2004 Regulations¹²² makes provision for the avoidance of harmful methods of working. The model clause states that the Licensee shall not flare any gas from the licensed area or use gas for the purpose of creating or increasing the pressure by means of which petroleum is obtained from that area, except with the consent in writing of DECC and in accordance with the conditions, if any, of the consent. Before deciding to withhold consent or to grant it subject to conditions, DECC shall give the Licensee an opportunity of making representations in writing about the technical and financial factors which the Licensee considers are relevant in connection with the case and shall consider any such representations made by the Licensee.

Consent shall not be required for any flaring which, in consequence of an event which the Licensee did not foresee in time to deal with it otherwise than by flaring, is necessary in order to remove or reduce the risk or injury to persons in the vicinity of the well in question or to maintain a flow of petroleum from that or any other well. In the latter scenario, the Licensee shall inform DECC and shall, in the case of flaring to maintain a flow of petroleum, stop the flaring upon being directed by the DECC to stop it.

As part of these consenting processes, DECC expects the applicant to demonstrate that flaring or venting will be kept to the minimum that is technically and economically justified. Specific limits to any flaring or venting will be applied. At the exploration stage, it is expected that companies exploring for shale gas will seek permission for an “extended well test”, which allows production for a sufficient length of time, often 90 days, to establish flow rates. As production facilities would not generally be in place, the gas has to be flared or vented. DECC will not normally consent to venting unless flaring is not technically possible. The flaring of methane will also be required to be reduced to the economic minimum so that where cost-effective routes for economic use of the gas are available, these must be used. However, concern has been expressed by one NGO interviewed, regarding the meaning of the term ‘economic minimum’ which is rather vague, and may vary depending on fluctuating gas prices.

While no field development plans for shale gas have yet been submitted in the UK, DECC would expect all such plans to demonstrate compliance with good production practices that currently apply for conventional hydrocarbon exploitation. The Borehole Sites and Operations Regulations 1995 and the Borehole Sites and Operations Regulations (Northern Ireland) 1995 (BSOR Regulations) prohibit commencement of a borehole operation unless the operator ensures that a health and safety document has been prepared, which must include a plan for the prevention of fire and explosions and any uncontrolled escape of flammable gases and for detecting the presence of flammable atmospheres and a fire protection plan. Regulation 9(1) also requires the Borehole Operator to ensure suitable well control equipment such as blow out preventers are provided and deployed on the well when the conditions require it. Under the provisions of the PEDL for the exploration phase any gases produced cannot be commercially exploited. As these gases and any in the flowback fluid will be discarded they have been determined to be extractive waste and their management the subject of a mining waste management plan and permit from the EA. Upon application for such a permit, the operator will be required to provide a waste management plan, alongside the permit application, which will include conditions covering general management, the operations and operating techniques to be used, emissions (including odour and noise) and monitoring, and information (maintaining of site records, reporting and notifications). Each waste management plan is incorporated in the permit and requires to be reviewed every five years. However, should the activities give rise to pollution, the EA can require that the plan be revised, submitted for approval and thereafter implemented by the operator.

The Industrial Emissions Directive may apply if shale gas is processed before injection into the gas pipeline or combusted to generate electricity and/or heat onsite. A permit would then be needed, requiring the operator to monitor emissions of methane (and other air pollutants). However, as shale gas in the UK is expected to be of high quality, large scale processing may not be necessary. Operators should still monitor potential leakages of methane and other emissions before, during and after shale gas operations.

Local authorities are also responsible under the Environmental Protection Act 1990 for inspecting sites for odour and noise associated with the venting or flaring of gas. Local authorities also have a statutory duty under the Air Quality Standards Regulations 2007 to monitor emissions to ensure they do not breach local air quality standards. According to the UK authorities, the mechanisms for the control and monitoring of fugitive emissions are however unclear and further clarification on this issue would be welcome.

In the UK, storage of wastewater in open ponds is prohibited. Storage has to be done in closed metal tanks before being treated. This is the only country where such a requirement has been identified. In Spain, authorities decided that most projects will have to use rafts for storing water and sludge with the exception of the project involving two wells (Enara-1 and Enara-2) that use a closed system for water treatment without any water and sludge rafts. However, the national studies did not look specifically at the existence of such requirement.

5.2.3 Sub-surface requirements during the exploration and extraction phase

5.2.3.1 Drilling requirements

- **Requirements for protection of groundwater (Section sub-surface)**

In seven of the selected Member States impacts of drilling on groundwater are taken into account in the authorisation procedure prior to the start of the mining works.

Germany requires that in the event that unforeseen artesian groundwater resources¹²³ are encountered during the drilling operations, the activity must be suspended and the mining authority must be informed immediately. The drilling activity may only be resumed through approval of an amended operating plan or administrative order.

5.2.3.2 Well integrity (casing and cementing)

At a functional level, there is a requirement for more robust well casing construction for hydraulic fracturing compared with conventional gas extraction. Both conventional and unconventional wells need to achieve the same integrity performance standards, however, the hydraulic fracturing process places additional stresses on the well casing. For hydraulic fracturing therefore there may be a requirement for changes to the well design and/or additional monitoring. In addition, the hydraulic fracturing casing must be compatible with the fracturing chemicals, which include acids. In the event of multiple fracturing stages then the casing must be designed to withstand the cumulative effects of high pressure operation.

However, there appears no specified standard for casing construction in the selected Member States. There is no BREF specifically for hydraulic fracturing.

With regard voluntary standards, ASTM International, formerly known as the American Society for Testing and Materials (ASTM) has recently began a process to develop consensus standards that guide best practices for hydraulic fracturing.¹²⁴ This suggests a need for specific requirements for hydraulic fracturing that may differ from conventional gas technologies.

- **Well design, construction and integrity, on the positioning of the casing and number of casings on the correct choice of cement and its setting time to ensure that wells withstand the cycle of stress during hydraulic fracturing preventing leaks**

There are no specific requirements relating to casing and cementing for unconventional gas wells. In three of the selected Member States, detailed requirements on the design, construction and integrity for conventional gas wells have been identified. In Romania, the well parameters are subject to the technical documentation prepared by attested persons and verified by independent experts in accordance with the geological characteristics of the site, thus they might vary on a case by case basis. In the UK, the legislation places a general duty on the well operator to ensure that the well is designed, modified, commissioned, constructed, equipped, operated, maintained, suspended and abandoned, that so far as is reasonably practicable, there can be no unplanned escape of fluids from the well and risks to the health and safety of persons from the well, including anything from within the well or from the strata to which the well is connected, so far as is considered as low as is reasonably practicable.

Casing requirements in Denmark¹²⁵

According to the Danish Energy Agency guidelines for Drilling-Exploration the programme for the positioning of casing shall include:

- Diameter of drilled hole
- Casing dimension
- Weight and quality of casing with reference to recognised standard
- Planned setting depth for the casing

¹²³ Groundwater which piezometric surface is above the ground surface.

¹²⁴ <http://www.astm.org/COMMIT/D1826.htm>

¹²⁵ According to the Danish Energy Agency guidelines for Drilling-Exploration. Available at: <http://www.ens.dk/en-US/OilAndGas/Licences/Guide/Documents/GuideToHC.pdf>

- Strategy for centering of casing, including type of exterior packers, where relevant.
- Programme for cementing of casing, including type of cement, estimated height of cement behind the casing, and strategy for calculations of necessary volumes of cement.
- Demonstration of the sufficiency of the casing string strength with regard to burst, collapse, and tension. Reference may be made to Company Procedure for casing design calculation. In this case the parameters used in the design (pressure, cementing height, mud density etc.) must be stated.
- Procedure and minimum requirements for testing the formation strength after drilling out the individual casings, including calculations demonstrating that the required formation strength is sufficient for drilling to the next casing setting depth.
- Precautions to be taken if the required formation strength is not obtained.

Well design, construction and integrity in Germany

Requirements on the design, casing and cementing of the well can be found in Article 19 of the deep drilling regulations. Accordingly, drilling wells have to be equipped with standpipes and secured by casing.

The core tube (*Ankerrohrfahrt*) ride must be installed before the drilling reaches the oil or gas containing rock strata. It shall be deposited in a way that the shut-off and isolating devices can be installed and the next lining tube (*Rohrfahrt*) can be carried out solidly.¹²⁶ The depth of the individual lining tubes have to pay regard to the strength of the rock and the expected pressure so that a rupture of the rock in an uncased well is avoided.¹²⁷ Further, the casing has to be fixed by cement into the rock. Each lining tube ride has to be cemented in a manner that a tight seal of the bore hole with the non-cemented one is achieved. Finally, the lining tube ride has to be cemented entirely.¹²⁸

The cementing has to further seal aquifers, unused oil or gas rock layers, as well as avoid ingress of water into usable salt deposits.¹²⁹ The pressure in the cementing tube is to be constantly monitored during the cementing phase. In case of any sign suggesting that the allowable operating pressure may be exceeded in the pipeline, the cement injection pumps have to be throttled and if necessary immediately switched off.¹³⁰

Moreover, the well head has to be equipped with shut-off devices, which guarantee the well completion and conclusion of the annular space (*Ringraum*) in case of a spill and outbreak.¹³¹ The drilling operations have to be carried out in a sustainable way in order to protect natural mineral deposits as well as salt springs and aquifers so that they are not adversely affected.¹³²

- **Well integrity tests before (e.g. pre-drilling water well testing) during and after drilling and objectives of such requirements (i.e. workers protection, environmental protection)**

Six of the selected Member States require well integrity tests for conventional wells (that would also be applicable to unconventional ones). For example the German legislation requires well integrity tests at several stages of the drilling procedure and afterwards. Lithuania requires well integrity test prior operations for exploration/exploitation of hydrocarbons only if the operations are carried out in existing wells i.e. wells which had been installed before. In the UK, the well operator must assess the conditions below ground through which the well will pass while the well is being drilled. Further,

¹²⁶ Article 19 para. 2 deep drilling regulation.

¹²⁷ Article 19 para. 3 deep drilling regulation.

¹²⁸ Article 19 para. 4 deep drilling regulation.

¹²⁹ Article 19 para. 5 deep drilling regulation.

¹³⁰ Article 19 para. 6 B deep drilling regulation.

¹³¹ Article 20 Section 1 deep drilling regulation.

¹³² Article 29 para. 1 deep drilling regulation.

similar to German legislation, the UK legislation requires operators to document the drilling, deepening, plugging or abandonment of all wells and of any alterations in the casing thereof.

In Denmark, after the casing strings have been installed and cemented, they shall be pressure tested in accordance with the approved drilling programme. For each casing the pressure test shall be adapted to the internal pressure to which the casing may be exposed in order to ensure that the casings installed are not leaking in the environment.

In Lithuania, the new draft law requires that the inspection programme of technical conditions of the well casing includes a description of a pressure test of the well casing and its thickness to be carried out by geophysical methods. The Lithuanian Geological Survey has to assess and make a conclusion on whether the project on inspection of technical conditions of the well casing is safe or not.

Well integrity tests in Germany

The borehole is to be monitored and measured several times¹³³ during the drilling process, each time prior to reaching a rock layer potentially containing oil or gas and after reaching the final depth. Moreover well integrity measurements relating to direction and inclination have to be undertaken in intervals determined by the operator. In the case of indications suggesting a larger horizontal deviation of the hole in relation to the position determined by the last survey back, it is also necessary to measure the borehole.¹³⁴ Further, the layers affected by the drilling have to be geologically identified and samples have to be stored until the end of the drilling activity.¹³⁵

A drilling report has to be issued over the course of each drilling activity. The report must contain certain minimum information, e.g. on depth, type, and thickness of the rock layers, diameter, material and depth and location of the casing and information on other mineral deposits, salt springs and water levels, as well as on test work and support attempt and pressure tests, depths, direction and inclination measurements.¹³⁶

Further, Article 29 contains provisions on the protection of deposits and water aquifers. Accordingly, the drilling has to be carried out so that exploitable deposits, salt springs, and aquifers are not adversely affected and the quality and usability of mineral deposits have to be tested and measured. In addition, measures relating to the health and safety of workers during drilling operations are included in the section on health and safety measures and the one on emergency measures.

- **Emergency or safety plans reporting of incidents/accidents measures**

The same requirements as to aboveground activities apply in all selected Member States (see section 5.2.2.1.).

5.2.3.3 Hydraulic fracturing

- **Obligation on the operator to monitor the effects of fracturing operations (e.g. induced seismicity) on the geology of the area**

None of the countries assessed have set in place measures to control and monitor induced seismicity due to hydraulic fracturing except the UK. The UK requires a fracking plan, which takes a cautious approach, starting with the injection of small amounts of fluid and analysing the results before

¹³³ Article 30 deep drilling regulation.

¹³⁴ Article 30 para 1 deep drilling regulation.

¹³⁵ Article 32 para 1 deep drilling regulation.

¹³⁶ See requirements article 32 deep drilling regulation.

proceeding further. A flow-back period will be required after each stage of injection in order to re-balance the pressure. Operators will also be required to monitor the growth of the fracturing to ensure that it is effective and developed in accordance with its design. The authority will only give consent to unconventional gas activities where a traffic-light system is in place to ensure that operations can be stopped quickly and reviewed if there is seismic activity. Operations will be halted, and immediate action taken to initiate flow-back to reduce pressure, if there is seismic activity above a certain level, which will be set based on the need to minimise disturbance to local residents and eliminate any risk of damage as far as possible.

In Denmark, according to the drilling guidelines, operators must provide daily reports to the Danish Energy Agency on performed hydraulic and chemical treatment of formation, including principal information on the operations carried out. Pursuant to the Danish Energy Agency, operators of future shale gas exploration wells will have to perform surface monitoring of seismicity of hydraulic fracturing activities.

The German legislation contains monitoring obligations arising from the general mining law, without specific requirements for hydraulic fracturing. According to the German legislation, the operating pressures, the production and withdrawal amounts and the composition of the injected substances have to be determined at regular intervals. The regular intervals are decided by the permitting authorities on a case-by-case basis. The data collected has to be recorded and handed on to the relevant authorities upon demand. In case of irregularities, the competent authority must be notified immediately.

- **Specific requirements applicable to the carrying out of the fracturing activity**

There is no common understanding amongst the selected Member States as to which legislation regulates the hydraulic fracturing operation (injection of fracturing fluids in the ground). Most Member States (Bulgaria, Denmark, Germany, Romania and the UK) consider that this operation falls under the water legislation. In Poland, there is at present no specific requirement to regulate the injection of fracturing fluids in the ground beyond general applicable legislation (e.g. on water abstraction, mining waste). In Lithuania, this issue is addressed through the EIA process. Finally, Spain does not have an official position on this question.

Member State	Legal framework applicable
Bulgaria	The activities, connected with the extraction of shale gas would normally be regulated by the Bulgarian water legislation.
Denmark	Injection of water and chemicals in the subsoil that may pollute soil and groundwater requires a permit pursuant to the Act on Environmental Protection Section 19. According to the Danish Nature Agency it is considered that this rule is sufficient and no further details and conditions as to when and how injection should be allowed have been specified. Furthermore the Danish Energy Agency underlines that operators must prepare programmes describing all activities in deep wells to be approved by the Agency before the start of operations. These programmes must thus provide information on all aspects of hydraulic fracturing activities to be carried out (e.g. type of equipment being used, composition/content of fracturing fluids, production equipment)
Germany	Hydraulic fracturing operations will be subject to permits under the water legislation. Under the German Federal Water Act, the definition of groundwater is not limited to groundwater bodies in geological formations close to the soil containing fresh water. Deep water formations are also included, even if they consist only of saline water. Every use of (ground-)water, e.g. input of substances into groundwater or water abstraction, requires a permit from the water authorities. These authorities will closely examine if the use of fracking fluids and the discharge of the flowback will have negative effects on the groundwater quality or in case of

Member State	Legal framework applicable
	abstractions for the groundwater quantity. In case of negative effects the permit must not be granted.
Lithuania	According to the authorities, the EIA procedure and operational permits (integrated permits) are the main instruments authorising the hydraulic fracturing operation (i.e. injection of water and chemicals in shale rocks), not the water legislation.
Poland	A water permit is not required for the injection of water and chemicals in the shale rock, however it is required for the abstraction of water.
Romania	Water permits (endorsement – “aviz” and authorisation - “autorizatie”) are necessary for any type of drilling works (irrespective of the fact that the extraction results from a fracturing operation).
Spain	The authorities consider that unconventional gas activities in Spain are in an early stage of development and there has not been any official position defining the legislation applicable to hydraulic fracturing in the context of unconventional gas extraction.
UK	<p>According to the authorities, the fracturing activity may require a permit under the Environmental Permitting (England and Wales) Regulations 2010 (EPR 2010), the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR 2011) or the Water (Northern Ireland) Order 1999 (WO 1999) where fluids containing pollutants are injected into formations that contain groundwater or where the fracturing activity poses a risk of mobilising natural substances that could then cause pollution. Each site will be assessed by the Environment Agency (EA) in England and Wales, and the Scottish Environment Protection Agency (SEPA) in Scotland and the Northern Ireland Environment Agency (NIEA) which regulate discharges to the water environment.</p> <p>Where a permit is required, in most cases this will be a bespoke permit due to the novel nature of the industry. A bespoke permit can take between four to six months to process compared to a standard permit which takes up to 13 weeks to process. For this reason, the EA will look to move to a standard permit in the further for shale gas, especially at the production stage.</p> <p>With regard to the injection of fracturing fluids, any injection of non-hazardous fluid is permitted. However, all discharges to groundwater are prohibited under the Water Framework Directive (2000/60/EC). The EA view is that the shale layer does not involve a direct discharge to groundwater and therefore they will waive the need for a permit if satisfied that all other controls provide adequate protection. However, if groundwater is present in the shale layer, it is possible that a direct discharge will not be permitted, although the EA considers that the risks relate to movement between the shale layer and aquifer caused by the flow back material, rather than due to water present in the injected fluids and shale.</p> <p>The EA is in the process of producing technical guidance for operators.</p> <p>The equivalent requirements are set out in Scotland in Regulation 4 of CAR 2011, which sets out the prohibition that no person shall carry on, or shall cause or permit others to carry on, any controlled activity, which included the direct and indirect discharge, and any activity likely to cause a direct or indirect discharge, into groundwater of any hazardous substance or other pollutant, except insofar as it is authorised under the groundwater regulations and carried out in accordance with that authorisation.</p> <p>In its revised regulatory guidance on ‘Coal bed methane and shale gas’, version</p>

Member State	Legal framework applicable
	<p>121119¹³⁷, SEPA state that the following activities will be subject to authorisation under CAR 2011:</p> <ul style="list-style-type: none"> • Borehole construction; • Injection of fracturing fluid; • Abstraction of water for injection purposes; • Abstraction of flow-back; and • Management of abstracted fluids. <p>Where more than one of the above activities requires to be authorised for the same site, ideally a single licence will be granted covering all activities.</p>

- **Waste management requirements**

None of the countries assessed provide particular requirements for the management of the specific waste from hydraulic fracturing. All selected Member States but one plan to rely on the legislation transposing the Mining Waste Directive. The remaining Member State considers that waste management requirements are to be set under provisions transposing the IED legislation. It is however currently preparing a draft legislation, which would set legally binding requirements for the exploration and extraction of unconventional gas that would also cover waste management. The table below presents the different interpretations of the selected Member States on the applicability of the Mining Waste Directive to this type of waste. The text below should be seen as the opinion of interviewed national authorities but is not an official position or interpretation. Furthermore the table below does not distinguish between waste management at the surface and in the ground.

Member State's interpretations of the applicability of the Mining Waste Directive

Bulgaria: The different waste generated from mining activity, fall under the requirements of chapter eight on "Mining waste management" of the Underground Resources Act, as well as the implementing Ordinance on the specific requirements for management of mining waste. These pieces of legislation transpose the requirements of the Mining Waste Directive, which is thus held applicable to shale gas development.

Denmark: The waste resulting from shale gas activities is considered as "mining waste" and fall under the Mining Waste Directive, as implemented by the executive Order on treatment of exploitation waste (*Udvindingsaffaldsbekendtgørelsen*).¹³⁸

Germany: To date, there is no specific legislation applicable to shale gas beyond the legislation applicable to conventional hydrocarbons. The handling of flow back liquids is subject to the requirements of the general mining waste regulations and wastewater regulations.

Lithuania: Waste management is regulated under the Law on Waste Management. The procedures on the management of waste from extractive industries transposed the requirements of Mining Waste Directive. However, the procedures are applicable to the extraction of natural resources through open excavations (quarries) only and do not cover hydrocarbons extraction. Most of the environmental requirements (deposit of waste water, emissions into the atmosphere) are currently controlled through IPPC permits at both exploration and production phases The latest information (obtained on 19 March

¹³⁷ Scottish Environment Protection Agency Regulatory Guidance on 'Coal bed methane and shale gas', version 121119, available at http://www.sepa.org.uk/customer_information/energy_industry.aspx (last accessed 25 February 2013)

¹³⁸ nr. 1150 af 28. november 2012

2013) shows that the Ministry of Environment has also decided to draft new legislation with the purpose of establishing legally binding requirements for exploration/extraction operations of shale gas. This legal act will replace the existing IPPC permits. The intention is to control shale gas exploration/extraction operations through legally binding requirements rather than through IPPC permits. It is expected to be adopted in 2013.

Poland: According to authorities, as long as the flowback water is in technological process it should not be treated as mining waste. The treated flowback water – liquid fraction, which is suitable after treatment for use in re-fracturing – should not be treated as waste. The flowback water, which has not been treated or has no further use, should be treated as mining waste. If the flowback water is treated in place (on drilling site during the technological process of extracting gas from the ground), the residues after such treatment should be treated as mining waste. When putting the flowback water to a waste facility for disposal, the operator of a mining waste facility is required to obtain a permit for the conduct thereof and a decision approving mining waste management plan. Furthermore the authorities mentioned that the fracturing fluids remaining underground after the fracturing operations would not be a waste according to the Waste Act and the Mining Waste Act.

Romania: Although the Ministry of Environment is of the opinion that unconventional gas projects should be subject to Government Decision no. 856/2008 on the management of waste from extractive industries, transposing the Mining Waste Directive, this position has not been officially confirmed by the other authorities. So far, Decision no. 856/2008 concerning mining waste from extractive industries is applicable regarding safety plans reporting of incidents/accidents measures and to the hydraulic fracturing activities themselves.

Spain: Hydraulic fracturing could be regulated under the Royal Decree 975/2009 on Mining Waste. The decisions requiring full impact assessments of projects submitted for authorisation of works under permits of unconventional gas investigation in the North of Spain request operators to submit information on the treatment systems of mining waste referring expressly to Royal Decree 975/2009.

United Kingdom: The EA considers the flow-back fluid as well as waste gases to be mining wastes, and therefore the management of such wastes is considered a mining waste operation, irrespective of whether it involves a mining waste facility. In Scotland and Northern Ireland, the production of ‘flow-back’ fluid from hydraulic fracturing is also treated as a mining waste activity and therefore will be required to have a waste management plan in place, to demonstrate to the planning authorities that the requirements of the Mining Waste Directive are met. However, the storage of waste from “prospecting”, at the site of production, pending transfer for recovery or disposal is exempt from the requirement for a waste management licence under paragraph 41 of Schedule 1 of the Waste Management Licensing (Scotland) Regulations 2011¹³⁹ and under similar provisions of the Waste Management Licensing Regulations (Northern Ireland) 2003

None of the countries assessed request operators to disclose the composition of wastewater from fracturing activities except for Romania which sets such a requirement for all water-related activities in order to obtain the relevant approval from the water authorities. To note that the substances are only disclosed to the authorities.

According to the Lithuanian authorities, shale gas facilities at both exploration and production stages should fall under the scope of the industrial installations¹⁴⁰ legislation transposing the Directive

¹³⁹ Scottish Environment Protection Agency Regulatory Guidance on ‘Coal bed methane and shale gas’, version 121119, para 47, available at http://www.sepa.org.uk/customer_information/energy_industry.aspx (last accessed 25 February 2013)

¹⁴⁰ This would typically cover installations falling under the scope of the IED regime or other national permitting regime applicable to industrial installations.

2010/75/EU on industrial emissions¹⁴¹ (Industrial Emissions Directive) since they use 100 cubic meters or more water or discharge 5 cubic meters or more effluents a day. Therefore a single operational permit which includes *inter alia* conditions for waste management, waste water management, and discharge of waste water will need to be granted.

Concerning the management of fracturing fluids remaining in the ground, the selected Member States do not have a common understanding of the application of the transposing provisions of Article 11(3)(j)¹⁴² of the Water Framework Directive with regard to the injection of wastewaters resulting from hydraulic fracturing activities for underground disposal or with regard to the re-use in subsequent fracturing operations. Interviewed national authorities in Bulgaria, Denmark, Lithuania consider that the derogation under Article 11(3)(j) of the Water Framework Directive does not apply.

In Poland, in the case of underground injection of wastewater into a geological formation, it would be necessary to obtain a licence for underground disposal of waste (*koncesja na podziemne składowanie odpadów*). The Polish authorities however indicated that the underground disposal of wastewater is not considered at the moment. They mentioned that the treated waste water is authorized to be re-used into other fracturing operations.

In the UK, the Scottish authorities consider that the re-use of waste water into subsequent fracturing operations can be authorised under Article 11(3)(j) of the Water Framework Directive, however they consider that the underground injection for disposal does not fall under the Article 11(3)(j) exemption of the Water Framework Directive and is thus prohibited. The authorities in England would allow, subject to an environmental permit the reuse of waste water into subsequent fracturing operation but prohibit the underground injection for disposal that would be in conflict with the Water Framework Directive and the Groundwater Directive. Northern Ireland has not yet a position on how to regulate the re-use of wastewater into subsequent fracturing operations, but similarly to England and Scotland would prohibit the injection of wastewater for disposal that would be in conflict with the Water Framework Directive and the Groundwater Directive.

Finally, the opinion of the interviewees from Germany Romania and Spain are still undefined. Note that the text below should be seen as the opinion of interviewed national authorities but is not necessarily an official position or interpretation. Furthermore, shale gas projects are in an early stage of development and often no authorisation has been yet granted for timing reasons. As a result, the national authorities' position is still to be confirmed by practice and through concrete experience of permitting process.

Member States	Legal framework applicable to the underground injection of wastewater for disposal and/or to re-use/ recycling of waste water into subsequent fracturing operations
Bulgaria	Up to now the Ministry of Environment and Water and the River Basin Directorates have not received investment proposal relating to prospecting, exploration and/or extraction of shale gas, based on which they could identify the circumstances relevant for the application of Article 118a (7) and (8) of the Water Act transposing Article 11((3)(j) of the Water Framework Directive , but having in mind that this

¹⁴¹ Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), *OJL 334, 17.12.2010, p. 17–119*.

¹⁴² Art. 11. 3 (j) of the Water Framework Directive provides for a prohibition of direct discharges of pollutants into groundwater subject to certain provisions. The first alinea is interpreted differently by Member States (“ injection of water containing substances resulting from the operations for exploration and extraction of hydrocarbons or mining activities, and injection of water for technical reasons, into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which for natural reasons are permanently unsuitable for other purposes . Such injections shall not contain substances other than those resulting from the above operations”).

Member States	Legal framework applicable to the underground injection of wastewater for disposal and/or to re-use/ recycling of waste water into subsequent fracturing operations
	Article has been adopted for conventional hydrocarbons activities, the derogation set forth should not apply for shale gas activities.
Denmark	Like injection - re-injection of water and chemicals from fracturing into the subsoil that may pollute soil and groundwater requires a permit pursuant to the Act on Environmental Protection Section 19. Hence, the Article 11(3)(j) does not apply.
Germany	<p>The Federal Environment Agency has assigned a further R+D study on the environmental impacts of fracturing. Management and Treatment is one of the topics of this study in progress (designated to be released in Feb 2014)¹⁴³</p> <p>The disposal obligation relies in general on the local authority, if state law did not regulate differently. The cleaning obligations shall be carried out according to the technical standards. In addition, the general requirements on radiation protection for sludge and deposits (“NORM”) in article 97 Radiological Protection Ordinance “(Strahlenschutzverordnung)” apply.</p>
Lithuania	Currently, Lithuania is not considering allowing the injection into geological formations of water used in shale gas exploration/exploitation operations for disposal. Such injection is not applied in practice with respect to exploration/exploitation of any kind of hydrocarbons. The ‘Procedures on Preparation of River Basin District Management Plans and Programme of Measures and their Co-ordination with Foreign Countries’ almost literally transposes Article 11(3)(j) of the Water Framework Directive.
Poland	<p>In the case of underground injection into the formation for waste disposal it is necessary to obtain a concession for underground disposal of waste (<i>koncesja na podziemne składowanie odpadów</i>). The underground disposal of flowback water is not considered at the moment.</p> <p>As long as the flowback water (<i>plyn zwrotny</i>) is in technological process it should not be treated as mining waste. The treated flowback water (<i>oczyszczony plyn zwrotny</i>) – liquid fraction, which is suitable after treatment for use in re-fracturing – should not be treated as waste. The flowback water, which has not been treated or has no further use, should be treated as mining waste.</p>
Romania	<p>Article 11(3)(j) of the Water Framework Directive refers to the water/substances that are extracted together with the oil/gas and not to the fracturing liquids. Therefore, it is considered that Article 11(3) (j) of the Water Framework Directive prohibits the injection of dangerous substances in the groundwater and that an amendment of the Directive is necessary in order to allow the injection of fracturing liquids.</p> <p>Even if the fracturing liquid could be considered mining waste, it is considered that it should also fall under the laws regulating hazardous waste, which would prohibit the storage of such liquids.</p>
Spain	The interviewed Spanish authorities do not have a clear-cut position as to the applicability of Article 11(3)(j).
The UK	<p>Re-use/ recycling of waste water into subsequent fracturing operations</p> <p><u>England:</u></p> <p>Potentially requirement for a permit under Environmental Permitting (England and</p>

¹⁴³ http://www.umweltbundesamt.de/wasser/themen/downloads/grundwasser/leistungsbeschreibung_fracking.pdf

Member States	Legal framework applicable to the underground injection of wastewater for disposal and/or to re-use/ recycling of waste water into subsequent fracturing operations
	<p>Wales) Regulations 2010 (EPR) to cover ‘groundwater activity’ Mining waste management plan encourages the minimisation of wastes, and reinjection would need to meet the original specification of hydraulic fracture fluid.</p> <p><u>Northern Ireland</u></p> <p>NI has no established position at present. Mining Waste Directive (MWD) has been transposed into land use planning legislation; similar to Scotland, but as yet has not been implemented. NI are therefore content to defer to position in rest of UK.</p> <p><u>Scotland</u></p> <p>The answer to this question partly depends on whether it is actually a “waste”. Was the water ever “intended to be discarded”, if it was always intended to reuse/recycle it then it is not yet “waste water”.</p> <p>The re-use or recycling of ‘waste’ water into groundwater for the purpose of fracturing operations will require authorisation by the Scottish Environment Protection Agency (SEPA) under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR). Before determining an application SEPA must apply the requirements of the Water Framework Directive (2000/60/EC) (WFD) and the Groundwater Directive (2006/118/EC) (GWD).</p> <p>Article 11(3)(j) of the WFD (and hence CAR) does not permit the direct discharge of pollutants into groundwater unless the discharge meets a number of exemptions. SEPA considers that the exemption that can apply in this case relates the ‘injection of water containing substances resulting from the operation for exploration and extraction of hydrocarbons or mining activities...’, This is because SEPA considers that the injection of fracking fluids can be a necessary step in operations for the exploration and extraction of hydrocarbons and therefore that the injection results from those operations.</p> <p>In Scotland, because authorisation is possible under Article 11(3)(j) of the Water Framework Directive the Management of Extractive Waste (Scotland) Regulations, which transposes the MWD does not apply. This is because ‘extractive waste’ as defined by the MWD does not include the injection of water and re-injection of pumped groundwater as defined in the first and second indent of Article 11(3)(j) of the to the extent authorised by that article.</p> <p>Underground injection for disposal</p> <p><u>England/ Northern Ireland</u></p> <p>Likely to be in conflict with WFD and GWD, so unlikely that would be acceptable. Where the discharge could be shown to comply with WFD and GWD would require and EPR permit</p> <p><u>Scotland</u></p>

Member States	Legal framework applicable to the underground injection of wastewater for disposal and/or to re-use/ recycling of waste water into subsequent fracturing operations
	The re-injection of flow-back water for disposal cannot be authorised under CAR. In Scotland the flow-back water for disposal would be regulated by the Management of Extractive Waste Scotland Regulations.

Competent authorities of three selected Member States Germany, Poland and the UK provided complementary information on the basis a questionnaire related to the requirements applying to the management of wastewater from unconventional gas exploration and possible future production.¹⁴⁴ Spain indicated that ‘these issues are still under consideration since there are no projects approved so far’. The answers received show that there are major differences between Member States and uncertainties as to the applicable legislation and requirements on the different options for the management of wastewater resulting from hydraulic fracturing either on the surface or in the ground. For example, the responses to the question on the waste management options authorised show that there is no consensus as to whether or not reused/recycled waste water into subsequent fracturing operations or other uses should be considered as a waste or not. In case of treatment and discharge to surface waters, all three Member States apply general legislation on waste water treatment/disposal (Urban Waste Water Treatment Directive). With regard to the option of surface storage, there are also differences in the Member States’ positions or even within a Member State: in the case of UK, in England, it would be subject to planning conditions while in Scotland, it will be controlled under the mining waste legislation.

- **Authorisation, monitoring, reporting and verification of water abstraction and use during hydraulic fracturing**

The analysis showed that, none of the selected Member States, have set specific requirements relating to the authorisation, monitoring, reporting and verification of water abstraction and use during hydraulic fracturing apart from the general water legislation transposing EU directives on water.

However, a permit would typically be required for water abstraction under legislation transposing the Water Framework Directive. For example, in the UK, an operator is required to seek an abstraction permit from the environmental regulator under the Water Resource Act 1991 if more than 20 m³ of water is to be abstracted per day from surface or groundwater bodies.

- **Movements of trucks (e.g. providing water, material)**

The analysis in the selected Member States showed that there are no specific requirements regulating the movement of trucks in the national legislation. Local regulation on truck movements and restrictions are applicable and might contain traffic limitations or speed restrictions between certain hours for the transport of heavy materials by trucks. Under certain conditions, a transport authorisation might be necessary from the administrator of the relevant roads.

- **Obligation on the operator to disclose information on the chemicals contained in the fracturing fluids and requirements (including prohibition) regarding use or non-use of certain chemicals.**

¹⁴⁴ Within the framework of this study the Commission sent a questionnaire to the national authorities of the selected Member States concerning the legislation applicable to the management of waste from hydraulic fracturing on the surface (e.g. surface storage, treatment or discharge to surface water) and in the ground (e.g. injection of waste water for underground disposal or re-use in other fracturing activities). Out of the eight Member States consulted four responded (Germany, Poland, the UK and Spain).

In the Member States assessed, operators of unconventional gas activities are not obliged to disclose information to public authorities and the public on the substances they are planning to use during the fracturing phase. They have not adopted legislation that would complement the Regulation (EC) No 1907/2006 of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals¹⁴⁵ (REACH Regulation).

In the UK, when assessing whether a permit will be required for groundwater activities, or whether any discharge to groundwater is to be prohibited, the authorities have the power to demand the disclosure of information in the fracturing fluids. In Bulgaria, national authorities can request operators to provide information on the chemical substances used within the mandatory EIA procedure for drilling of exploration or exploitation activities. In Spain, the Ministry's decision requiring EIA for all projects of unconventional gas involving hydraulic fracturing required information on the chemicals used and their expected impact. Furthermore certain companies gathered in a platform called 'Shalegas España'¹⁴⁶ have committed to disclose the chemicals used in fracturing to the competent authorities.

Germany issued best practice examples on drilling¹⁴⁷ which requests to establish specific operating plans for certain substances used in mining and drilling activities. The operators will have to provide the exact name quantity and concentration of certain chemical substances, as well as possible substitutes for the substances. It is important to note that the hazardous substances substitution test is based on occupational health and safety protection requirements, and other requirements, such as on groundwater protection requirements, are irrelevant. The obligation to carry out a substitutes test would apply to the substances used in hydraulic fluids if they fall under the following categories: inorganic acids (except hydrochloric acids and phosphonic acids) such as hydrofluoric acids, fluoride hypochlorite peracids and inorganic 'breakers' such as hypochlorite / chlorite, peroxides persulfatesperborates bromates and gasoline-condensates, radioactive material, biogenic substances.

Even if it is not mentioned in the Danish legislation, according to the Danish Energy Agency, all chemicals being used for hydraulic fracturing have to be described in the operational programmes to be approved by the Agency before commencement of operations.

In Poland, authorities responsible for EIA procedures have the right to oblige operators to include information on the chemicals contained in the fracturing fluids in the EIA report (in cases when an EIA is required). The Polish authorities are planning to amend the legislation to require operators to disclose information on the substances used in fracking fluids and their quantities to the public.

- **Permanent monitoring of the impacts of hydraulic pressure on the well or ground and adoption of measures (stopping or resuming activity)**

None of the selected Member States have established requirements relating to monitoring of the hydraulic pressure during fracturing activities, except in the UK and Germany. The UK set a "traffic light" system which will be used to identify unusual seismic activity requiring reassessment, or halting, of operation due to hydraulic fracturing. German legislation establishes that the pressure in the well is to be constantly monitored and shut off in cases that the pressure exceeds the standard pressure in the line as a general requirement. In other Member States, specific requirements may be set during

¹⁴⁵ Regulation (EC) No 1907/2006 of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, *OJ L 396, 30.12.2006, p. 1–849*.

¹⁴⁶ <http://www.shalegasespana.es/es/index.php/recursos/medio-ambiente/medio-ambiente-y-seguridad>

¹⁴⁷ Best Practice Example of the handling of exploitation drillings (Handlungsempfehlung zur Behandlung von Förderbohrungen Stand: 21.09.2007).

the permitting procedure. For example, the Lithuanian legislation leaves room to the authority to determine if a well and its pressure have to be monitored.

- **Emergency or safety plans, reporting of incidents/accidents of pollution**

The selected Member States refer to the general emergency or safety plans, as discussed above. (see section 5.2.2.1.). German legislation contains provisions on conducts to adopt and emergency measures in the event of spills or well collapse. Furthermore, the standard conditions of an environmental permit granted by the EA in the England and Wales require monthly reporting of monitoring data for emissions to air and water and process monitoring data. The operator is obliged to notify the EA without delay the detection of any malfunction, breakdown or failure of equipment or techniques, accidents, the breach of a limit specified in the permit; or any significant adverse environmental effects. In Scotland, any authorisation issued for controlled activities, or under the Pollution Prevention and Control (Scotland) Regulations 2012, will include general conditions on reporting and incidents.

- **Impacts towards public and local communities affected by the activity in relation to noise from hydraulic fracturing.**

In the selected Member States, noise in relation to hydraulic fracturing activities is regulated under the general legislation on noise or within the planning legislation.

5.3 Project cessation and closure phase/ post closure phase

Comparative key findings throughout the country studies:

- There are no specific requirements applying to the closure of unconventional gas extraction wells in the examined Member States, the regulation on conventional extraction wells apply.
- Seven selected Member States require a well abandonment plan including measures on land use and site rehabilitation and safety, as well as on waste treatment, as set for conventional gas projects.

- **Requirements for (temporary) abandonment/ well idle time**

Seven Member States require a well abandonment plan¹⁴⁸ including measures on land use and site rehabilitation and safety, but also on waste treatment. This requirement is typically set by legislation applicable to conventional gas.

Mine closure operational plans in Germany

For example in Germany, the mine closure operational plan has to include amongst others the name of the extraction operator, as well as the municipality and the county in which the operation lies, the name of the extracted mineral resources along with a chemical analysis and for hydrocarbons the heating value, a description of other encountered minerals, information on mining and safety disruptions and problems occurred within the activity. Further, information about the use of the recovered mineral resources as well as a description of the technical and economic operating conditions and a graphical representation of the operation has to be disclosed along with the details of

¹⁴⁸ Milieu does not have information whether such plan applies to both temporary and definitive abandonment of the wells.

the day of start of the operation and the reasons for close and the description of the storage and deposit area. In addition a description of the natural mineral deposit with a list of the stocks of natural resources and capacity thereof and a representation of the treatment plants (“Aufbereitungsanlagen”) with information on type, capacity, and chemical analyses and output of the finished products goods have to be established in the closure plans. Lastly, a representation of the traffic and transport situation has to be included as well.¹⁴⁹

- **Requirements to maintain the integrity of the well in a long term perspective**

In six selected Member States, measures need to be taken by the operator to maintain the integrity of the well: filling up the well with the material with the same characteristics, as previously extracted, set-up of monitoring equipment¹⁵⁰ and equipment to facilitate any required interventions.

- **Requirements to dismantle the installations and restore the land**

Seven selected Member States oblige operators to dismantle the installation and restore the land. In Lithuania, operators are obliged under the Standard Exploitation Agreement to dismantle installations and restore the land. Similar provisions are applicable in Spain. In the UK, the planning permission contains conditions relating to restoration and after-care. These rules apply also to exploration installations when relevant.

Requirements to dismantle the installations and restore the land in the UK, at Annas Road, Westby, Blackpool.

The Annas Road planning permission sets out in condition 23 that all plant, buildings, hard standing, pollution control membranes, aggregates and hardcore are to be removed from the land, and a specified depth of subsoil replaced prior to the laying of topsoil. In accordance with planning condition 24, within three months of completion of the restoration, a scheme and programme for the aftercare of the site for a period of five years to promote the agricultural after use of the site is to be submitted to the planning authority for approval. The scheme shall set out the steps required to maintain and manage the restored site in order to promote its agricultural use, any necessary weed control and measures to relieve compaction or improve drainage. An annual site inspection shall be carried out by the planning authority during the 5 years of the after care plan.

5.4 Enforcement regime

Comparative key findings throughout the country studies:

- There is no specific sanction regime for unconventional gas extraction in the selected Member States.
- The sanction regime applicable to all hydrocarbon extraction varies amongst the selected Member States. It is generally covered by sanctions either under mining, water or other environmental legislation.

- **Requirements on liability (including for the longer term) and responsibility**

Most of the selected Member States do not go beyond the Environmental Liability Directive. Only Spain does as while the Directive limits responsibility for activities outside Annex III when there is

¹⁴⁹ Article 53 para 2 Federal Mining Act.

¹⁵⁰ Milieu does not have information for how long such monitoring would take place after closure.

fault or negligence to damage to species and habitats. Spanish law covers all damages for activities outside Annex III if there is fault or negligence. Further it applies strict responsibility for activities outside Annex III in relation to prevention and avoidance measures, sanctioning the lack of them as serious infraction (no restoration).

Strict liability applies to damages or imminent threats caused by activities listed in Annex III of the Directive, including:

- IED installations;
- Waste management operations, including the collection, transport, recovery and disposal of waste and hazardous waste, including the supervision of such operations and after-care of disposal sites, subject to permit or registration;
- The discharge or injection of pollutants into surface water or groundwater which require a permit, authorisation or registration in pursuance of the Water Framework Directive;
- Water abstraction and impoundment of water subject to prior authorisation in pursuance of the Water Framework Directive;
- Manufacture, use, storage, processing, filling, release into the environment and onsite transport of dangerous substances or preparations as defined by the Regulation (EC) No 1272/ on classification, labelling and packaging of substances and mixtures (CLP Regulation)¹⁵¹;
- Manufacture, use, storage, processing, filling, release into the environment and onsite transport of biocidal products as defined by the Biocide Regulations¹⁵²;
- The management of waste from extractive industries, in accordance with the Mining Waste Directive.

Most of the activities of unconventional gas exploration and exploitation would fall under this list and be subject to the corresponding strict liability system. However, the national authorities interviewed have expressed divergent views on the applicability of strict liability to unconventional gas activities. For example, some interviewees consider that unconventional gas exploration and exploitation would not fall under the Mining Waste Directive. If to consider that these activities do not fall under Annex III, liability will be only fault-based and limited to damage or threat of damage to protected species and natural habitats.

Spain is the only Member State going beyond the Environmental Liability Directive. Spanish law covers all damages for activities outside Annex III¹⁵³ if there is fault or negligence. Furthermore for activities outside Annex III, operators are required to adopt prevention and avoidance measures even if they acted without fault or negligence. The lack of adoption of these measures is considered as a serious infringement leading to sanctions (i.e. fines)

In addition, several of the selected Member States have set up liability regimes specific to mining operations. However, Milieu has not assessed whether these specific liability regimes take properly into account the characteristics of unconventional gas activities.

¹⁵¹ Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, *OJL 353*, 31.12.2008, p. 1–1355.

The CLP Regulation will, after a transitional period, replace the current rules on classification, labelling and packaging of substances (Directive 67/548/EEC) and mixtures (Directive 1999/45/EC). The date from which substance classification and labelling must be consistent with the new rules will be 1 December 2010 and for mixtures 1 June 2015.

¹⁵² Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products, *OJL 167*, 27.6.2012, p. 1–123. This Regulation is repealing Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market, *OJL 123*, 24.4.1998, p. 1–63.

¹⁵³ The Directive limits environmental liability with fault or negligence outside activities in Annex III to damages to protected species and natural habitats

For example, Germany has a special liability regime in place within the existing mining legislation applicable to mining subsidence damage. In the UK, operators have an open-ended liability to remediate any ineffective abandonment operations.

- **Sanction regime specific to unconventional gas extraction**

There is no specific sanction regime for unconventional gas extraction in the selected Member States. The sanction regime applicable to conventional gas extraction applies.

- **Sanctions including restorative measures and injunctive measures (e.g. suspension of the activity until in conformity) related to non-compliance with permits, concessions, licences or authorisations**

The sanction regime applicable to all hydrocarbon extraction varies amongst the selected Member States. It is generally covered by sanctions either under mining, water or other environmental legislation.

Please find below examples in the following countries:

Bulgaria

The Bulgarian mining legislation sets out an administrative sanctioning regime, including fines which range from 5,000 to 500,000 BGN (2,500 to 255,000 Euro) depending on the offence. Offences sanctioned with up to 50,000 BGN (25,000 Euro) are for instance prospection and/or exploration of underground resources without permit or if the permit has been suspended¹⁵⁴; if the conditions of the permit and/or mining waste management plan are not respected¹⁵⁵; if the access of the control bodies is not provided to the operational site¹⁵⁶ and if the information and documentation for underground resources is not submitted to the National Geological Fund.

Denmark

The Subsoil Act as well as the Model Licence includes an option for the Danish Energy Agency to revoke this licence if any provisions and conditions contained in the Subsoil Act, the licence or any permits issued pursuant thereto are not complied with. Moreover revocation may take place if incorrect or misleading information is given in an application for a licence or if one or more holders of the licence are getting into economic difficulties inter alia declared bankrupt or go into liquidation (Act Section 30 & Model Licence Section 35).

If production has been initiated and is then suspended for a period of more than two consecutive years, and such suspension is not part of an approved plan, the licence shall lapse for the area concerned, unless the licensee can substantiate that continuing production is temporarily non-viable commercially (Model Licence Section 35).

The expiry, relinquishment, lapsing or revocation of the licence shall not relieve the licensee of its obligations pursuant to legislation, this licence or any other applicable rules, conditions or orders. Where any part of the work programme or in prolongations to the licence is not performed, the licensee, unless exempted by the Danish Energy Agency, shall pay to the Treasury an amount equal to the cost of performance of the obligations (Model Licence Section 36).

¹⁵⁴Article 93(1) of URA

¹⁵⁵Article 94 (2) of URA

¹⁵⁶Article 93 (4) of URA

Any party that carries out activities without a licence or failing to submit the samples and other information required or disregards enforcement notices issued in accordance with the Subsoil Act or administrative regulations is punishable by a fine or imprisonment for a term of up to four months. Legal persons may be held criminally liable in accordance with the provisions laid down in Part 5 of the Danish Criminal Code. In case of non-payment, the taxes and fees payable under this Act shall be recoverable through execution proceedings (Subsoil Act Section 39-40)

Germany

In Germany, the Federal Mining Act establishes that administrative offences conducted intentionally or negligently, are sanctioned with a fine ranging from 2,500 to 25,000 Euro, depending on the offence. Offences sanctioned with up to 25,000 Euro are for instance exploration or extraction of mineral resources under public domain without licence for exploration and/or extraction and seeking ownership thereof¹⁵⁷ or in case a natural or juridical person contravenes an enforceable obligation imposed pursuant to Article 16 para. 3¹⁵⁸ or carries out an activity which is subject to the approval of an operational plan, without getting the required approval.¹⁵⁹

In addition, criminal sanctions arise as well. Accordingly, offences punished with imprisonment of up to five years or a fine arise in the case that for example a person commits an administrative offence like exploring or exploiting without the required authorisation and thereby endangers the life or health of a person or a property of significant value.¹⁶⁰

In especially serious cases causing grievous bodily harm the penalty shall be imprisonment from six months to ten years. If the person acts negligently and causes the danger negligently, he/she shall be punished with imprisonment up to two years or a fine.¹⁶¹

Lithuania

The Law on Environment is applicable. Article 32 of the Law provides that users of natural resources as well as the persons pursuing economic activities (“economic entities”) must take all the measures necessary to prevent environmental damage, damage to human health and life, property and interests of other persons, and the persons guilty of causing damage must restore the state of the environment, where possible, to baseline condition as it was prior to the damage to the environment, and compensate for all the losses. The baseline condition shall be determined on the basis of the information available on the best state of the environment. The state of the environment shall be restored by rehabilitating the damaged environment or elements thereof or the impaired functions thereof. In the event of land damage (surface thereof or the underground) as elements of the environment, any threat of adverse effect on human health must be eliminated.

Procedures for choosing measures to restore of state of environment and for receiving of the anticipatory consent,¹⁶² approved by the Ministry of Environment aim at selection of restorative measures.

Poland

¹⁵⁷ Article 146 para 1 No. 1 Federal Mining Act.

¹⁵⁸ Article 146 para 1 No. 2 Federal Mining Act.

¹⁵⁹ Article 146 para 1 No. 8, see No. 6, 9 to 11, 15 to 18, 20, 21 and para.3 no. 2 and para 2 Federal Mining Act for further examples.

¹⁶⁰ See Article 146 para 1 in conjunction with article 145para 1 no.6, 8,9,16 and 17, in conjunction with Article 145para 2, or Article 145para.3 no. 2 Federal Mining Act.

¹⁶¹ Article 146 para. 3 Federal Mining Act.

¹⁶² http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=422340

In case of violation of the requirements of the Geological and Mining Law Act (e.g. failure to comply with the conditions specified in the concession), after a letter of formal notice, the administrative authority is entitled to withdraw the concession or limit its scope without compensation. The withdrawal of the concession, the expiry or loss of its validity, whatever the reason, does not exempt the operator from carrying out the obligations concerning environmental protection and those related to the closing down of the mining plant.

According to Article 129.6-8 of the Geological and Mining Law Act, the Director of district mining authorities (*dyrektor okręgowego urzędu gorniczego*) may, in justified cases, impose on the operator to close or dismantle the mining plant or its part. According to Article 176 of the same act, an individual, who without the required license or without an approved plan of geological works, or in violation of the conditions set out therein, while performing activities of: prospecting for or exploration of mineral deposits, extracting minerals from deposits, underground non-reservoir storage of substances or underground storage of waste, causes substantial damage to property or serious damage to the environment, is punishable by imprisonment up to three years. If the offender causes immediate threat to property or to the environment, he/she is subject to a fine or imprisonment up to two years. If the offender unintentionally commits the aforementioned act, he/she is subject to fine, restriction of liberty, or imprisonment up to one year.

According to Article 177 of the Geological and Mining Law Act, a person, who without the required license or without an approved plan of geological works, or in violation of the conditions set out there is performing the following activities: prospecting for or exploration of mineral deposits, extracting minerals from deposits, underground non-reservoir storage of substances or underground storage of waste, can be imposed an imprisonment penalty or a fine.

Finally, pursuant to Article 175 of the Geological and Mining Law Act, the President of the State Mining Authority can impose an administrative fine on an operator, who fails to fulfil his/her obligation to identify the risks associated with mining plant operations and take measures to prevent and remove these threats. The amount of the fine is 3percent of the revenue of the operator achieved in the previous calendar year.

Romania

In Romania, the maximum fine provided by the Environmental Protection Law of 100,000 RON (22,000 Euro) can apply in case of pollution which threatens the life and safety of humans or animals and imply, in principle, an intended act of unauthorised discharge of polluting substances, omission of notifying an accident, unauthorised transport of substances or the continuation of activities after the permits were revoked. In these cases, the fine is applied under the criminal law regime.

The said law also provides for imprisonment (up to 20 years) in certain cases where the non-compliance with the environmental legislation has serious consequences (including important material losses or deceases).

The Petroleum Law which covers natural gas extraction also provides for sanctions in case the beneficiary of a Petroleum Agreement does not comply with the health and safety obligations and with those related to the protection of the environment. Besides fines of 100,000 RON (22,000 Euro), the non-compliance may also trigger the termination of the Petroleum Agreements or their suspension.

Spain

There is no sanction regime specific to unconventional gas extraction. The system applied for

conventional hydrocarbon exploration and extraction applies.

Under the permitting procedure established by Law 34/1998 on Hydrocarbon sector, operators are required by the Ministry of Industry, Energy and Tourism to provide a liability insurance that covers unlimited liability for any damage to people, to property or to the environment and this regime can overlap with the one regulated under the Environmental Liability Directive (and national legislation). Furthermore Article 109 of Law 34/1998 considers serious breaches for which a penalty of 30,000,000 Euros will be imposed the following:

- The performance of the activities regulated in this Act without the necessary concession or administrative authorisation, or failure to satisfy conditions of such concessions and authorisations whenever people or property are clearly endangered.
- The use of instruments, equipment or elements subject to industrial security without meeting the technical standards and obligations whenever they might endanger or cause serious damage to people, property or the environment.

Further sectoral legislation provides for additional enforcement rules. The Spanish water legislation, considers any action that cause damage to public water, failure to comply with the conditions imposed in the concessions and authorisations as administrative offences. These offences are either qualified as minor, less serious, severe, or very severe, according to their impact on persons, goods and the environment and the degree of liability.

- Minor offenses, a fine of up to 10,000 Euro
- Less serious offenses, a fine of 10,000.01 to 50,000 Euro
- Serious offenses, a fine of 50,000.01 to 500,000 Euro
- Very serious offenses, a fine of 500,000.01 to 1,000,000 Euro

Under Article 31 of the Law 16/2002 on integrated prevention and pollution control (provided it is considered applicable to shale gas extraction activities), the exercise of an activity without the required environmental permit or not complying with the conditions established in it is considered a very serious infraction if the damages to the environment or to the human health were serious. Sanctions may reach up to 2,000,000 Euro. When there is no damage or impact on human health the infractions would be considered serious and the sanctions may be of up to 200,000 Euro.

United Kingdom

Under Regulation 39 of the Environmental Permitting (England and Wales) a person guilty of the offence of not having in place an environmental permit or failing to comply with or contravene an environmental permit condition, is liable (a) on summary conviction to a fine not exceeding £50,000 or imprisonment for a term not exceeding 12 months, or to both, or (b) on conviction on indictment to a fine or imprisonment for a term not exceeding 5 years, or to both. Regulation 41 of the EPR 2010 makes provision for offences by bodies corporate. In Scotland, Regulation 44 of CAR 2011 on water provides that if a person fail to comply with or contravene a general binding rule, registration or water use licence, or fail to comply with the requirements of an enforcement notice liable (a) on summary conviction (i) to a fine not exceeding £40,000 or to imprisonment for a term not exceeding 12 months, or to both or to both, and (ii) in the case of a continuing offence, to a further fine not exceeding £250 for every day during which the offence is continued after conviction; or (b) on conviction on indictment (i) to a fine or to imprisonment for a term not exceeding 5 years, or to both, and (ii) in the case of a continuing offence to a further fine not exceeding £1,000 for every day during which the offence is continued after conviction. There are several regulatory regimes in Northern Ireland where non-compliance can be enforced through the use of enforcement/stop notices and prosecution for not meeting the conditions of the permit/licence or consent and these include offences under the Water

(Northern Ireland) Order 1999, Water Abstraction and Impoundment (Licensing) Regulations (Northern Ireland) 2006; Waste Management Licensing Regulations (Northern Ireland) 2003; and the Planning (Northern Ireland) and General Development Order (2003).

The competent authority has the power to revoke a licence in certain circumstances. These include where there has been any breach or non-observance by the Licensee of any of the terms and conditions of the licence or a development scheme or the bankruptcy of the Licensee. In such cases DECC may revoke the licence and following which all the rights granted shall cease and determine but subject to any obligation or liability incurred by the Licensee or imposed upon him by or under the terms and conditions of the licence.

If the Licensee shall at any time fail to perform the obligations under clauses 12, 17, 20 or 21 of the licence, DECC shall be entitled, after giving the Licensee reasonable notice in writing, to execute any works and to provide and install any equipment which may be necessary to secure the performance of those obligations or any of them and to recover the costs and expenses of so doing from the Licensee.

6 CONCLUSIONS

Unconventional gas activities, due to the intensity and scale of operations involved, generally involve a larger environmental footprint compared to conventional gas activities.

At present, the selected Member States rely mainly on the general mining, hydrocarbons and environmental legislation and its related permitting procedure transposing the EU legislation to regulate such activities (as for conventional gas extraction) and very few have adopted specific requirements.

Operators may be obliged to request several permits under different acts (e.g. water law, mining waste law).

In order to address the specificities of unconventional gas exploration and exploitation, several Member States have adopted/are reviewing their legislation or develop guidance focused on unconventional gas developments. A few useful examples of regulatory provisions applying specifically to unconventional gas activities were identified in the selected Member States (e.g. management of induced seismicity). Some competent authorities also called for clarification from the European Commission on applicable legislation.

Among the main differences in national approaches, areas of legal uncertainty / possible limitations identified as part of this study are featured the following:

- The status of EIA requirement for exploration and/or extraction (i.e. full EIA or ad hoc screening) differs amongst the individual Member States selected, as it depends on how the EIA Directive requirements are transposed and applied. Certain Member States adopted new legislation requiring a mandatory EIA for unconventional gas exploration and/or extraction projects or projects involving the use of hydraulic fracturing.
- Details of the financial guarantee requirements vary greatly across countries.
- Areas of legal uncertainty have been identified within the applicable national legislation (e.g. whether hydraulic fracturing should be controlled under a water permit and/or industrial installation permit and/or a mining waste permit, whether fracturing fluids remaining underground are considered as mining waste or not) leading to the application of different and sometimes contradictory requirements between/within Member States.
- Prior to operation, information disclosed or accessible to the public is essentially limited to the general one linked to the licensing and EIA process. In the Member States assessed, operators of unconventional gas activities are not obliged by law to disclose information to public authorities and the general public on the substances they are planning to use during the fracturing phase. The requirement may be set on an ad hoc basis as part of the EIA procedure or permit conditions. One Member State is considering requiring mandatory public disclosure.
- General requirements for geological characterisation designed for the extraction of conventional hydrocarbons apply. However, these may not be specific enough to deal with the characteristics of unconventional gas extraction as they often do not focus on potential underground risks in the context of hydraulic fracturing (e.g. identification of existing faults and fractures; hydrogeology; existing abandoned wells)

- No specific requirements on baseline monitoring prior to drilling or fracturing have been identified. The requirements may be set under the EIA procedure or permit conditions on an ad-hoc basis. There is however no explicit legal guarantee that such monitoring will be comprehensive enough to identify possible impacts from unconventional gas developments (e.g. migration of contaminants to groundwater, methane leakage).
- There is no legislation in the selected Member States that explicitly addresses venting and flaring in the context of hydrocarbon projects. The competent authorities retain a large discretion on deciding whether or not flaring and venting can be allowed.
- The study has not identified specific requirements relating to casing and cementing for unconventional gas wells beyond those applicable to conventional gas wells. Only in two of the selected Member States, detailed requirements on the design, construction and integrity for conventional gas wells have been identified.
- None of the countries assessed have set in place measures to control and monitor the effects of hydraulic fracturing in the ground with the exception of induced seismicity in the UK.
- There is no common understanding amongst the selected Member States as to which sectoral legislation regulates the injection of fracturing fluids in the ground (e.g. water legislation, EIA procedure) and, in some cases, there is a lack of or uncertainty as to the applicable requirements.
- None of the selected Member States provide particular requirements for the management of waste from hydraulic fracturing beyond the general waste and mining waste legislation. There are major differences between Member States and uncertainties as to the applicable legislation and requirements regarding the different waste management options as underlined in the following three points:
 - The selected Member States have not a common understanding of the application of the transposing provisions of Article 11(3)(j) of the Water Framework Directive with regard to the injection of wastewaters resulting from hydraulic fracturing activities for underground disposal or with regard to re-use in subsequent fracturing operations, leading to potential contradictory approaches between Member States.
 - None of the selected Member States provide specific requirements for the treatment and discharge to surface waters of waste water from unconventional gas projects. They rely on the water legislation transposing the Water Framework Directive and the Urban Waste Water Directive.
 - None of the selected Member States have set specific requirements with regard to the surface storage of wastewater from unconventional gas activities. They consider that surface storage of wastewater falls either under the mining waste or could be subject to planning conditions for surface water storage.
- No specific requirements apply to the closure and post closure phase of unconventional gas extraction wells beyond those applicable to conventional gas wells. For the latter, most Member States' legislation on conventional gas require a well abandonment plan and set post closure measures to be taken by the operator to maintain the integrity of the well.