Study on the application in relevant member states of the Commission recommendation on minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high-volume hydraulic fracturing

Final Report

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List of abbreviations

BMWFW	Austrian Federal Ministry for Science, Research and Economics
DEA	Danish Energy Agency
EIA	Environmental Impact Assessment
EA	Environment Agency
EGS	Eurogeosurveys
ENMC.	the National Entity for the Fuels Market
EPA	Environmental Protection Agency
ETUC	European Trade Union Confederation
FEAD	European Federation of Waste Management and Environmental Services
HEAL	Health and Environment Alliance
HVHF	High Volume Hydraulic Fracturing
IADC	International association of drilling contractors
IED	Industrial Emissions Directive
IOGP	International association of oil and gas producers
LBEG	Mining and Energy competent authority for the states of Lower Saxony, Schleswig-Holstein, Bremen and Hamburg, and of the continental shelf area of the North Sea.
MAGRAMA	Spanish Ministry of Agriculture, Food and Environment
MINETUR	Spanish Ministry of Industry, Energy and Tourism
NAMR	National Environmental Protection Agency in Romania
NIEA	Northern Ireland Environment Agency
OPPPW	Polish Exploration and Production Industry Organisation
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency

Abstract

In January 2014, the Commission adopted a Recommendation setting out minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high-volume hydraulic fracturing (HVHF). The effectiveness of the Recommendation is to be reviewed by the Commission 18 months after its publication. At present, based on available information, there is no on-going commercial production of hydrocarbons using HVHF in the EU. However, the following Member States have granted or plan to grant authorisations for the exploration or production of hydrocarbons (such as shale gas) that may require the use of HVHF, namely: Austria, Denmark, Germany, Hungary, Lithuania, Netherlands, Poland, Portugal, Romania, Spain, and the United Kingdom (UK). The present study supports the Commission in the review of the Recommendation's effectiveness by 1) assessing how Member States apply the principles of the Recommendation and selected EU legal requirements at the planning, licensing and permitting levels, 2) describing regulatory and non-regulatory developments in Member States after the adoption of the Recommendation and 3) gathering stakeholders' views. In addition, it gathers information on the possible cost of the measures taken as a result of the adoption of the Recommendation.

Executive summary

In January 2014, the Commission adopted a Recommendation setting out minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high-volume hydraulic fracturing (HVHF). The effectiveness of the Recommendation is to be reviewed by the Commission 18 months after its publication. At the end of 2014, the Commission invited the Member States to report on the measures they put in place in response to the Recommendation. Out of 28 Member States, eleven replied to the questionnaire indicating that they granted or were planning to grant authorisation for the exploration or production of hydrocarbons that may require the use of high-volume hydraulic fracturing (in onshore and/or offshore operations). The Member States concerned are Austria, Denmark, Germany, Hungary, Lithuania, Netherlands, Poland, Portugal, Romania, Spain, and the United Kingdom (UK).

At present, based on available information, there is no on-going commercial production of hydrocarbons using HVHF in the EU. However, some developments have taken place or are planned, as follows:

- In three countries - Germany, Poland and the UK- HVHF was carried out for exploration purposes and for a limited number of sites.
- In the Netherlands, a SEA for the spatial strategy on shale gas development was completed and will undergo a public consultation phase in 2016.
- In Lithuania, two SEAs were adopted prior to granting hydrocarbon licenses and shale oil and gas exploration. Low volume hydraulic fracturing was carried out at two sites.
- In Hungary, low volume hydraulic fracturing was carried out at the exploratory phase targeting shale gas and tight gas resources.
- In Spain, licenses were granted and EIA procedures are on-going.
- In Romania and Denmark, shale gas exploratory drillings were carried out without hydraulic fracturing nor further developments.
- In Austria and Portugal, no licenses have yet been granted or are active with the view of exploring and/or exploiting hydrocarbons using HVHF (license applications are being assessed in Portugal).

The present study supports the Commission in the review of the Recommendation's effectiveness by 1) assessing how Member States apply the principles of the Recommendation and selected EU legal requirements at the planning, licensing and permitting levels, 2) describing regulatory and non-regulatory developments in Member States after the adoption of the Recommendation and 3) gathering stakeholders' views. In addition, it gathers information on the possible cost of the measures taken as a result of the adoption of the Recommendation.

Assessment of the application of the Recommendation principles and of selected EU legal requirements

The assessment is based on desk-top research and case studies carried out in the countries, involving interviews and a thorough review of the permitting process and documents for selected sites, including Strategic Environmental Assessments (SEAs), licences, permits, Environmental Impact Assessments (EIAs), EIA screenings and risk assessments.

For each country, up to five case studies were selected based on specific criteria e.g. HVHF carried out or planned, timing of the permitting procedure in relation to the

adoption of the Recommendation, size of the project, transboundary aspects, environmental aspects involved, etc. The case study evaluated how the permitting documents reflected the principles of the Recommendation and selected requirements set by relevant EU legal acts, for example water and waste related directives.

Country	Case studies selected
Austria	None. Austria granted exclusive rights to explore and exploit hydrocarbons in defined geographical areas to two companies. Both companies have not made use of their licence.
Denmark	- Nordjylland shale gas exploration well
Germany	- Damme 3 shale gas exploration site
Hungary	None. Low volume hydraulic fracturing was carried out at the exploratory phase targeting shale gas and tight gas resources. None of the current hydrocarbon sites under exploration were or will be subject to HVHF as defined under the Recommendation in the near future.
Lithuania	- Two SEAs (performed in 2007 and 2011) - Gargždai licence (Pietų Šiūpariai-5 site) - Rietavas licence (Rietavas-1 site)
The Netherlands	- SEA (still subject to public consultation in 2016)
Poland	- Wejherowo licence - Lidzbark Warmiński licence - Lębork licence (Żarnowska and Lublewo sites) - Wodynie-Łuków licence - Łeba licence
Portugal	None. Three exploration and production licences have been requested under direct negotiation to date, but the process is still being evaluated by the Portuguese authorities.
Romania	- Barlad EV-2 licence (Pungesti, Bacesti and Gagesti, Puiesti sites)
Spain	- Sedano licence: (Sedano 1, 2 and 3 site) - Urraca licence (Urraca 1, 2 and 3 site) - Bezana and Bigüenzo licence (El Coto and Cadialso sites)
The UK	- Preese Hall Farm site - Land at Roseacre Wood site - Land north of Preston New Road site

The national reports also reviewed the relevant regulatory and non-regulatory developments adopted after the publication of the Recommendation and case law. Finally, the reports identified potential legal uncertainties and useful practices related to the planning, licensing, permitting for exploration and production of hydrocarbons using HVHF.

While the national reports cover all aspects of the Recommendation and selected EU legal requirements, the present report on the study main findings focuses on key principles of the Recommendation, identified in consultation with the Commission. The selected principles are those where the study revealed divergence in the application across Member States (e.g. EIA related principles), incomplete application (e.g. SEAs, dissemination of information), or principles for which good practices have been identified (e.g. monitoring).

Strategic planning and environmental impact assessment

Only Lithuania and the UK prepared a SEA prior to the grant of licences which may result in the use of HVHF. Netherlands granted a few hydrocarbon licenses which were then put on hold until the completion of a SEA (currently under public consultation).

In most countries, legislation establishes restrictions to activities in particular areas such as flood or seismic prone areas, reflecting the principle of the Recommendation (point 3.2). Restrictions are set in two different ways: they apply specifically to hydraulic fracturing or they are set as part of general legislation applicable to different activities, including hydrocarbon exploration and exploitation. None of the countries covered include in their legislation all the restrictions set under Point 3.2 of the Recommendation.

In general, it was considered that the public had an early and effective opportunity to participate in the EIA procedure, when it is carried out (some of the examined sites were not subject to either an EIA or a screening). However, in countries where EIAs were completed or are being completed, the public participation procedures and EIA timeframes differ significantly from one country to another. Even though this element is not covered by the Recommendation, it is to be noted that there is no common approach to EIAs, for instance whether the EIA covers one specific well project, several well projects in a licence area or the whole licence area. In the countries covered, the scope of the EIAs is decided on a case by case basis by the competent authorities.

Requirements concerning the thresholds that trigger the application of the EIA Directive differ from one country to another. Several countries have adopted or plan to adopt specific EIA requirements related to projects involving the use of hydraulic fracturing (i.e. Austria, Denmark, Germany, Lithuania, Portugal and Spain). Other countries apply specific EIA/screening thresholds related to the depth of the drilling, the size of the installation and/or the proximity to sensitive areas (i.e. Netherlands, Hungary, Poland and the UK) whereas some countries apply literally the EIA directive requirements and thresholds (i.e. Romania).

In practice, the EIAs carried out (i.e. Poland and the UK) or being carried out (i.e. Spain) for the examined projects, cover the main characteristics of unconventional hydrocarbon exploration and the potential related impacts of HVHF. It was beyond the scope of this study to carry out an in-depth technical review of their content.

Finally, even though not covered by the Recommendation, it is noteworthy that none of the countries covered by the study have adopted specific guidelines and/or rules on the content of the EIA for projects involving the exploration and production of hydrocarbons using HVHF.

Baseline study

Overall, the ten parameters the Recommendation advised to include in the baseline study are not systematically reflected in practice. The study has revealed such instances in several cases in relation to air quality, seismicity, the presence of methane and other volatile organic compounds in water, the status of infrastructure and buildings, as well as existing wells and abandoned structures. Although not covered under the Recommendation, it is important to note two elements which are not clearly defined in the law, permitting procedures or guidance. The first one is the geographical scope of the baseline study. The second one relates to data requirements, i.e. whether or not the baseline must rely on specific samples in the surrounding areas of the exploratory wells rather than on available data. This is generally decided on a case by case basis by agreement between the competent authorities and the operators. Finally, it is also not always clear whether baseline studies are required before any operations and/or specifically before HVHF.

Monitoring requirements

Monitoring measures were implemented at the sites were HVHF was carried out (Germany, Poland, the UK). In Spain, some monitoring measures are foreseen in the EIA documents drafted by the operators. No specific trends can be identified on the way the monitoring requirements were applied or are planned to be applied at specific sites with the exception of the UK where post-recommendation sites (unlike the pre-recommendation site) apply specific monitoring measures reflecting to a large extent the principle of the Recommendation. Lithuania has adopted in its law specific monitoring requirements for hydraulic fracturing covering a number of aspects of this Principle.

Dissemination of information

The principle on dissemination of information either by operators or by competent authorities is not fully reflected within legislation, at the permitting level or on a voluntary basis in the countries covered by the study. The situation varies from one Member State to another, a minority publishes environmental permits or has set up a dedicated website, while others do not disclose information publicly or very little upon request.

Main findings on the application of selected EU requirements

The assessment of EU legal requirements at selected sites and interviews with competent authorities showed that views and approaches as to the application of selected EU requirements to the exploration and production of hydrocarbons (such as shale gas) using HVHF differ across countries covered by the study. This remark concerns in particular the application of Directive 2010/75/EU (Industrial Emissions Directive), Directive 2006/21/EC (Extractive Waste Directive), and Directive 2000/60/EC (Water Framework Directive). It was not within the scope of this study to examine compliance or conformity with the existing EU legislation.

Stakeholder consultation

The purpose of this task was to collect and analyse national and EU stakeholder views on the effectiveness of the EU approach to regulating activities that may use HVHF. The consultation targeted the oil and gas industry, the water industry, the chemical industry, NGOs and geological surveys.

EU stakeholders' interviews

Two interviewees respectively from the oil and gas industry and the chemical industry consider that it is problematic to make a judgement as to the effectiveness of the Recommendation. The oil and gas industry representative argued that it was too early in view of the small extent of shale gas exploration in Europe. The chemical industry representative highlighted that it was difficult to distinguish the effect of the Recommendation from the effect of other EU and national legislation in relation to environmental management, waste management and hydrocarbon exploration/production.

Overall, EU stakeholders' views on the effectiveness of the Recommendation differ significantly. For the representatives of the chemical and oil and gas industry, the Recommendation has achieved its purpose, as in their views, it led to changes at the permitting level and served as the starting point of many debates. They mentioned that new legally binding provisions on HVHF were not necessary and would make the shale gas development phase too difficult in the EU. They argued that the current EU regulatory framework, supplemented by national requirements and industry guidelines was sufficient. They considered that the Recommendation constituted a thorough checklist/best practice guide that did not need to be revised.

Conversely, NGO and water industry representatives suggested specific measures and amendments to the Recommendation or were in favour of the introduction of legally

binding provisions on HVHF. They argued that the regulatory framework for HVHF was not consistent across Member States. NGO representatives emphasised divergences in the legal interpretation as to the applicability of EU environmental legislation to HVHF. The adequacy of the current EU legislation to regulate the environmental impacts of HVHF was also challenged by NGO representatives.

All interviewees agreed on the importance of informing the public about HVHF while underlying that the Recommendation did not help alleviate public concern. According to an industry representative, the Recommendation was contributing to better transparency whereas NGO representatives stressed that information remained difficult to obtain, and that the Recommendation did not appear to have resulted in an improvement in this regard.

Online survey

A clear divergence of opinion between oil and gas industry respondents and NGOs is noticeable in the replies received to the on-line survey. The opinion of the geological surveys is mostly aligned with that of the oil and gas industry, while the water industry generally aligns with NGOs. Respondents from the oil and gas industry considered that the principles of the Recommendation were already reflected in national legislation and applied in practice. Because of the perceived existence of adequate national legislation these respondents considered that the purpose of the Recommendation was already partly or fully achieved. On the other hand, other respondents (mainly NGOs) disagreed. They were of the opinion that the Recommendation did not achieve its objectives because the safeguards identified were not sufficient for the protection of health and the environment.

There was a consensus among respondents that the Recommendation had not or only partly alleviated public concerns.

Cost analysis

In eight Member States, the study did not reveal any examples of changes in relation to planning and permitting for HVHF activities as a direct result of the application of the Recommendation (Austria, Denmark, Germany, Hungary, Netherlands, Poland, Romania and Spain). In three Member States (Lithuania, Portugal and the UK), the national expert reports and stakeholders survey indicated that the application of the Recommendation may have resulted in changes, which may in turn have associated costs. However a thorough analysis of the situation in these three countries identified only three instances where changes are likely to have been implemented as a result of the Recommendation, and only in Portugal and in Lithuania. In Portugal a website has been set up to provide for the dissemination of information on activities involving HVHF. Moreover as a result of the Recommendation, EIAs are mandatory for exploratory drilling (*sondagem*) and/or extraction of hydrocarbons by unconventional methods (including hydraulic fracturing). The cost to the regulatory authority associated with setting up the database was estimated to be low. HVHF has not been carried out at any site in Portugal, and hence no costs associated with the provision of information by operators have yet been incurred. Concerning the new EIA requirements, this change could potentially incur a cost for any projects which would require an EIA under this new law. In Lithuania the legislation was amended to include monitoring requirements that reflect some elements of the principle of the Recommendation on monitoring. Monitoring requirements can incur costs which are further specified in this report. It is to be noted that there have been no HVHF activities in Lithuania.

Résumé

En janvier 2014, la Commission a adopté une Recommandation relative aux principes minimaux applicables à l'exploration et à la production d'hydrocarbures (tels que le gaz de schiste) par fracturation hydraulique à grands volumes. L'efficacité de la Recommandation doit être examinée par la Commission 18 mois après sa publication. À la fin de 2014, la Commission a invité les États membres à rapporter les mesures qu'ils ont mis en place liées à la Recommandation. Sur les 28 États membres, 11 ont répondu au questionnaire en indiquant qu'ils avaient l'intention d'accorder ou ont accordé une autorisation pour l'exploration ou la production d'hydrocarbures qui peut nécessiter l'utilisation de la fracturation hydraulique à grands volumes sur terre et/ou en mer. Cela concerne les Etats membres suivants: l'Autriche, le Danemark, l'Allemagne, la Hongrie, la Lituanie, les Pays-Bas, la Pologne, le Portugal, la Roumanie, L'Espagne, et le Royaume-Uni.

Actuellement sur la base d'informations disponibles collectées pour cette étude, il n'y a pas dans l'Union Européenne de production commerciale d'hydrocarbures qui utilise la fracturation hydraulique à grands volumes. Toutefois, certains développements ont eu lieu ou sont prévus dans les pays suivants:

• Dans trois pays - l'Allemagne, la Pologne et le Royaume-Uni, la fracturation hydraulique à grands volumes a été effectuée à des fins d'exploration et pour un nombre limité de sites.

• Aux Pays-Bas, une évaluation stratégique des incidences sur l'environnement de la stratégie spatiale sur le développement des gaz de schiste a été achevée et fera l'objet d'une phase de consultation publique en 2016.

• En Lituanie, deux évaluations stratégiques des incidences sur l'environnement ont été adoptées avant la procédure d'octroi de licences d'hydrocarbures concernant l'exploration des gaz et pétroles conventionnels et non-conventionnels. Des fracturations hydrauliques à bas volumes ont été réalisées sur deux sites.

• En Hongrie, des fracturations hydrauliques à bas volumes ont été réalisées durant des phases d'exploration ciblant des gisements de gaz de schiste et de gaz compact.

• En Espagne, des licences ont été accordées et des procédures d'étude d'incidence sur l'environnement sont en cours de réalisation.

• En Roumanie et au Danemark, des forages exploratoires ciblant des gisements de gaz de schiste ont été effectués sans fracturation hydraulique. Aucune autre activité d'exploration n'est prévue.

• En Autriche et au Portugal, aucune licence n'a encore été accordée ou est active en vue de l'exploration et/ou de l'exploitation d'hydrocarbures par fracturation hydraulique à grands volumes. Des demandes de licence sont actuellement évaluées au Portugal.

Cette étude a pour but d'assister la Commission dans l'examen de l'efficacité de la Recommandation en 1) évaluant la façon dont les États membres appliquent les principes de la Recommandation et certaines dispositions juridiques européennes durant les phases de planification et d'obtention des licences et permis. 2) décrivant les développements réglementaires et non réglementaires dans les Etats membres suite à l'adoption de la Recommandation et 3) en collectant les points de vue des parties prenantes. En outre, cette étude analyse le coût éventuel des mesures prises à la suite de l'adoption de la Recommandation.

Évaluation de l'application des principes de la Recommandation et de certaines dispositions juridiques européennes

L'évaluation est basée sur un examen approfondi de la procédure d'autorisation (incluant les évaluations stratégiques des incidences sur l'environnement, les évaluations des incidences sur l'environnement, les licences, les permis et les évaluations des risques) et sur des entretiens avec les autorités compétentes pour les sites sélectionnés. Pour chaque pays, jusqu'à cinq études de cas ont été sélectionnées en fonction de critères précis (par exemple la réalisation ou non de fracturation hydraulique à grands volumes, le calendrier de la procédure d'autorisation par rapport à l'adoption de la Recommandation, la taille du projet, les aspects transfrontières, les aspects environnementaux). Les études de cas ont évalué comment les principes de la Recommandation et certaines dispositions juridiques européennes concernant par exemple les directives sur l'eau et les déchets sont reflétés durant les phases de planification et d'obtention de licences et permis pour ce type de projet.

Pays	Etudes de cas sélectionnées
Allemagne	- Site d'exploration de gisement de gaz de schiste Damme 3
Autriche	Aucune. L'Autriche a accordé à deux sociétés des droits exclusifs d'explorer et d'exploiter les hydrocarbures dans des zones géographiques définies. Les deux sociétés n'ont pas fait usage de leur licence.
Danemark	- Puit d'exploration de gaz de schiste au Nordjylland
Hongrie	Aucune. Des fracturations hydrauliques à bas volumes ont été réalisées durant des phases d'exploration ciblant des gisements de gaz de schiste et de gaz compact. Aucune fracturation hydraulique à grands volumes a été réalisée ou est prévue dans un futur proche sur des sites d'exploration d'hydrocarbures.
Lituanie	- deux évaluations stratégiques des incidences sur l'environnement (complétées en 2007 et 2011) - Licence Gargždai (site Pietų Šiūpariai-5) - Licence Rietavas (site Rietavas-1)
Pays Bas	- évaluation stratégique des incidences sur l'environnement (phase de consultation publique en 2016)
Pologne	- Licence Wejherowo - Licence Lidzbark Warmiński - Licence Lębork (site de Żarnowska et Lublewo) - Licence Wodynie-Łuków - Licence Łeba
Portugal	Aucune. Trois demandes de licence d'exploration ont été soumises. Elles sont en cours d'évaluation par les autorités portugaises.
Roumanie	- Licence Barlad EV-2 (sites de Pungesti, Bacesti, Gagesti, et Puiesti)
Espagne	- Licence Sedano: (Site Sedano 1, 2 et 3) - Licence Urraca (Site Urraca 1, 2 et 3) - Licence Bezana et Bigüenzo (Sites de El Coto et Cadialso)
Royaume Uni	- Site de Preese Hall Farm - Site de Land at Roseacre Wood - Site de Land north of Preston New Road

Les rapports nationaux ont également examiné les développements réglementaires et non-réglementaires adoptés après la publication de la Recommandation et les décisions judiciaires importantes. Enfin, les rapports devaient aussi identifier les incertitudes juridiques potentielles et les bonnes pratiques liées à la planification, aux licences et aux permis d'exploration et de production d'hydrocarbures par fracturation hydraulique à grands volumes.

Alors que les rapports nationaux couvrent tous les aspects de la Recommandation et toutes les dispositions juridiques européennes sélectionnées**,** le présent rapport sur les principales conclusions de l'étude se concentre sur les principes clés de la Recommandation, identifiés en consultation avec la Commission. Les principes retenus sont ceux où l'étude a révélé des applications divergentes dans les États membres (par exemple les principes lies aux évaluations des incidences sur l'environnement), ou incomplète (par exemple les principes liées à l'évaluation stratégique des incidences sur l'environnement, la diffusion des informations), mais aussi où celle-ci a identifié des bonne pratiques (par exemple en ce qui concerne les obligations liées au suivi).

La planification stratégique et l'évaluation de l'impact environnemental

Seule la Lituanie et le Royaume-Uni ont préparé une évaluation stratégique des incidences sur l'environnement avant l'octroi des licences. Les Pays-Bas ont accordé des licences qui sont suspendues jusqu'à la finalisation de l'évaluation stratégique des incidences sur l'environnement (actuellement en phase de consultation du public).

Dans la plupart des pays, la législation établit des restrictions aux activités dans des zones particulières telles que les zones inondables ou les zones sujettes aux séismes reflétant le principe de la recommandation (point 3.2). Les restrictions sont définies de deux façons différentes: soit elles s'appliquent spécifiquement à la fracturation hydraulique, soit elles s'appliquent dans le cadre de la législation applicable à différentes activités, y compris à l'exploration et l'exploitation des hydrocarbures en général. Aucun des pays couverts incluent dans leur législation toutes les restrictions prévues au point 3.2 de la Recommandation.

En général, le public a eu une réelle possibilité de participer au plus tôt à la procédure d'évaluation des incidences sur l'environnement, quand elle est effectuée (quelques-uns des sites examinés n'ont pas été soumis à une évaluation des incidences sur l'environnement). Cependant, dans les pays où les évaluations des incidences sur l'environnement ont été achevées ou sont en cours d'achèvement, les procédures de participation du public et les délais pour la réalisation de ces évaluations diffèrent sensiblement d'un pays à l'autre. Même si cet élément n'est pas couvert par la Recommandation, il est intéressant d'observer qu'il n'y a pas d'approche commune concernant les évaluations des incidences sur l'environnement. Par exemple, les évaluations des incidences sur l'environnement couvrent soit un projet spécifique, soit plusieurs projets de puits dans une zone de licence ou l'ensemble de la zone de licence. Dans les pays couverts, la portée de l'évaluation est décidée au cas par cas par les autorités compétentes.

Les règles concernant les seuils qui déclenchent l'application de la directive sur les évaluations des incidences sur l'environnement diffèrent d'un pays à l'autre. Plusieurs pays ont adopté ou envisagent d'adopter des règles spécifiques pour les projets impliquant l'utilisation de la fracturation hydraulique (à savoir l'Autriche, le Danemark, l'Allemagne, la Lituanie, le Portugal et l'Espagne). D'autres pays appliquent des seuils relatifs à la profondeur du forage, la taille de l'installation et/ou la proximité des zones sensibles à partir desquels les autorités déterminent si une évaluation des incidences sur l'environnement est nécessaire (Pays-Bas, Hongrie, Pologne et Royaume-Uni), tandis que certains pays appliquent à la lettre les exigences et les seuils de la directive (Roumanie).

Dans la pratique, les évaluations des incidences sur l'environnement qui ont été finalisées (Pologne et Royaume-Uni) ou qui sont en cours (à savoir l'Espagne) pour les projets examinés, couvrent les principales caractéristiques de l'exploration des hydrocarbures non conventionnels et les impacts potentiels liés à la fracturation hydraulique à grands volumes. Un examen technique approfondi des contenus de ces évaluations ne faisait pas partie du cahier des charges de cette étude.

Enfin, même si cela n'est pas mentionné par la Recommandation, il convient de noter qu'aucun des pays couverts par l'étude a adopté des lignes directrices et/ou des règles spécifiques concernant le contenu des évaluations des incidences sur l'environnement pour les projets impliquant l'exploration et la production d'hydrocarbures utilisant la fracturation hydraulique à grands volumes.

Étude de référence

Dans l'ensemble, les dix paramètres de la Recommandation dans l'étude de référence ne sont pas systématiquement reflétés dans la pratique. Dans plusieurs études de cas les paramètres en relation avec la qualité de l'air, la sismicité, la présence de méthane et d'autres composés organiques volatils dans l'eau, l'état des infrastructures et des bâtiments, ainsi que les puits existants et les structures abandonnées ne sont pas couverts. Bien que non mentionné par la Recommandation, il est important de noter deux éléments qui ne sont pas clairement définis dans la loi et les procédures d'autorisation. Le premier élément concerne la portée géographique de l'étude de référence. Le second concerne les données requises, à savoir si l'étude de référence doit se fonder sur des échantillons spécifiques dans les zones environnantes des puits d'exploration ou sur des données déjà disponibles. Ceci est généralement décidé au cas par cas entre les autorités compétentes et les exploitants. Enfin, il n'est pas toujours mentionné dans les procédures d'autorisation si les études de référence doivent être réalisées avant toutes opérations et/ou spécifiquement avant l'utilisation de la fracturation hydraulique à grands volumes.

Obligations liées au suivi

Des obligations liées au suivi ont été mises en œuvre sur les sites où ont été réalisées des fracturations hydrauliques à grands volumes (Allemagne, Pologne, Royaume-Uni). En Espagne, certaines mesures liées au suivi sont prévues dans les évaluations des incidences sur l'environnement rédigées par les exploitants. Aucune tendance spécifique ne peut être identifiée sur la façon dont les obligations liées au suivi ont été appliquées ou prévues d'être appliquées à des sites spécifiques, à l'exception du Royaume-Uni où les sites post-Recommandation (à la différence des sites pré-Recommandation) appliquent des mesures de contrôle spécifiques reflétant dans une large mesure le principe de la Recommandation. La Lituanie a adopté des obligations liées au suivi concernant, entre autres, la fracturation hydraulique et couvrant de nombreux aspects de ce principe.

Diffusion des informations

Le principe de la diffusion des informations, par les exploitants ou par les autorités compétentes n'est pas pleinement pris en compte dans la législation, de manière volontaire ou au niveau de la procédure d'autorisation dans les pays couverts par l'étude. La situation varie d'un État membre à l'autre, une minorité publie les permis environnementaux ou a mis en place un site web dédié, tandis que d'autres ne divulguent pas ces informations publiquement ou seulement une petite partie de ces informations sur demande.

Principales conclusions sur l'application des dispositions juridiques européennes sélectionnées

Les études de cas et les entretiens avec les autorités compétentes ont révélés des points de vue et des approches différentes dans les Etats membres quant à l'application à l'exploration et à la production d'hydrocarbures par fracturation hydraulique à grands volumes de certaines dispositions juridiques européennes sélectionnées. Cette remarque concerne en particulier l'application de la directive 2010/75/UE (directive relatives aux émissions industrielles), la directive 2006/21/CE (directive concernant les déchets de l'industrie extractive), et la directive 2000/60/CE (directive cadre sur l'eau). Cette étude n'examine pas la conformité de la législation nationale ou des procédures d'autorisation avec la législation communautaire existante.

Consultation des parties prenantes

Le but de cette tâche était de collecter et d'analyser les points de vue des parties prenantes au niveau national et européen concernant l'efficacité de l'approche européenne pour réglementer les activités qui peuvent utiliser la fracturation hydraulique à grands volumes. L'industrie pétrolière et gazière, l'industrie de l'eau, l'industrie chimique, les ONG et les services géologiques ont été consultés.

Les entretiens des parties prenantes au niveau européen

Deux personnes interrogées respectivement de l'industrie du pétrole et du gaz et de l'industrie chimique considèrent qu'il est difficile de porter un jugement sur l'efficacité de la Recommandation. Un représentant de l'industrie pétrolière et gazière a fait valoir qu'il était trop tôt pour juger l'efficacité de la Recommandation compte tenu du nombre limité de sites d'exploration de gaz de schiste dans l'Union Européenne. Un représentant de l'industrie chimique a souligné qu'il était difficile de distinguer l'effet de la Recommandation de l'effet des autres législations européennes et nationales en matière de gestion de l'environnement, gestion des déchets et d'exploration et de production des hydrocarbures.

Au niveau européen les points de vue des parties prenantes sur l'efficacité de la Recommandation diffèrent de façon significative. Pour les représentants de l'industrie pétrolière et gazière et de l'industrie chimique la Recommandation a atteint selon leur point de vue son objectif. Elle a conduit à des changements au niveau des procédures d'autorisation et a servi de point de départ pour de nombreux débats. Ils ont aussi mentionné que des nouvelles dispositions juridiquement contraignantes concernant la fracturation hydraulique à grands volumes ne sont pas nécessaires et créeraient un frein au développement des gaz de schiste dans l'Union Européenne. Ils ont fait valoir que la réglementation actuelle de l'Union Européenne, complétées par les dispositions juridiques nationales et les lignes directrices de l'industrie, était suffisante pour règlementer la fracturation hydraulique à grands volumes. Ils estiment que la Recommandation constitue un guide, des bonnes pratiques ou une 'check list' détaillée qui n'a pas besoin d'être révisée.

Inversement, les représentants des ONG et de l'industrie de l'eau ont suggéré des mesures et des amendements spécifiques à la Recommandation ou étaient en faveur de l'introduction de dispositions juridiquement contraignantes concernant la fracturation hydraulique à grands volumes. Ils ont fait valoir que le cadre réglementaire concernant la fracturation hydraulique à grands volumes est différent d'un État membre à un autre. Les représentants des ONG ont souligné les divergences d'interprétation juridique concernant l'applicabilité de la législation environnementale de l'Union Européenne à la fracturation hydraulique à grands volumes. La capacité de la législation actuelle de l'Union Européenne à réglementer de manière adéquate les impacts environnementaux de la fracturation hydraulique à grands volumes a également été contestée par les représentants des ONG.

Toutes les personnes interrogées ont convenu de l'importance d'informer le public sur la fracturation hydraulique à grands volumes tout en soulignant que la Recommandation n'a pas aidé à atténuer les préoccupations du public. Selon un représentant de l'industrie la recommandation a contribué à améliorer la transparence alors que les représentants des ONG ont souligné que l'information reste difficile à obtenir, et que la Recommandation ne semble pas avoir donné lieu à une amélioration à cet égard.

Sondage en ligne

Une nette divergence d'opinion entre les représentants de l'industrie pétrolière et gazière et les ONG apparait dans les réponses reçues dans le cadre de l'enquête en ligne. L'opinion des services géologiques est en grande partie alignée sur celle de l'industrie pétrolière et gazière, tandis que l'opinion de l'industrie de l'eau s'aligne généralement avec celle des ONG.

Les représentants de l'industrie du pétrole et du gaz ont estimé que les principes de la Recommandation ont déjà été reflétés dans la législation nationale et sont appliqués en pratique. Du fait qu'ils considèrent que la législation nationale est adéquate ils estiment que le but de la Recommandation a déjà été partiellement ou totalement atteint. Les autres sondés (principalement des ONG) sont en désaccord avec ce point de vue. Ils estiment que la Recommandation n'a pas atteint ses objectifs parce qu'elle ne garantit pas des protections suffisantes pour la santé et l'environnement.

Les sondés ont reconnu de manière consensuelle que la Recommandation n'avait pas ou seulement partiellement atténué les préoccupations du public.

Analyse du coût

Dans huit États membres, l'étude n'a pas révélé de changements en matière de législation et de procédure de planification et d'autorisation des projets impliquant l'utilisation de la fracturation hydraulique à grands volumes dus à l'application de la Recommandation (Autriche, Danemark, Allemagne, Hongrie, Pays-Bas, Pologne, Roumanie et Espagne). Dans trois États membres (Lituanie, Portugal et Royaume-Uni), les rapports nationaux, le sondage en ligne a indiqué que la Recommandation aurait pu entraîner des modifications règlementaires et des coûts associés. Cependant une analyse approfondie de la situation dans ces trois pays a permis d'identifier seulement trois cas où des changements sont susceptibles d'avoir été mis en œuvre à la suite de la Recommandation, et seulement au Portugal et en Lituanie. Au Portugal, un site web a été mis en place pour assurer la diffusion des informations sur les activités impliquant la fracturation hydraulique à grands volumes. En outre, les évaluations des incidences sur l'environnement sont obligatoires pour les forages exploratoires (sondagem) et / ou l'extraction d'hydrocarbures par des méthodes non conventionnelles (incluant la fracturation hydraulique). Le coût pour l'autorité réglementaire associé à la mise en place de la base de données a été estimé comme faible. Aucune fracturation hydraulique à grands volumes n'a été effectuée sur un site au Portugal, il n'y a donc pas de coûts associés à la fourniture d'informations par les exploitants à ce stade. En ce qui concerne les nouveaux critères liés aux évaluations des incidences sur l'environnement, ce changement pourrait créer des coûts pour tous les projets qui nécessiteraient cette évaluation en vertu de cette nouvelle loi. En Lituanie, la loi a été modifiée pour inclure des dispositions concernant les obligations liées au suivi qui reflètent certains éléments de ce principe de la recommandation. Les nouvelles dispositions concernant les obligations liées au suivi peuvent engendrer des coûts qui sont précisés dans l'étude. Il est à noter qu'il n'y a pas eu de fracturation hydraulique à grands volumes en Lituanie.

1 Objectives and methodology

In January 2014 the Commission adopted a Recommendation setting out minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high-volume hydraulic fracturing ('the Recommendation')[1]. The Recommendation includes principles on:

- Strategic environmental assessment
- Environmental impact assessment
- Exploration and production permits
- Site selection
- Baseline studies before starting operations
- Spill prevention in the design and construction of the installation
- Operational requirements
- Use of chemical substances and water
- Monitoring
- Environmental liability and financial guarantee
- Administrative capacity
- Closure obligations
- Dissemination of information

They aim to address certain environmental aspects that are currently not comprehensively addressed in EU environmental legislation, and to help create a level playing field for operators, and respond to the public concerns with regard to shale gas developments.

The effectiveness of the Recommendation is to be reviewed by the Commission 18 months[2] after its publication. Building on the results of the review, the Commission will then decide whether further action is necessary, such as updating the Recommendation's provisions and/or putting forward legislative proposals with legally binding provisions on the exploration and production of hydrocarbons using high-volume hydraulic fracturing[3]. This study supports the Commission in this review through:

- The assessment of how the principles of the Recommendation and selected EU legal requirements were applied at the planning, licensing and permitting levels in Member States.
- The gathering of stakeholder views on the effectiveness of the Recommendation.
- The cost analysis of measures taken as a result of the adoption of the Recommendation

1.1 Assessment of the application of the Recommendation principles and selected EU legal requirements

Member States were invited to inform the Commission by the end of 2014 on measures they put in place in response to the Recommendation. Based on the responses received from Member States to the Commission questionnaire, the assessment of the application of the Recommendation's principles and EU selected requirements covered 11 countries (Austria, Denmark, Germany, Hungary, Lithuania, Netherlands, Poland, Portugal, Romania, Spain, and the UK) which answered positively to the question ' *Did you grant or do you plan to grant authorisations for the exploration or production of hydrocarbons that may require the use of high-volume hydraulic fracturing (in onshore and/or offshore operations)?*'.

[1]Commission Recommendation of 22 January 2014 on minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high volume hydraulic fracturing, 2014/70/EU

[2] See Point 16.2 of the Recommendation

[3] See Point 16.4 of the Recommendation

For each country report, up to five case studies were selected and approved by the Commission. In order to guide the Commission on the selection of case studies, the different sites were mapped based on the following criteria:

- HVHF carried out or planned
- EIA/screenings carried out
- Before/after the adoption of the Recommendation
- Size of the project
- Protected areas/environmental aspects involved
- Geographical location
- Transboundary aspects
- Geological specificity
- In case of decentralised permitting procedures, permits/licenses granted in different regions
- Significance of public interest

For each case study, national experts had to analyse how the Strategic Environmental Assessments (SEAs), licenses, permits, Environmental Impact Assessments (EIAs), EIA screenings, and risk assessments, applied the principles of the Recommendation and selected legal requirements under the following EU legal texts:

- Directive 94/22/EC (Hydrocarbons Directive)
- Directive 2001/42/EC (SEA Directive)
- Directive 2011/92/EU (EIA Directive)
- Directive 2010/75/EU (IED)
- Directive 96/82/EC (Seveso II)
- Directive 92/43/EEC (Habitats Directive)
- Directive 2009/147/EC (Wild Birds Directive)
- Regulation (EU) No 525/2013 GHG Monitoring Regulation) and Decision No 406/2009/EC (ESD)
- Directive 2008/98/EC (Waste Framework Directive)
- Directive 2006/21/EC (Extractive waste Directive)
- Directive 2000/60/EC (Water Framework Directive)
- Directive 2006/118/EC (Groundwater Directive)
- Directive 2013/59/Euratom (exposure to ionising radiation)

Please note that the above list of EU legal requirements is a selection and is not meant to be exhaustive. This report also did not carry out a conformity or a compliance check, hence by mentioning that some pieces of EU legislation were "applied" or "considered" at planning, licensing or permitting level does not mean that they were "properly" or "comprehensively" applied.

The table below provides an overview of the case studies selected for this assessment.

Country	Case studies selected
Austria	None. Austria granted exclusive rights to explore and exploit hydrocarbons in defined geographical areas to two companies. One of the two companies, *Rohöl-Aufsuchungs Aktiengesellschaft,* never made any attempt to use this license for shale gas exploration or exploitation activities. The other company, *OMV Austria Exploration & Production GmbH*, planned shale gas exploration and exploitation activities in the '*Weinviertel*' area of Austria. The shale gas exploration and exploitation was supposed to be carried out through 'clean fracking', with only water, corn starch and quartz sands. However, the company withdrew these plans before having carried out any activities in 2012.
Denmark	Denmark granted two licenses for the exploration and production of hydrocarbons where the exploration target is shale gas, respectively one in Nordjylland and one in Nordsjælland): - In Nordjylland a drilling site was selected and an exploration well was spudded on 4 May 2015. - Total and NF relinquished license 2/10 (Nordsjælland) with effect from 1 July 2015. Therefore the Nordjylland exploration well was the only case study in Denmark.

Country	Case studies selected
Germany	In Germany, according to available information, a total of four wells were subject to HVHF as defined in the Commission Recommendation: - In 1982, HVHF was carried out at the well Söhlingen Z4 with a total water injection volume of 2,336 m³ during one frac. - In 1984, HVHF was carried out at the well Söhlingen Z3 with a total water injection volume of 1,693 m³during one frac. - In 1985, HVHF was carried out at the well Söhlingen Z5 with a total water injection volume of 1,382 m³ during one frac. - In 2008, HVHF was carried out at the well Damme 3 with a total water injection volume of slightly more than 12,000 m³ during three fracs. Since the first three sites were subject to HVHF thirty years ago, when a number of pieces of EU legislation were not yet in force, this study only focused on the Damme 3 site where HVHF was carried out more recently (2008).
Hungary	No case studies identified. Low volume hydraulic fracturing was carried out at the exploratory phase targeting shale gas and tight gas resources. None of the current hydrocarbon sites under exploration were or will be subject to HVHF as defined under the Commission Recommendation in the near future, according to available information. However Hungary does not exclude the possibility to use HVHF.
Lithuania	In Lithuania, SEAs were carried out prior to the public tender procedure to grant licenses for the prospecting, exploration and exploitation of hydrocarbons for the Šilutės–Tauragės 1800 square km area in 2011 and for the Rietavas 1599 square km area in 2006. Chevron won the public tender procedure launched in 2012 by the Lithuanian Geological Survey concerning the Šilutės–Tauragės area, but decided to pull out prior to the grant of a license for the exploration and production of hydrocarbons including unconventional ones. The Lithuanian report covers these two SEAs. Shale gas exploratory developments already occurred in Lithuania at two sites under the Rietavas and Gargždai license areas. At one site, hydraulic perforation tests were carried out, and at another site, a hydraulic fracturing test was completed, which did not meet the definition of HVHF. The Lithuanian report covers these two sites based on limited available information.
Netherlands	The Netherlands granted three onshore licenses[4] during 2009 and 2010, for the exploration of hydrocarbons in which the applicants have mentioned shale gas and or coal bed methane. In 2011, the Ministry of Economic Affairs agreed with the permit holders on a suspension of the permits, awaiting further examination on the possible effects of shale gas exploration and production[5]. During this so-called moratorium, no new exploration permit requests have been considered. In July 2015, the Minister of Economic Affairs informed the Parliament that the existing licenses will not be extended, and that new applications will not be considered. Commercial exploitation and exploration of shale gas will not be considered for the next five years. The national report therefore only covers the SEA for the spatial strategy on shale gas development which was completed in July 2015 but is still subject to public consultation in 2016.
Poland	As of January 2015[6], there were 53 licenses on the exploration of hydrocarbons (shale gas) in Poland. None of these covered the production of hydrocarbons using HVHF. The following case studies were selected: - Wejherowo license no. 04/2009/p issued in 2009 held by PGNiG, large project located in Pomorskie Region, EIA and last environmental decision granted in 2012, HVHF carried out; - Lidzbark Warmiński license no. 11/2011/p issued in 2011 held by Wisent oil&gas (currently ShaleTech Energy), project located in Warmińsko-Mazurskie Region, close to the Russian border, only EIA screening in

[4] http://www.rijksoverheid.nl/onderwerpen/schaliegas/proefboringen-naar-schaliegas
[5] http://www.nrc.nl/schaliegas/
[6] Ministry of the Environment, http://lupki.mos.gov.pl/gaz-z-lupkow/stan-prac-w-polsce.

Country	Case studies selected
	2011/2012, environmental decision granted in 2012, HVHF carried out; - Lębork license no. 16/2007/p issued in 2007 held by Lane Energy Poland Ltd., medium project located in Pomorskie Region, the EIA process was ongoing in 2014 (one site location), some public concern was identified, environmental decision granted in 2015, HVHF carried out; - Wodynie-Łuków, license no. 51/2009 issued in 2009 held by Orlen Upstream Ltd, project located in Lubelskie Region, close to the Ukrainian border, no EIA or screening, permits (e.g. concerning extractive waste) granted in 2013, HVHF carried out; - Łeba license no. 37/2001/p issued in 2001 held by LOTOS Petrobaltic S.A., offshore project with new environmental permit- 2014 (EIA carried out in 2014), no HVHF;
Portugal	None. Even though studies showed that Portugal has some potential for the exploration and production of hydrocarbons by unconventional methods,[7] and some geological areas have been defined as having potential for shale gas and oil, the exploration and production of hydrocarbons by unconventional methods in Portugal has not yet been initiated. No shale wells have been drilled or tested yet. Three exploration and production concessions have already been requested under direct negotiation to date, but the process is still being evaluated by the Portuguese authorities.
Romania	The Pungesti shale gas exploration site within the perimeter of the Barlad EV-2 concession area into the North-Eastern part of Romania held by Chevron was selected as a case study. It is the only site where actual exploration work has been carried out in Romania (without involving HVHF). The other three sites under this concession, with similar permitting requirements, were also analysed where relevant.
Spain	Three investigation and exploration permits have been selected, covering a total of eight sites: - "Sedano" license: covering the sites Sedano 1, 2 and 3 - "Urraca" license: covering the sites Urraca 1, 2 and 3 - "Bezana and Bigüenzo" license: covering the "El Coto" and "Cadialso" sites. All of the licenses were granted before the Recommendation and exploratory drilling or HVHF has not been carried out under any of them. Out of the selected licenses, Sedano and Urraca are the most advanced, since an EIA has already been submitted to the competent authorities and at the time of writing this report, it is under public consultation.
The UK	The following case studies were selected in the UK: - Preese Hall Farm, Weeton, Kirkham, Lancashire, Cuadrilla Resources Ltd, (Permission granted, HVHF carried out prior to the adoption of the Recommendation) - Land at Roseacre Wood, Lancashire, Cuadrilla, environmental permits granted but planning application rejected in June 2015 - Land north of Preston New Road, Lancashire, Cuadrilla environmental permits granted but planning application rejected in June 2015.

The national reports also included sections on the regulatory and non-regulatory developments in this area adopted after the publication of the Recommendation, relevant case law, potential legal uncertainties and useful practices related to the planning, licensing, permitting for the exploration and production of hydrocarbons using

[7] For more information please see the replies of Portugal to the EU Survey on the Recommendation, available at https://ec.europa.eu/eusurvey/publication/ShalegasRec2014

HVHF. Competent authorities were contacted and interviewed to cross-check desk research and guide experts in gathering all permitting documents for the assessment.

Each national report was reviewed by the relevant Member State competent authorities to avoid factual errors.

1.2 Gathering of stakeholders views on the effectiveness of the Recommendation

The purpose of this task was to collect and analyse national and EU stakeholder views on the effectiveness of the EU approach to regulating activities that may use HVHF. To that end we carried out an online survey and interviewed eight EU stakeholders. The online survey targeted representatives of the oil and gas industry, the waste management industry, the chemical industry, NGOs, the labour unions and the scientific community in eleven countries: Austria, Denmark, Germany, Hungary, Lithuania, Netherlands, Poland, Portugal, Romania, Spain, and the UK. Two hundred stakeholders were contacted and had the opportunity to respond to an online questionnaire (questionnaire template in Annex II) within a four month timeframe from February 2015 to May 2015. In addition to the online survey, we also interviewed the main EU stakeholders to understand their views on the effectiveness of the approach chosen at EU level to regulate activities that may use HVHF. The following EU stakeholders were contacted for interviews:

- International association of oil and gas producers (IOGP)
- Business Europe
- European Federation of Waste Management and Environmental Services (FEAD)
- International association of drilling contractors (IADC)
- European Federation of Bottled Water
- Food and Water Europe
- Friends of the Earth Europe
- Health and Environment Alliance (HEAL)
- European Trade Union Confederation (ETUC)
- Eurogeosurveys (EGS)
- EUREAU
- CEFIC
- Petrochemicals Europe

Interviews were completed between February and May 2015. In the absence of a reply, no interviews could be organised in the end with FEAD and ETUC.

1.3 Cost analysis

The aim of this task was to identify and gather evidence on costs incurred by competent authorities in Member States as well as by operators as a consequence of implementing the Recommendation. Evidence on the consequences of the implementation of the Recommendation was mainly based on an online survey into the effectiveness of implementation of the Recommendation and individual Member State case study interviews.

From this material, we have sought to determine first whether Member States are likely to have incurred costs from implementing the Recommendation. If any examples of cost increases or reductions were identified, we considered whether these costs could be estimated from the evidence gathered.

When reviewing the information, it was important to distinguish between evidence gathered on costs which have been incurred, and potential future costs associated with the previous or anticipated adoption of the Recommendation, or opinion on theoretical

costs. The focus of this task is on actual costs incurred to date by competent authorities in Member States and operators.

1.4 Main challenges encountered

- *Access to information*

In several countries we have experienced some difficulties in accessing permitting documents from competent authorities which led to some delays in the completion of the national reports. In Germany, our experts were not able to access Damme 3 site permitting documents over a period of five months (April to August 2015) despite contacting the competent authorities on several occasions. In Poland several permitting documents were not available online but only through lengthy official administrative request procedures[8]. In Lithuania some permitting documents such as 'drilling well projects' were considered confidential and could not be accessed. Due to the lack of or limited available information on hydraulic fracturing carried out and the amount of water used in Denmark, Hungary and Lithuania in particular, we experienced some difficulties in assessing which hydrocarbon exploration and exploitation developments, if any, could fall under the scope of the Commission Recommendation in these countries.

- *Early stage of development*

No commercial production of hydrocarbons through HVHF is on-going in the EU. In three countries (Germany, Poland and the UK) HVHF was carried out. Within these countries there have been few 'post-recommendation' permitting procedures. In the Netherlands, a SEA was completed and will undergo a public consultation phase in 2016. In Lithuania, two SEAs were adopted and shale oil and gas exploration including low volume hydraulic fracturing was carried out at two sites. In Hungary, low volume hydraulic fracturing was carried out at the exploratory phase targeting shale gas and tight gas resources. In Spain, EIA procedures are on-going and the principles of the Recommendation and EU requirements were assessed based on EIA documents drafted by the operators and that were not yet approved by competent authorities. In Romania and Denmark, shale gas exploratory drilling was carried out without hydraulic fracturing. In Austria and Portugal, no licenses and permits for the exploration and/or exploitation of hydrocarbons that may require the use of HVHF have been granted.

- *Limited number of responses from the online survey*

While just over 200 national stakeholders were contacted to complete the online questionnaire, and several reminders sent within a four month period, only 18 responses were received and covering only seven Member States out of the eleven targeted. Responses from two countries represent two-thirds of the total responses: seven Spanish organisations and five British organisations replied to the questionnaire. Responses were not received from stakeholders in Austria, Hungary, Lithuania, and Romania.

[8] Note that in this case the expert could have access to permitting documents

Table 1: Overview of respondents

Respondents	Type of respondents
Denmark	
Danish Society for Nature Conservation	NGO
Germany	
Deutscher Naturschutzring e.V.	NGO
Hungary	
Hungarian Mining Association	Oil and gas industry
Netherlands	
Geological Survey of the Netherlands	Geological Survey
Poland	
The Polish Exploration and Production Industry Organization	Oil and gas industry
Polish Geological Institute	Geological Survey
Portugal	
QUERCUS - ANCN	NGO
Spain	
Ente Vasco de la Energia / Sociedad de Hidrocarburos de Euskadi	Oil and gas industry
BNK Hidrocarburos	Oil and gas industry
ACIEP	Oil and gas industry
Shale gas España	Oil and gas industry
Montero Energy Corp.	Oil and gas industry
Frontera Energy Corp. S.L.	Oil and gas industry
ANEABE - Spanish Association of Bottled Waters	Water industry
United Kingdom	
The UK Environmental Law Association (UKELA)	NGO
No Fracking in Balcombe Society (No FiBS)	NGO
UK Onshore Oil and Gas (UKOOG)	Oil and gas industry
Halliburton	Oil and gas industry
Cuadrilla Resources Ltd.	Oil and gas industry

2 Overall findings per country

The section below provides a summary of the key findings identified in each national report.

2.1 Austria

Although Austria holds potential shale gas resources, to date, these resources have not been explored or exploited using high-volume hydraulic fracturing. Licenses have been granted by the government to two companies to explore and exploit hydrocarbons in specific areas. However, so far no permits have been granted for the actual exploration and exploitation activities by the relevant authorities at the regional level (Bundesländer). One of the two companies, the OMV Austria Exploration & Production GmbH, had planned exploration activities in 2011. However, these plans were abandoned by the company, due to financial infeasibility in 2012. Little information exists regarding the exploration and production of unconventional reservoirs in Austria. The majority of information presented in this report is based on a questionnaire and a number of follow-up questions, filled in by a representative of the department for Mining and Energy in the Austrian Federal Ministry for Science, Research and Economics (BMWFW).

2.2 Denmark

Pursuant to information provided by the DEA, there have been in the past (before the adoption of the Recommendation) two to three instances where HVHF may have been used offshore for conventional oil and gas extraction. No further information is available. There is only one shale gas exploratory well drilled onshore in Denmark: 1/10 Nordjylland. For this site, Total only had a drilling permit to carry out exploratory drilling without the use of HVHF. Total has returned its license for 2/10 Nordsjælland, the second envisaged site for HVHF in Denmark. In 2012 the Danish government introduced a moratorium for new shale gas licenses. This moratorium was introduced to explore the possibility of enabling the production of shale gas taking into account public health, safety and environment. The Danish EIA law requires that projects where fracturing is planned for exploration or extraction of shale gas are subject to a compulsory EIA. The commercial exploitation of gas resources is subject to the Ministerial Order No 669 of 18 June 2014 transposing the IED. Well integrity tests must be reviewed by an independent and qualified third party. A financial guarantee is required to obtain a license for exploration.

2.3 Germany

Hydraulic fracturing has been used in Germany since 1961 (300 times in more than 150 wells). Almost all of these hydraulic fracturing operations were carried out in tight gas reservoirs and fall outside the scope of the Commission Recommendation. In the 1980s, three HVHF operations were performed, but these are not examined in detail in this report as they were carried out before a number of pieces of environmental legislation were in place. In recent years only one HVHF was carried out in Germany (Damme 3) in 2008. According to the law no EIA or screening had to be carried out prior to granting this particular permit. The current German law does not refer to deep drilling as a criterion to trigger an EIA screening procedure. This would mean that all onshore hydrocarbons wells that do not meet the 500 000 m3 gas per day and 500 tons of oil per day threshold are not subject to either an EIA or a EIA screening. Currently (since 2011 in North Rhine Westphalia and since 2012 in Lower Saxony), no new permits related to the use of HVHF (and tight gas fracturing) have been granted, since the States have decided to wait until the current legislation is reviewed and revised to comprehensively address the environmental impacts of the fracking technology. Until now, companies have accepted this 'political moratorium' and have not applied for new permits. A new draft law on hydraulic fracturing is being discussed in the German Parliament

(Bundestag). The proposed final reading in the Parliament was planned for July 2015. However, it was postponed to a new date (not yet specified as of 14 October 2015).

2.4 Hungary

No HVHF activities were carried out in Hungary, or are planned to be carried out in the near future. However Hungary does not exclude the possibility to use HVHF. Hydraulic fracturing below the threshold as set out in the definition of HVHF in the Commission Recommendation was carried out at the exploratory phase in shale gas and tight gas wells. Neither an EIA nor screening was carried out prior to the grant of these permits unless they were located within a Natura 2000 site. However environmental requirements were set out in the co-authority resolutions of the environmental inspectorates in all cases. The legislative framework has not changed as a result of the adoption of the Commission Recommendation. No SEAs have been carried out for the exploration and/or exploitation of hydrocarbons in Hungary. However, prior to the launch of a concession tender, a 'sensitivity and loadability' assessment is carried out on areas subject to this concession tender. This assessment includes several environmental aspects.

2.5 Lithuania

No licenses and permits were granted in Lithuania after the adoption of the Recommendation. Exploratory developments using hydraulic fracturing/perforation however already occurred in Lithuania at two sites under the Rietavas and Gargždai license areas in 2012. At one site, hydraulic perforation tests were carried out and at another site, a hydraulic fracturing test was undertaken, which did not meet the definition of HVHF. At Pietų Šiūpariai-5 site, the aim of hydraulic fracturing was to explore the potential for shale gas and shale oil. At Rietavas-1 site, the aim of the hydraulic perforation was to explore the potential for conventional oil but shale gas was also a potential target. Part of the principles (e.g. mandatory SEA prior to granting of licenses for hydrocarbon exploration or production, compulsory EIA for the activity of extraction and/or direct exploration of unconventional hydrocarbons using hydraulic fracturing) was already reflected in Lithuanian legislation prior to the adoption of the Recommendation. Since the adoption of the Recommendation, several legal requirements have been adopted to regulate hydraulic fracturing and unconventional hydrocarbons. Some of these requirements reflect several elements of the principle 11 on monitoring of the Recommendation. As further detailed in the section on SEA, two SEAs were performed prior to the issuance of the public tender procedure to grant licenses for the prospecting, exploration and exploitation of hydrocarbons in 2007 and 2011. Chevron won the public tender procedure launched in 2012 by the Lithuanian Geological Survey but decided to pull out prior to the grant of a license for the prospecting and exploitation of hydrocarbons. The Lithuanian Geological Survey was planning to issue a new public tender on use of hydrocarbon resources in the Šilutės-Tauragės area in the autumn 2015 but such plan was abandoned due to lack of interest from operators.

2.6 The Netherlands

The three onshore exploration permits that were granted under the Mining Law in 2009 and 2010 were put on hold in 2011, awaiting the approval of a national strategy (including a SEA). For these permits, no EIAs were carried out. However, before deep drilling (below 100 m) would be allowed to start, the authorities would need to screen the activity to determine whether an EIA is required. In May 2014, the Dutch Government issued a concept note regarding the SEA's scope, which was approved in October 2014 following public consultation. On the basis of this note, the SEA was prepared and published in July 2015, with further public participation in early 2016. In view of the prepared SEA, it can be concluded that the Commission Recommendation 2014/70/EU appears to be fully applied at the planning level, although this is a preliminary conclusion that would need to be confirmed once the SEA consultation process has been fully completed in 2016. In July 2015, the Minister of Economic Affairs informed the Parliament that the existing permits will not be extended, and that new applications will

not be considered. Also, there will be no drilling for shale gas during the current government period. The government is preparing an Energy Report 2015 to present an integrated vision on sustainable energy after which a National Underground Strategy will be prepared in 2016. Considering the importance of an integrated vision, there will no longer be a separate National Strategy on Shale gas. Commercial exploitation and exploration of shale gas will not be considered for the next five years. Local governments will be actively involved in the decision making process. As all permits have been put on hold and will not be extended, the application of the majority of the principles of the Commission Recommendation 2014/70/EU could not be assessed.

2.7 Poland

In Poland, out of the 53 licenses granted as at the end of 2014, two licenses were granted after the adoption of the EC Recommendation, and 51 licenses were issued before the EC Recommendation. 29 licenses with an EIA procedure were found, out of which EIA procedures for seven licenses were carried out during 2014, after the adoption of the Recommendation. There were no EIAs carried out for 17 licenses. For these licenses, there was only a screening concerning impacts on the Natura 2000 areas without a consultation process. A number of elements listed in the Commission Recommendation were applied at the selected sites, however none of the principles of this Recommendation were fully applied, with the exception of a few principles (see country report for further details).

No major differences have been identified in the application of the Recommendation principles between those sites that pre-date and post-date the Recommendation. In other words, the Recommendation does not seem to have influenced the permitting requirements in Poland. The national laws transposing the selected pieces of EU legislation under this study were considered as part of the proposed development at the considered sites.[9] In Poland, the license granting procedure is based on public procurement rules according to the provisions of the Geological and Mining Act. The gas exploration and/or production license granting system is not specifically subject to SEA and no SEA was carried out. The Polish government, in cooperation with other institutions, carried out a number of regulatory and non-regulatory developments such as: research on the environmental impacts of HVHF processes at seven locations, awareness raising campaigns and public consultation, and organisational and legal modifications, the latter aiming essentially at a simplification of the existing framework for investors.

2.8 Portugal

Neither SEAs nor EIAs have been carried out so far, and no licenses and permits have been issued for the exploration or production of hydrocarbons using HVHF. On-going licensing applications are currently under review by the Ministry of Environment, Spatial Planning and Energy, hence many aspects of the Recommendation are currently not relevant to Portugal due to the very early stage of development. Following a 2015 amendment of the Portuguese EIA legislation, EIAs are mandatory since September 2015 for "exploratory drilling (*sondagem*) and/or extraction of hydrocarbons by unconventional methods (including hydraulic fracturing)". A dedicated webpage was also set up.

2.9 Romania

No HVHF has been carried out or was planned in the shale gas exploratory sites examined in Romania; the permitting documents examined only cover exploration activities, not giving the right to carry out HVHF or exploitation works. The procedures for obtaining licenses for hydrocarbon exploration and for the Environmental Agreement

[9] It is beyond the scope of this study to conclude whether or not the identified pieces of EU legislation have been properly/comprehensively applied.

for all wells have been carried out before the entry into force of the Recommendation The Commission Recommendation appears to be partially applied at the planning, permitting, licensing levels at the selected site (Pungesti) and at the three other sites (Puiesti, Gagesti, Bacesti), where environmental permits have been issued but which were not analysed in detail for the purpose of this study. In this context, it seems that only points 3.3 and 3.4 (EIA) were fully applied for the sites analysed for this early phase of exploration. Shale gas resources are not explicitly mentioned in the legislation on oil and natural gas. It was recently clarified by the High Court of Cassation and Justice [10] that shale gas resources are included under petroleum resources.

2.10 Spain

Neither exploratory drilling nor high volume hydraulic fracturing has yet been carried out in Spain. To date, the only licences that have been issued in Spain are for the purposes of exploration. They were all granted prior to the Recommendation. The most advanced sites where HVHF might potentially be used are at the stage of the EIA procedures. At the time of writing this report, the EIAs are under public consultation and have not yet been approved by the competent authorities. The assessment of the Recommendation principles and applicable EU requirements are mainly based on the environmental documentation presented by the operators within the framework of the EIA procedure. Therefore, all the conclusions or views gathered and reflected are considered preliminary. These findings are subject to the decisions that the competent authorities might adopt in the remaining stages of the authorisation procedure. Under the 2013 new Law on Environmental Assessment hydraulic fracturing projects are subject to a compulsory EIA before operational permits are granted whether at exploration or production stages.

2.11 The UK

The Commission Recommendation 2014/70/EU appears to be partially applied at the planning, permitting, licensing levels at the two selected sites, for which applications for consent were made after the introduction of the Recommendation. However, while the principles of the Recommendation are not all fully applied, in some case partial application results from the current stage of the planning and permitting process, which is ongoing.

Most of the main pieces of EU environmental legislation are considered[11] at the two sites for which an application was made for planning permission after the publication of the Recommendation.

The comparison between the available planning and environmental permitting documentation for the site which pre-dates the Recommendation and those for the post-Recommendation sites highlights that the principles of the Recommendation as well as the requirements of various pieces of EU legislation, are now considered when assessing the current applications for hydraulic fracturing. However, this does not appear to have been as a direct result of the publication of the Recommendation, as a number of regulatory and non-regulatory changes were introduced in the UK prior to the introduction of the Recommendation, to address the environmental aspects of shale gas developments in the UK, especially due to heightened public sensitivity.

One main development however, since the publication of the Recommendation, has been the publication of new framework legislation, the Infrastructure Act 2015, which has two key implications for the development of shale gas in England and Wales. First, a new statutory right is introduced to use deep-level land (land at a depth of at least 300

[10] Interpretative Decision no. 25 of 29 June 2015 on Article 1 of the Petroleum law 238/2004 (binding from 21 August 2015) stated that shale gas shall be comprised in the category of 'petroleum resources' which are exclusively object to the public property and belong to the Romanian State'.

[11] It is beyond the scope of this study to conclude whether or not the identified pieces of EU legislation have been properly/comprehensively applied.

metres below surface level) in any way for the purposes of exploiting petroleum in England and Wales. Second, a number of safeguards for HVHF (referred to as 'associated hydraulic fracturing' in the Act) have been introduced through amendments made to the Petroleum Act 1998 (not yet in force).

Finally, it should be noted that there are a number of key differences in the regulatory approach adopted in other jurisdictions of the UK. While there are moratoria in place in Scotland and Northern Ireland, the regulatory approach in both Scotland and Northern Ireland is likely to be reviewed following the outcome of the research and public consultation. In Wales even though an official moratorium has not been adopted, the Welsh Government declared that it was opposed to unconventional gas and oil extraction.

3 Main findings on the application of Commission Recommendation 2014/70/EU

This section provides a detailed analysis of the application of certain principles of the Recommendation. These were identified as the main areas of interest in consultation with the Commission, due among others, to divergences in the application in Member States (e.g. EIA related principles), relative lack of application in Member States (e.g. SEAs, dissemination of information), and the good practices identified (e.g. monitoring). The reference and conclusions under this section on pre-Recommendation sites are only used for comparative purposes since the Recommendation was not applicable during the permitting procedures at these sites.

3.1 Strategic planning and environmental impact assessment (Point 3)

3.1 Before granting licenses for exploration and/or production of hydrocarbons which may lead to the use of high-volume hydraulic fracturing, Member States should prepare a strategic environmental assessment to prevent, manage and reduce the impacts on, and risks for, human health and the environment. This assessment should be carried out on the basis of the requirements of Directive 2001/42/EC.

3.2 Member States should provide clear rules on possible restrictions of activities, for example in protected, flood-prone or seismic-prone areas, and on minimum distances between authorised operations and residential and water-protection areas. They should also establish minimum depth limitations between the area to be fractured and groundwater.

3.3 Member States should take the necessary measures to ensure that an environmental impact assessment is carried out on the basis of the requirements of Directive 2011/92/EU.

3.4 Member States should provide the public concerned with early and effective opportunities to participate in developing the strategy referred to in point 3.1 and the impact assessment referred to in point 3.3.

3.1.1 Strategic environmental planning (Points 3.1 and 3.4)

Only Lithuania, the Netherlands and the UK prepared a SEA prior to the grant of licenses which may have led to the use of HVHF.

In the Netherlands, as part of the National Spatial Strategy on Shale Gas, the government decided to prepare a SEA specifically targeting shale gas extraction which was finalised in July 2015.The list of environmental aspects covered by this SEA is comprehensive and encompasses all expected impacts and risks of unconventional gas extraction and all phases of exploration, including closure. The SEA covers all the national territory.

Environmental aspects covered in the SEA in the Netherlands

Deep subsurface

- Sensitivity to deep subsurface migration of gases and liquids (e.g. possible presence of existing faults, fractures, abandoned wells, groundwater)
- Interference with other functions at the surface
- Consideration of waste remaining underground after fracturing activities
- Potential conflicts with other sub-surface activities (e.g. extraction activities, CO2 storage and energy storage, geothermal energy, water abstraction wells)

Stability and vibration

- Risk of seismic activity

- Risk of vibration at ground level

Soil

- Impact on the quality of soil
- Disruption of soil structure

Groundwater

- Impact on the quality of groundwater
- Impact on the quantity of groundwater

Surface water

- Impact on the quality of surface water
- Impact on the quantity of surface water

Air quality

- Impact on air quality (increase of emissions of methane, other volatile organic compounds and other gases that are likely to have harmful effects on human health/environment)
- Total nitrogen deposits due to NOx and NH3 emissions

Noise

- Noise pollution on housing
- Noise pollution on sensitive zones (e.g. silent zones and habitat zones)

Light pollution

- Light emissions

Climate change

- Contribution to climate change (CO2 and methane emissions)

Nature

- Pressure on public space
- Disturbance of biodiversity fauna and flora
- Fragmentation
- Acidification/eutrophication from nitrogen deposits

Landscape and cultural history

- Impact on elements and patterns of the landscape and cultural past
- Impact on the spatial and visual features of the landscape

Archaeology

- Impact on known/foreseen archaeological sites

Traffic

- Flow of traffic
- Infrastructure availability
- Conveying movements

The public concerned was provided with an early and effective opportunity to participate in the development of the scope of the SEA, as evidenced by the relatively high number of responses received. Public participation on the prepared SEA itself is foreseen in early 2016 as part of the preparation of the National Strategy on Underground, following the development of an Energy Report in late 2015. The SEA contributed to the political discussion on shale gas development.

In the UK, the SEA assessed the environmental effect of the draft Licensing Plan related to the 14th and potential further rounds of onshore oil and gas licensing in landward areas in parts of England, Scotland and Wales. HVHF gas extraction plans were therefore subject to SEA within the wider context of the oil and gas licensing rounds and considered alongside conventional oil and gas extraction in those areas. The SEA however considered the specific environmental effects of hydraulic fracturing during the exploration and production stages of unconventional oil and gas exploration. It assessed the potential activities that could follow on from the licensing round and which may have environmental effects, and more specifically the effects associated with the six exploration and production stages (non-intrusive exploration, exploration drilling, production development, production/ operation/ maintenance, decommissioning of wells, and site restoration and relinquishment) for each activity of conventional oil and gas, shale gas, virgin coalbed methane and gas storage. The public concerned had early and effective opportunities to participate in developing the Licensing Plan and the Updated Environmental Report took into account their responses. The revised Environment Report was issued for public consultation between 17 December 2013 and 28 March 2014.

In Lithuania, SEAs were carried out prior to the public tender procedure to grant licenses for the prospecting, exploration and exploitation of (unconventional) hydrocarbons for the Šilutės–Tauragės 1800 square km area in 2011 and for the Rietavas 1599 square km area in 2006 . The SEA Reports do not specifically indicate and/or cover HVHF and were prepared according to the broader plans or programmes related to oil and gas extraction development strategies in Lithuania. However they cover all aspects of oil and gas prospecting, exploration and extraction and indirectly several aspects linked to the use of HVHF. The public was informed on how to access the SEA Report and on how to provide comments and on the dates of the public meeting and any other relevant information. The public and competent authorities had the opportunity to give their opinions. Comments were taken into account in the course of the planning procedure. The Šilutės–Tauragės SEA Report was under public consultation between 6 June 2011 and 8 July 2011.

In Portugal no SEAs have been carried out so far for oil and gas exploration and/or production in general. There is no plan or programme on exploration and production of hydrocarbons by unconventional methods ongoing at this stage, and according to the National Entity for the Fuels Market (ENMC), unconventional methods have not been used so far for the exploration of hydrocarbons. ENMC mentioned that in case the use of unconventional methods proves to be a "strong possibility", a SEA would be required.

3.1.2 Rules on possible restrictions of activities (Point 3.2)

	AT	DE	DK	ES	HU	LT	NL	PL	PT	RO	UK
Rules on restrictions targeting hydraulic fracturing		√				√	√				√
Rules on restrictions applying to several activities including hydrocarbon exploration and production		√				√		√		√	

Very few countries have set specific rules on possible restrictions of HVHF activities according to Point 3.2 of the Recommendation. Only the UK and Lithuania through the adoption of a legal text, have set specific restriction rules applying to HVHF. In the UK, according to the Infrastructure Act 2015, hydraulic fracturing is prohibited within protected groundwater source areas or other protected areas. The draft Onshore Hydraulic Fracturing (Protected Areas) Regulations 2015 define such areas as areas of land at a depth of less than 1,200 metres beneath any land within 50 metres of an abstraction point or within or above a zone defined by a 50-day travel time for groundwater to reach a groundwater abstraction point, and areas of land at a depth of less than 1,200 metres beneath a National Park, the Broads, an area of outstanding natural beauty, or a World Heritage site respectively. New section 4A of the Petroleum Act 1998 (not yet in force) also provides that a well consent must now include a condition which prohibits associated hydraulic fracturing (= HVHF) from taking place in land at a depth of less than 1000 metres, and a condition which prohibits associated hydraulic fracturing from taking place in land at a depth of 1000 metres or more unless a hydraulic fracturing consent has been granted.

In Lithuania, exploration and/or production of unconventional hydrocarbon resources (such as shale gas) using HVHF is forbidden in groundwater protection zones and drinking water extraction zones.

In the Netherlands, the SEA sets criteria to exclude a priori certain regions/areas from its future shale gas exploration activities or pay particular attention to these areas. The following surface areas are excluded from the SEA scenarios for future shale gas exploration activities:

- Protected areas such as Natura 2000 sites[12]
- Drinking water catchment sites
- Water protection areas such as sites for groundwater protection
- Large surface water bodies
- Urban/residential areas[13]

For the depth limitations, the SEA uses a depth limitation of 1,000 meters for horizontal drilling, including for groundwater areas. There is no specific distance limitation between groundwater and the fractured zone.

In Germany certain federate laws set restrictions for fracking in specific areas (e.g. in water protection areas).The current federal legislation does not set such restriction of activities targeting specifically HVHF. However the draft law as of April 2015 contains some of these restrictions (e.g. prohibition of fracking activities in protected areas, setting of the minimum depth limitations of 3,000 metres) but not concerning all elements (e.g. no minimum distance between operations and residential areas required; no restrictions in flood prone or seismic prone areas).

Several countries (e.g. Germany, Lithuania Poland, Romania) contain in their legislation restrictions similar to some of the ones set under Point 3.2 of the Recommendation but that apply to all types of activities (e.g. all activities restricted in flood prone areas) or to all hydrocarbon activities (e.g. prohibition of oil and gas operation in protected areas and near water sources).

It is also common practice that such restrictions are set at the permitting level for each site on a case by case basis depending on whether the site falls within a protected area, flood prone area, seismic prone area or water protection area.

Overall none of the countries covered include in their legislation all the restrictions set under Point 3.2 of the Recommendation.

3.1.3 EIA in accordance Directive 2011/92/EC (Point 3.3 and Point 3.4)

- *EIAs carried out at specific sites*

The table above provides an overview of the application of the EIA Directive at specific sites examined under this study.

	DE	DK	ES	HU	LT	PL	RO	UK
No EIA nor screening carried out at some of the examined sites				√		√		
Screening carried out at all sites examined	P	√			√		√	

[12] Although horizontal drilling underneath 1000 meters is not excluded
[13] Ibid.

	DE	DK	ES	HU	LT	PL	RO	UK
Screening carried out at some of the examined sites			√			√		√
EIA carried out at some of the examined sites						√		√
EIA carried out at all examined sites		√	√				√	

P means in this specific case that the EIA screening did not cover the entire project but only the construction of the well pad.

At Damme 3 site in Germany, no EIA was required. A screening was undertaken for the construction of the well pad but no screening was carried out for the entire site and HVHF activities. In Poland, an EIA was carried out for three out of the five sites reviewed. A screening procedure with no EIA was applied at one site and neither a screening nor an EIA was carried out at the fifth site. In the UK, an EIA was carried out at the two post Recommendation sites (a screening without an EIA was carried out for the third site which pre-dates the Recommendation). In Spain from the sites selected, EIAs have been submitted to competent authorities by the operator in the "Sedano"[14] and "Urraca"[15] licenses. None of these EIAs have yet been approved by competent authorities. For the "Bezana" and "Bigüenzo" licenses, the authorities have only issued the EIA "scoping" decision at the time of writing this report. In Denmark when Total applied for the necessary permits to perform exploratory drilling at Vendsyssel-1, the Municipal Council in Frederikshavn decided subsequent to an EIA screening that a full EIA was required before any such permit could be granted. This EIA should only concern drilling without any use of hydraulic fracturing. Future exploratory drilling using fracturing would require a whole new EIA. In the same vein in Romania, the EIAs only covered exploratory drilling without HVHF. A first screening procedure applied. In case of exploitation works, a new permitting procedure would be required as well as a new EIA. In Lithuania two EIA screenings were carried for specific project wells where hydraulic fracturing was planned but the competent authorities decided that an EIA in these two cases was not necessary.

- *Public participation in EIA procedures*

In countries where EIAs were completed or are being completed, the public participation procedures and EIA timeframes are significantly different from one country to another.

Countries	Preliminary public consultation timeframe[16]	EIA public consultation timeframe	Comments received	EIA overall timeframe in practice
Denmark	28 days	8 weeks	66 documents containing: feedback from public authorities, who were invited to comment; feedback	22 months (from Total's submission of a project description for the purpose of

[14]BNK Petroleum, July 2013, Environmental Document for the Exploratory Drilling of Hydrocarbons in the Interest Areas Sedano 1, Sedano 2 and Sedano 3 ("Sedano" permit) (*Documento Ambiental para las Perforaciones de Hidrocarburos en las Áreas de Interés Sedano 1, Sedano 2 y Sedano 3*).
[15]BNK Petroleum, November 2014, Environmental Impact Assessment for the Exploratory Drilling of Hydrocarbons in "Urraca 1" ("Urraca" license) and December 2014, Environmental Impact Assessment for the Exploratory Drilling of Hydrocarbons in "Urraca 2 and 3" ("Urraca" license).
[16]Before the presentation of the EIA

Countries	Preliminary public consultation timeframe[16]	EIA public consultation timeframe	Comments received	EIA overall timeframe in practice
			(predominantly objections) from NGOs; and feedback (predominantly objections) from other private stakeholders (*e.g.* neighbours).	an EIA screening to the date of the permit).
Poland	21 days (30 days under a draft law[17])	21 days (30 days under a draft law)	None	6 to 8 months
Romania	45 days	22 days	39 documents containing stakeholders/community feedback and related responses from companies were available	2 months 16 days
Spain	Five to six months in case studies. Maximum 30 days according to a new law not yet in force for the case studies	At least 30 days	At the time of writing the public consultation has not been concluded.	More than 2 years for current EIAs. The procedure is ongoing
UK	Four months in practice. The Statement of Community involvement describes 4 key stages of consultation undertaken prior to the submission of the application. The first two stages were not site specific. The final 2 stages (Jan-May 2014) covered the specific exploration sites, the planning and EIA process and emerging findings from the EIA.	21 days, extended to 12 weeks. Further consultation (21 days) carried out on additional information.	- Roseacre wood: 66 documents containing stakeholders/community feedback and related responses from companies were available - Preston new road: 60 documents containing stakeholders/community feedback and related responses from companies were available (200 representations supporting the proposal and 11127 representations objecting to the proposal were received	18 months - from pre-application consultation (January 2014) until decision of planning authority (June 2015).

[17] At the time of writing this report this draft law is about to be adopted.

In all case studies it was however considered that the public had an early and effective opportunity to participate in the EIA procedure. In Denmark, the Municipal Council in Frederikshavn performed a public participation procedure leading to the publication of an 'objective notice' where all objections against the project were addressed. In the UK, for the two EIAs a Statement of Community Involvement described the result of the public consultation programme during each EIA procedure as further detailed in the box below. Such Statement of Community involvement is considered as an example of good practice since it records in a detailed manner the public participation procedure during EIAs to ensure the efficient involvement of the public in such procedures.

Details on the Statement of Community involvement for the Preston New Road exploration site

The Statement of Community Involvement (SCI) describes the community engagement which has been undertaken in connection with the proposed exploration site at Preston New Road which was announced on 4th February 2014. It also describes the wider consultation activities associated with the shale gas exploration project, which were undertaken before this date. There were two key stages: (a) general consultation which was not site specific to enable comments to inform development of the EIA, and (b) site specific consultation to provide information on the emerging findings of the EIA. The SCI provides a summary of the principal issues raised and how the operator responded to the issue through the design of the project and through mitigation measures. Chapter 8 of the SCI details how the consultation activities influenced and shaped proposals for the Preston New Road site and informed the technical work (such as the EIA) and sets out the responses to the issues raised.

In Romania, according to the Environmental agreements for the four sites, the procedure for information and public involvement was carried out pursuant to the law. tIt is to be noted however that there were violent protests at the examined site. In Poland the public was informed about the EIA procedure (via internet, notice board) and was able to review and comment at an early stage of the process. However no comments were submitted during the consultation process.

- *Scope of the EIA*

Even though not covered by the Recommendation, it is to be noted that in none of the countries is the scope of the EIA clearly defined in the law. In particular, it is unclear in the law whether the EIA has to cover one specific well project or several well projects in a license area or the whole license area. In Spain, for the Sedano license, one EIA covered three potential wells (Sedano 1, Sedano 2, Sedano 3) and where relevant it provided a specific analysis or assessment based on the characteristics of one potential drilling well area. For the Urraca license two EIAs were carried out: One covering the Urraca 1 proposed well site, and another covering Urraca 2 and 3 proposed well sites which are located very close to each other.

In Poland, concerning the Lebork license, that covers three well clusters, only one EIA was required for the planned drilling work 'Żarnowska' that covered one well (vertical and horizontal) and to some extent possible further developments of other wells. For the Wejhorowo license the EIA covered 2 well clusters with 8 potential wells. The EIA for the Leba license covered 3 wells.

In the UK, the EIAs for the Roseacre Wood and the Preston New Road exploration sites respectively covered a cluster of four exploratory wells. In Romania and Denmark EIAs covered only one specific exploratory well[18].

[18] Note however that there were no other potential areas of interest in the license area.

Therefore in the countries covered, the scope of the EIA is decided on a case by case basis by the competent authorities.

- *Thresholds to trigger the application of the EIA Directive*

	AT	DE	DK	ES	HU	LT	NL	PL	PT	RO	UK
Specific EIA requirements for hydraulic fracturing	√	√[19]	√	√		√			√		
Specific thresholds for EIA or screening(e.g. depth of drilling; presence of sensitive areas or size of the installation)					√		√	√			√
EIA Directive requirements										√	

The legal EIA requirements applying to the projects covered under the case studies are not necessarily the ones that are in force at the time of writing this report. As outlined in the overview table below, several countries have adopted or plan to adopt specific EIA requirements related to projects involving the use of hydraulic fracturing (i.e. Austria, Denmark, Germany, Lithuania, Portugal and Spain), other countries have set specific EIA thresholds depending on the depth of the drilling, the size of the installation and/or the presence of sensitive areas (i.e. Netherlands, Poland and the UK) whereas some countries apply literally the EIA directive requirements and thresholds (i.e. Romania). This is further explained in the table below which details for each country covered the EIA thresholds which apply to the exploration and production of hydrocarbons (such as shale gas) using HVHF.

Countries	EIA thresholds applying to the exploration and production of hydrocarbons (such as shale gas) using HVHF.
Austria	The exploration and exploitation of rock layers in **unconventional** oil and gas deposits through **hydro-mechanic fracturing** ('frac treatment') is subject to an EIA.
Denmark	Projects where fracturing is planned for the exploration or extraction of **shale gas** are subject to a compulsory EIA.
Germany	No specific requirements or thresholds related to HVHF. If the production rate is larger than 500 tons of oil/day resp. 500,000 m³ of gas/day, a formal procedure with EIA is mandatory. An EIA is also mandatory for the establishment and operation of drilling platforms in the areas of coastal water and in the continental shelf. The current German law does not refer to deep drilling as a criterion to trigger an EIA screening procedure. In the draft Regulation of the Federal Ministry of the Economy and Energy for the introduction of EIAs in the use of fracking technology and deep drilling (not yet adopted), an EIA would become compulsory for projects that plan to carry out **hydraulic fracturing in both conventional and unconventional** hydrocarbon deposits.

[19] Specific EIA requirements for hydraulic fracturing set in the draft law (not yet adopted). At present, there are no such requirements (see table below)

Countries	EIA thresholds applying to the exploration and production of hydrocarbons (such as shale gas) using HVHF.
Hungary	No specific requirements or thresholds related specifically to HVHF. The requirements of the EIA Directive related to oil and gas production apply. A screening procedure must be applied in the following cases: a) Below the production threshold of gas production of 500'000 m3/day), oil 500 tons/day without size limitation. b) Exploratory drilling in protected natural zones, Natura 2000 zones, protected areas of caves, protected areas of underground water (if the start of the operation is not excluded by legislation on the protection of water resources and drinking water facilities).
Lithuania	An EIA is required for the activity of extraction or (and) direct exploration of **unconventional** hydrocarbons using **hydraulic fracturing**.
Netherlands	No specific requirements or thresholds related to HVHF. The requirements of the EIA Directive related to oil and gas production apply. In case of deep drilling (**100 meters depth or more)** a screening must be carried out. The Dutch EIA commission in the Netherlands advised the Minister that in the case of shale gas, all permits (whether for exploration or production) should be subject to an EIA.
Portugal	EIAs are mandatory since September 2015 for "exploratory drillings (*sondagem*) and/or extraction of hydrocarbons by **unconventional** methods (including hydraulic fracturing)".

Poland	A screening procedure is required for the following prospecting or exploration of mineral deposits:
	
	• located in offshore waters of Poland,
	• underground mining,
	• carried out using borehole techniques, at depths below 1 000 m
	  ○ a)in water intake protection zones,
	  ○ b)in inland water reservoirs protection zones
	  ○ c)in areas covered by nature protection schemes or in buffer zones for nature protection schemes ,
	• carried out using borehole techniques at depths below **5000 m** in other areas (not listed in c)
	
	As a consequence neither a screening nor an EIA is required for all exploration projects of mineral deposits (including oil and gas) taking place between 1000 and 5000 m depth, except if the projects are located in the protection zones or maritime areas mentioned above.[20]
	Projects likely to have a significant effect on Natura 2000 sites must be subject to an EIA. The requirements of the EIA Directive related to oil and gas production apply. In addition an EIA is also compulsory in case of exploitation or processing of gas, oil and its derivatives if these projects are located in offshore waters of Poland. The EIA procedure is now required before obtaining the investment decision

[20] The Commission sent a reasoned opinion to Poland regarding compliance issues with the EIA Directive. The reply received from Polish authorities is currently under examination.

Countries	EIA thresholds applying to the exploration and production of hydrocarbons (such as shale gas) using HVHF.
	(e.g. Decision on Approval of Mining Work Plan), not before granting the license.
Romania	Literal transposition of the EIA Directive thresholds
Spain	All projects involving drilling for the prospection, exploration, or exploitation of hydrocarbons, CO2 storage, gas storage and medium and high geothermal enthalpy, which require the use of **hydraulic fracturing** techniques, shall be subject to an EIA
The UK	The requirements of the EIA Directive related to oil and gas production apply. An EIA screening is required for deep drilling projects, where the area of the works exceeds **1 hectare**, and surface industrial installations for the extraction of petroleum, where the development exceeds **0.5 hectares**. It should also be noted that following the changes introduced by the Infrastructure Act 2015, new section 4A(3) of the Petroleum Act 1998 (not yet in force; will apply only to England and Wales) requires that the Secretary of State must be satisfied that the environmental impact of the development has been taken into account by the local planning authority, before issuing a hydraulic fracturing consent (this is required for any activity where hydraulic fracturing is carried out at a depth of 1000 metres or more in connection with the use of the relevant well to search or bore for or get petroleum[21]). While this does not alter the requirements for an EIA or screening, the local planning authority will be required in all cases to confirm, by providing a notice that the environmental information was taken into account in deciding to grant the relevant planning permission.

- *HVHF impacts covered*

In Poland, Spain and the UK, the EIAs covered the main characteristics of unconventional hydrocarbon exploration and the potential related impacts of HVHF.. Further details are set in the national reports on the coverage of each EIA. Even though not covered by the Recommendation it is noteworthy that none of the countries covered under this study have adopted specific guidelines and/or rules on the content of the EIA for projects involving the production and production of hydrocarbons using HVHF.

In Lithuania the two EIA screening decisions did not cover specific impacts related to hydraulic fracturing.

3.2 Exploration and production permits (Point 4)

Member States should ensure that the conditions and the procedures for obtaining permits in accordance with applicable Union legislation are fully coordinated if:

(a) more than one competent authority is responsible for the permit(s) needed;
(b) more than one operator is involved;
(c) more than one permit is needed for a specific project phase;
(d) more than one permit is needed under national or Union legislation

This principle on the coordination of the permitting procedure was met in all sites covered (for the exploration stage) with the exception of Romania where local authorities were not involved in the permitting procedure for the exploration wells. The lack of involvement of the local authorities was one of the reasons why 15 Local Councils in Vaslui County adopted regulations stating that exploration works with the objective of

[21] Encompassing both oil and gas.

finding possible shale gas reserves were forbidden at the perimeter of the villages concerned.

In Poland, Marshall was the main body in charge of the coordination of the process of permits issuing. In the UK, according to a statement made in August 2015, the Secretary of State will consider calling in shale applications, in particular where applications are made to local planning authorities that have previously failed to meet the statutory timescales.

3.3 Selection of the exploration and production sites (Point 5)

5.1. Member States should take the necessary measures to ensure that the geological formation of a site is suitable for the exploration or production of hydrocarbons using high-volume hydraulic fracturing. They should ensure that operators carry out a characterisation and risk assessment of the potential site and surrounding surface and underground area.

5.2. The risk assessment should be based on sufficient data to make it possible to characterise the potential exploration and production area and identify all potential exposure pathways. This would make it possible to assess the risk of leakage or migration of drilling fluids, hydraulic fracturing fluids, naturally occurring material, hydrocarbons and gases from the well or target formation as well as of induced seismicity.

5.3.The risk assessment should:
(a) be based on the best available techniques and take into account the relevant results of the information exchange between Member States, industries concerned and non-governmental organisations promoting environmental protection organised by the Commission;

(b) anticipate the changing behaviour of the target formation, geological layers separating the reservoir from groundwater and existing wells or other manmade structures exposed to the high injection pressures used in high-volume hydraulic fracturing and the volumes of fluids injected;

(c) respect a minimum vertical separation distance between the zone to be fractured and groundwater;

(d) be updated during operations whenever new data are collected.

5.4.A site should only be selected if the risk assessment conducted under points 5.1, 5.2 and 5.3 shows that the high-volume hydraulic fracturing will not result in a direct discharge of pollutants into groundwater and that no damage is caused to other activities around the installation

This principle could only be assessed for the exploration sites in Poland, the UK and to some extent Spain through information from the EIA documents. In Poland this principle was partially reflected at the permitting level in the post- Recommendation sites with the exception of the dynamic modelling of impacts or the update of the risk assessment.

In the UK, a qualitative environmental risk assessment is required as part of the environmental permit application, which addresses exposure pathways, although it is not directly linked to site selection. The requirements to mitigate the risk of seismicity is considered as an example of good practice within the risk assessment framework as it obliges operators to follow a set of detailed steps to demonstrate that the proposed development is satisfactory from a geological point of view.

UK 2012 Ministerial statement on controls to mitigate the risk of seismicity

The new controls to mitigate the risks of seismic activity announced in the Ministerial Statement at the end of 2012 require the operator to 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 to hydraulic fracturing until it has seen and is satisfied with the fracking plan submitted by the operator.

3.4 Baseline study (Point 6)

Before high-volume hydraulic fracturing operations start, Member States should ensure that:
(a) the operator determines the environmental status (baseline) of the installation site and its surrounding surface and underground area potentially affected by the activities;
(b)the baseline is appropriately described and reported to the competent authority before operations begin.
6.2.A baseline should be determined for:
(a) quality and flow characteristics of surface and ground water;
(b)water quality at drinking water abstraction points;
(c) air quality;
(d) soil condition;
(e) presence of methane and other volatile organic compounds in water;
(f) seismicity;
(g) land use;
(h) biodiversity;
(i)status of infrastructure and buildings;
(j) existing wells and abandoned structures.

Overall the parameters listed in the baseline study were well reflected at the examined sites with the exception of air quality, seismicity, the presence of methane and other volatile organic compounds in water, the status of infrastructure and buildings and existing wells and abandoned structures, which were not systematically assessed.

Although not covered under the Recommendation, it is noteworthy that the geographical scope of the baseline study and whether or not it is based on available data rather than on specific samples taken from the surrounding areas of the exploratory wells is not clearly defined in the law or permitting procedures of the countries covered. It is rather decided on a case by case basis between competent authorities and operators. It is also not always clear whether a baseline must be set before any operations and/or specifically before HVHF.

In the UK, whereas this principle was not met for the site that pre-dates the Recommendation, for both post- Recommendation sites, baseline studies on air quality, archaeology/cultural heritage, greenhouse gases, community & socio-economics, ecology, hydrogeology & ground gases, induced seismicity, land-use, landscape & visual amenity, lighting, noise, resources & waste, transport, water resources and public health had to be carried out prior to the start of operations. They covered all aspects set in the Recommendation with the exception of the status of infrastructure and buildings, existing wells and abandoned structures[22]. It is to be noted that the UK asks for a baseline study on public health, which goes beyond the list of elements set in the Recommendation. It can be noted as an example of good practice that at the Preston Hall site it was planned to set groundwater monitoring boreholes around the edge of the well pad to set the baseline of the quality of groundwater prior operations close to the HVHF activities. It was also proposed in the permit to install surface network seismometers and seismometer array over an area of 2870 ha to collect baseline seismic data before HVHF occurs.

In Spain the decision of the competent authorities establishing the scope of the EIA[23] also determines the content of the baseline study. It covers all the aspects mentioned in the Recommendation with the exception of the presence of methane and other VOCs in

[22] The status of sensitive structures (no definition available) is assessed by DECC in consenting to hydraulic fracturing.
[23] Ministry of Agriculture, Food and Environment, Determination of the scope and level of detail of the EIA for the sites "El Coto-2" and "Cadialso-2", 16 June 2014; Ministry of Agriculture, Food and Environment, Notification of the decision to subject the project to EIA, "Urraca 1", 25 February 2014 and "Urraca 2 y 3", 5 August 2013; Junta de Castilla y Leon, Decision to subject to EIA, "Sedano" permit, 19 November 2013.

water, the status of infrastructure and buildings, existing wells and abandoned structures.

In Poland, a baseline study was carried out before operation/HVHF. The baseline area is defined on a case by case basis.

A description of the baseline is included in the environmental reports for three sites: Łeba and Łębork (post-date Recommendation) and Wejherowo (pre-Recommendation). The elements listed for the baseline are covered by the baseline study, with the exception of the presence of methane or other VOCs in water, air quality, seismicity and abandoned structures (depending on the sites). As part of the EIA procedure, the baseline description was reported to the competent authorities. Results of environmental monitoring for one site (Wejherowo license) had to be sent to the competent authorities. However, in the case of the other sites, the monitoring results conducted before the start of operations and after the EIA are not reported to the competent authorities. They are generally available in the operator's offices[24] and are made available to the competent authorities upon request or during inspection. In the case of the pre-recommendation Lidzbark Warmiński site, the detailed information concerning the baseline study was unavailable and the baseline study covered only part of the listed environmental elements.

The geographical scope of the baseline differs from one country to another and from one site to another. For example in Spain, the EIA for Sedano 1,2, 3 submitted by operators refers to the ambient air quality baseline based on available data from air quality stations located between 40 km to 65 km away from the License, whereas for example, at the Zanowska site in Poland, air quality samples are taken within the site.

3.5 Monitoring requirements (Point 11)

1.1.Member States should ensure that the operator regularly monitors the installation and the surrounding surface and underground area potentially affected by the operations during the exploration and production phase and in particular before, during and after high-volume hydraulic fracturing.
11.2. The baseline study required under points 6.1 and 6.2 should be used as a reference for subsequent monitoring.
11.3.In addition to environmental parameters determined in the baseline study, Member States should ensure that the operator monitors the following operational parameters:
(a) the precise composition of the fracturing fluid used for each well;
(b)the volume of water used for the fracturing of each well;
(c)the pressure applied during high-volume fracturing;
(d)the fluids that emerge at the surface following high-volume hydraulic fracturing: return rate, volumes, characteristics, quantities reused and/or treated for each well;
(e)air emissions of methane, other volatile organic compounds and other gases that are likely to have harmful effects on human health and/or the environment.
11.4. Member States should ensure that operators monitor the impacts of high-volume hydraulic fracturing on the integrity of wells and other manmade structures located in the surrounding surface and underground area potentially affected by the operations.
11.5. Member States should ensure that the monitoring results are reported to the competent authorities.

Monitoring measures were implemented at the sites were HVHF was carried out (Germany, Poland, the UK). In Spain, some monitoring measures are foreseen in the EIA documents drafted by the operators. No specific trends can be identified on the way the monitoring requirements were applied or planned to be applied at specific sites with the exception of the UK where post-recommendation sites, unlike pre-recommendation sites, apply specific monitoring measures reflecting the principle of the Recommendation (with

[24] In case no EIAs are carried out this information would still be available (e.g. case of Wodynie Łuków)

the exception of the monitoring of the integrity of wells[25] and other manmade structures in the surrounding area).

In Poland, at each site examined, monitoring of both the surface and underground area potentially affected was planned or carried out before and where relevant, after fracturing operations. Boundaries of monitoring area were defined on a case by case basis usually covering the drilling site and adjacent areas. In Poland, monitoring is based on the parameters set under the baseline study and refer to the baseline study in the selected sites where HVHF was carried out; with the exception of the seismicity monitoring which was only monitored at two sites (all of the sites are not located in seismic prone areas).. The well integrity and monitoring of impacts on manmade structures located in the surrounding surface and underground area potentially affected by the operations are carried out at the Wejherowo site (pre-dates Recommendation) and the Lębork sites (post-dates Recommendation) only. For the Wodynie Łuków site and Lidzbark Warmiński sites (pre-dates Recommendation) there is no information concerning the monitoring of manmade structures. For three of the sites (post-and pre-Recommendation) the obligation of reporting to the competent authorities of the monitoring results (for soil and groundwater only) is implemented.

In the UK, whereas the monitoring principles were not met for the site that pre-dates the Recommendation, for the sites that post-date the Recommendation, monitoring is to be carried under the terms of an Environmental Management and Monitoring Plan. The monitoring rules planned for these two sites are considered as an example of good practice (see table below).

Environmental Management and Monitoring Plan at Preston New Road and Roseacre Wood sites

Monitoring is to be carried out under the terms of an Environmental Management and Monitoring Plan (EMMP). The EMMP will be comprehensive in scope, and will cover baseline monitoring before operations, monitoring to be carried out during the drilling, fracturing and completion phases, and ongoing monitoring during production and post-abandonment. Monitoring would cover a range of environmental parameters including seismicity, ambient air quality around the site, noise levels, flowback fluid composition, surface water and groundwater composition and concentrations, ground gas composition and concentrations and fugitive gas emissions. Monitoring of the groundwater monitoring wells would continue following exploration well abandonment for a period agreed with the regulators, and subsequent decommissioning of the groundwater monitoring wells. The environmental permit requires sampling of groundwater and surface water for 46 parameters at a minimum. In each case monitoring works were to cover a 4km radius of the proposed sites comprising the construction, operation and restoration of two seismic monitoring arrays comprising of 80 buried seismic monitoring stations and 10 (8 at Roseacre Wood) surface seismic monitoring states. The seismic monitoring stations would comprise underground installation of seismicity sensors, enclosed equipment and fenced enclosures. The surface array would also comprise monitoring cabinets. The applications were also for the drilling of three boreholes, each installed with two monitoring wells, to monitor groundwater and ground gas.

For these two sites all monitoring parameters of the Recommendation are covered with the exception of the "status of infrastructure and buildings" and "existing wells and abandoned structures". For these two sites no specific undertaking was identified in respect of monitoring the integrity of wells and other manmade structures in the surrounding area. However, under Regulation 13 of the Offshore Installations and Wells (Design and Construction) Regulations 1996, the well must be designed, constructed, operated, maintained and decommissioned in such a way that there is no unplanned release of fluids from the well so far as is reasonably practicable. The operator is required to provide a weekly report to HSE with details of the operations that week, the diameter

[25] However, it should be noted that HSE will monitor well operations during construction and operation based on weekly operations reports submitted to HSE by the well operator.

and depth of the borehole and diameter and depth of the casing, and appoint an independent well examiner to ensure that regulatory requirements and industry standards are adhered to. When constructing the well, there is also a requirement to establish whether there are any nearby mine workings in which case the operator would need to consult with the Coal Authority and may require separate permission.

In Germany, based on available information, seismic monitoring of the Damme 3 well was carried out from the neighbouring well Damme 2. There is no information as to whether further elements were monitored at this site. Note that the German draft law package (not yet adopted) contains monitoring requirements for fracturing activities as well as for subsurface storage of flowback water.

3.6 Dissemination of information (Point 15)

Member States should ensure that:
(a) the operator publicly disseminates information on the chemical substances and volumes of water that are intended to be used and are finally used for the high-volume hydraulic fracturing of each well. This information should list the names and Chemical Abstracts Service (CAS) numbers of all substances and include a safety data sheet, if available, and the substance's maximum concentration in the fracturing fluid;
(b) the competent authorities should publish the following information on a publicly-accessible internet site within 6 months of this Recommendation's publication and in intervals of no longer than 12 months:
(i) the number of wells completed and planned projects involving high-volume hydraulic fracturing;
(ii) the number of permits granted, the names of operators involved and the permit conditions;
(iii) the baseline study produced under points 6.1 and 6.2 and the monitoring results produced under points 11.1, 11.2 and 11.3(b) to (e);
(c)the competent authorities should also inform the public of the following without undue delay.
(i)incidents and accidents under point 9.2(f);
(ii)the results of inspections, non-compliance and sanctions.

The principle on dissemination of information either by operators or by competent authorities is not adequately reflected either within legislation, at the permitting level or on a voluntary basis in the countries covered under this study as outlined in the paragraphs below. In several countries due to the lack of (planned) HVHF activities, this principle is not always applicable. In fact this principle could only be assessed entirely in Germany, Poland and the UK.

3.6.1 Dissemination of information by operators

Dissemination of information by operators	DE	ES	PL	UK
Chemical substances intended to be used		√	P	P
Chemical substances used	√	N/A	√	√[26]
Safety data sheets				
CAS	√		P	
Volume of water intended to be used		√	P	
Volume of water used for HVHF	√	N/A	√	
Substance's maximum concentration in the fracturing fluid	√	√	P	P

[26]This principle is not applicable to the Roseacre Wood Site and Preston New Road where no HVHF was carried out.

P: means partial when not applied at all sites
Blank cells: not addressed,
N/A: not applicable

In none of the countries covered is there a specific legal obligation to ensure that operators disseminate information on fracturing fluids. The only exception is the draft legislation in Germany (not yet adopted) that includes disclosure obligations concerning fracturing substances. In several countries such information is provided in practice but does not reflect all the specific points set in the Recommendation. For example, in none of the examined countries were safety data sheets disseminated by operators.

In Spain, as part of the permitting procedure, EIA decisions require operators to provide information on the fracturing fluids including the concentration levels or quantities of the components. The operators have made available on their websites the EIA documents that contain information on the fracturing fluids planned to be used. For example the EIA prepared by operators on the Sedano licence provides the composition of the fluid, the function of each of its elements and the concentration in percentage. However it does not include information on related safety data sheets and CAS number of substances planned to be used.

In Germany at the Damme 3 site, fracturing substances were not disclosed prior to their use. Around 2010, when the public discussion on the environmental side effects of fracking grew, companies, but also the mining authorities, started publishing more detailed information on their websites, including information on the chemicals used. For instance, ExxonMobil published information[27] on chemicals used for fracking including well specification, date, number of fracks, quantities of used fluids and chemicals, CAS-numbers, and concentration in fracking fluid. Safety data sheets were not included. The table below shows in details how chemicals used at Damme 3 were disclosed by Exxon Mobil.

Materials used in fracturing treatments at Damme 3-2008 (total mixture)							
Position	Description	Total mass kg	Subset in kg	Ingredient	CAS	Classification of product components	Classification of the total product
	Total fluid with proppants	12.683.000					
Proppants	Ceramic proppants	588.000		Ceramic materials (bauxites)	66402-68-4		Not dangerous according to Directive 1999/45/EC
Water	Carrier fluid (without proppants)	12.095.000					
	Clay stabilizer	10.612	6.367	Tetramethylammonium chloride	75-57-0	T;R21-25 Xi; R36/37/38 N; R50	T; R21, R25 Xi; R36/37/38 N; R50
			4.245	Not dangerous according to Directive 1999/45/EC	-	Not dangerous according to Directive 1999/45/EC	
	Water friction reduction agents	8.801	2.640	Lightweight (petroleum) distillates, hydrotreated	64742-47-8	Xn;R65 H,4	Xn; R65
			440	Polymer (polyethylene	9036-	Xi; R41	

[27] http://www.erdgassuche-in-deutschland.de/hydraulic_fracturing/frac_massnahmen.html

Materials used in fracturing treatments at Damme 3-2008 (total mixture)							
				glycol-octylphenyl-ether	19-5		
			5.721	Not dangerous according to Directive 1999/45/EC	-	Not dangerous according to Directive 1999/45/EC	
	Biocide	460	23	Magnesium Chloride	7786-30-3	Xi;R36/37/38.	N C; Xi R34; R43; R20/21/22; R61/63
			46	Magnesium Nitrate	10377-60-3	Xi;R36/38. O;R8.	
			46	5-Chloro-2-Methyl-2H-Isothiazol-3-One and 2-Methyl-2H-Isothiazol-3-One (3:1)	55965-84-9	T;R23/24/25 N;R50/53 C;R34 R43	
			345	Not dangerous according to Directive 1999/45/EC	-	Not dangerous according to Directive 1999/45/EC	

In Poland an illustrative composition of the fracturing fluid and water consumption which may be used is provided in environmental reports before use (with the exception of Wodynie-Lukow and Lidzbark where no information is available prior to use). This illustrative composition does not always specify the exact list of chemicals that will be used.

The information about the composition of the fracturing fluid after use is provided by the operators on their website. There is also an obligation for reporting of the composition and amount of fracturing fluid and flowback fluid to the Mining Office after use. Beyond the disclosure of chemicals used, the licenses were also available at operators' websites for all sites (except the Lidzbark Warmiński sites where the operator is experiencing changes of name and owners). The environmental decisions were available for the Wejherowo and Łeba sites but not for the other sites.

In the UK, the principles of the Recommendation are not fully met for the Preese Hall site. While the operator has published information on the chemical substances used at the site but not before use, it does not refer to the specific substances or CAS numbers of each substance. Information on volumes of water that were used is not disclosed on the operators' website and this information is not available from the planning documentation reviewed.

For the Preston New Road and Roseacre Wood sites, the principles of the Recommendation are not met as the operator only lists information on the chemical substances used at another site (the Preese Hall site) as an illustrative example in the permit applications. Information on volumes of water that are intended to be used is not disclosed on the operators' website. Information on the substances to be used is available as part of the permit application, which states that the hydraulic fracturing fluid will comprise mainly water, a friction reducer and may include diluted hydrochloric acid < 10% but does not provide the CAS number or safety data sheet or the name of the friction reducer.

In Denmark, only drilling was planned and carried out (no HVHF). On the website for Vendsyssel-1, Total lists the following substances, which they intended to use for the exploratory drilling*:* bentonite; soda ash; potassium chloride; potassium bicarbonate; citric acid; chalk; and conventional salt.

In Hungary, there is no information available on the operators' websites (e.g. Falcon or Exxon Mobil) related to chemical substances and volume of water used in low volume hydraulic fracturing.

In Lithuania no information was provided by operators of the two exploratory wells where low hydraulic fracturing was carried out.

In Romania, it could not be verified at this date whether the operator published information on drilling fluids, because due to the decision of definitively withdrawing from Romania, Chevron closed up its website and any other office.

3.6.2 Dissemination of information by competent authorities

Dissemination of information by CA on publicly-accessible internet website	AT	DE	DK	ES	HU	LT	NL	PL	PT	RO	UK
Number of wells completed involving HVHF								√	√		
Number of wells planned involving HVHF								√	√		
Number of permit granted, name of operators, permitting conditions			√						√	√	√
Baseline study									√	√	√
Monitoring results											√

blank cells: not addressed

In Germany, permitting documents are not publically available. LBEG did not carry out any specific dissemination activities related to HVHF permits in relation to the Damme 3 site. Brief information specifying the well name (but without well or fracking details) was published in the annual reports as for any other new permits.

In Denmark, pursuant to available information, there have been in the past (before the adoption of the Recommendation) two to three instances where HVHF may have been used. Such information is not publicly accessible on a Competent Authority website.

In Hungary, no HVHF has been carried out. Competent authorities do not disclose information mentioned in Point 15 of the Commission Recommendation on their websites related to oil and gas exploration/extraction projects involving low volume hydraulic fracturing.

In Lithuania, no information as mentioned under principle 15 of the Recommendation on the two shale gas exploratory developments that occurred in Lithuania under the Rietavas and Gargždai license areas were available on the competent authority website.

The distribution of competences between the State and the Autonomous Regions in Spain[28] result in a lack of a centralised source of information covering information listed in principle 15 of the Recommendation for all projects across Spain. For those projects falling under the competence of the State, the MAGRAMA has an online research engine in which the relevant documentation (i.e. EIA documentation and in some cases, the licenses and permits) can be accessed and which shows the timeline of the proceedings[29]. The Recommendation establishes that the information should be updated

[28] In environmental matters as established in Arts. 148 (1) (9) and 149 (1) (23) of the Spanish Constitution.

[29] Ministry of (Agriculture, Food and) Environment, Catalogue of Projects, available in Spanish at https://servicios.magrama.es/irj/servlet/prt/portal/prtroot/pcd!3aportal_content!2fMMA!2fcom.mm

in intervals no longer than 12 months. The interviewed authorities[30] indicated, however, that the information available in the referred engine might not be totally up to date. The Hydrocarbons Technical Archive of the MINETUR[31] also provides information on the status of the proceedings both for State and Autonomous region projects. However, the website does not include any documentation. For Autonomous regions, there is no electronic format database. The documentation can be requested from the competent department in charge of environmental matters. This approach is therefore not in line with the Recommendation, which requires information to the published on the internet.

In Poland, the Ministry of the Environment maintains a special website[32] providing information about licenses and wells (the number of wells completed and planned projects involving high-volume hydraulic fracturing, license issue date, area of the license, expired time, counties covered by the license). However, information is not available concerning all environmental permits or more detailed data like monitoring results, baseline study or accidents/incidents and inspection results.

In Romania, details of environmental permits / approvals / consents granted are publicly accessible on the public registers of the Environmental Protection Agencies. NAMR publishes a map showing the areas of all current prospecting, exploratory, development and exploitation activities in Romania. Baseline studies are publicly available on the EPA website, while monitoring results are not but can be consulted on request.

In the UK, for the site that pre-dates the publication of the Recommendation, planning documentation for the Preese Hall site is publicly available on the website of Lancashire County Council. To date, there is no central registry of the wells completed or planned projects involving HVHF in the UK. However, details of environmental permits granted are publicly accessibly on the public registers of the EA, SEPA and the NIEA. Applications for an environmental permit, along with any supporting documentation, are available on the EA's website. Details of incidents and accidents reported to HSE are not publicly available nor are they available on request, although details of formal enforcement action are publicly available Details of non-compliance with an environmental permit are available of the public registers of the EA, SEPA and the NIEA.

In Portugal, the website of ENMC includes information on the exploration and production of hydrocarbons by unconventional methods based on the principles of the Recommendation, namely the number of wells involving high fracturing methods (none), number of permits granted (none) and information on baseline studies carried out (none).

a.anonimo!2fcom.mma.launcher_anonimo?NavigationTarget=navurl://2b0b5dbfb58d23967759a697b58759ea&CurrentWindowId=WID1258101186250&NavMode=3.

[30] Technical Advisors of the Ministry of Industry, May 2015.

[31] MINETUR, 'Hydrocarbons Technical Archive' (*Archivo Técnico de Hidrocarburos*) available in Spanish at https://geoportal.minetur.gob.es/ATHv2/public/permisos/verPermisoSoloLectura.do?permisoid=140.

[32] http://lupki.mos.gov.pl/gaz-z-lupkow/stan-prac-w-polsce

4 Main findings on the application of selected EU legal requirements at planning, licensing and permitting levels

As a disclaimer, it is important to note that this task was not aimed at checking the conformity or compliance with existing EU legislation but was aimed only at examining how the Recommendation 2014/70/EU and selected pieces of EU legislation were considered in practice at planning, licensing and permitting level.

The assessment of EU legal requirements at selected sites and interviews with competent authorities led to the conclusion that there are divergent views and approaches in the countries covered by this study, in particular on the application of Directive 2010/75/EU (IED), Directive 2006/21/EC (Extractive waste Directive), and Directive 2000/60/EC (Water Framework Directive) to the exploration and production of hydrocarbons (such as shale gas) using HVHF.

4.1 Directive 2010/75/EU (IED)

In Denmark, in the case of an application for commercial exploitation of oil and gas resources, the transposing legislation of the IED comes into play and no specific volume thresholds are set out in Danish law. No environmental permit is however required for exploratory drilling.

In Poland, the activities concerned at all sites covered by the case studies are not subject to the national law transposing the IED provisions. Gas combustion in flares is defined as a diffuse emission and does not require an air emission permit. Emissions may be subject to environmental fees.

In Spain, no information was available on whether the competent authorities plan to apply this Directive to shale gas developments. However, the Royal Decree 815/2013, which transposes Directive 2010/75/EU and adapts Law 16/2002 to the requirements of the Directive, does not specifically cover activities of extractive industries.

The application of the IED has been considered for both the Preston New Road and Roseacre Wood sites in the UK. For each, the IED applies to the proposed incineration by flaring of hazardous waste, namely natural gas above 10 tonnes per day, as an activity listed in schedule 1 of the Environmental Permitting (England and Wales) Regulations 2010.

This differs from the situation in Scotland, where the IED is not applied until the activity of refining is carried out. The flaring of gases is therefore not treated as the incineration of waste under the national legislation transposing the IED. Where an activity under Schedule 1 of the Pollution Prevention and Control (Scotland) Regulations 2012 is being carried out (this includes refining activities), any flaring or venting within the site boundary can be regulated as a 'directly associated activity'. However Scotland considers that no such activities are carried out during the exploratory phase (HVHF is not listed as an activity under Annex I of the IED), and consequently that the flaring of gases is not regulated and therefore would not require a permit.

In Romania, the law on industrial emissions transposing the IED does not apply to the oil and gas production sector and the relevant environmental documents at the Pungesti site do not mention it either.

4.2 Directive 2006/21/EC (Extractive Waste Directive)

- *Extractive waste definition*

In Poland, according to permitting practice, as a result of the HVHF processes, the following extractive waste arises:

- Drilling cuttings and muds
- Flowback
- Solid part of the flowback

Gas produced during the exploration stage and oil recycled from the flowback was not classified as extractive waste. Gas was flared and oil was sold to a refinery. Hydraulic fracturing residues remaining in the underground after fracturing were not classified as waste. No information could be found on their status.

In Spain, the current EIA documents prepared by operators mention how non-extractive waste and extractive waste will be managed. They include as extractive waste the flowback water and the gravel (*ripios*) and mud (*lodos*) from the drilling well to be collected and stored on-site and transferred to treatment facilities for their appropriate management. They however do not consider the residues of fracturing fluids remaining underground as extractive waste.

At the Preston New Road and Roseacre Wood sites in the UK (England), extractive waste included drill cuttings, flow-back fluid, natural gas, scale, cement, spacer fluid and hydraulic fracturing fluid remaining in the formation after fracturing. In Scotland and Northern Ireland, the production of 'flowback' fluid from hydraulic fracturing will be treated as an extractive 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 Extractive waste Directive are met.

In Germany, according to a study carried out on behalf of the Federal Environmental Agency in 2012[33], handling of flowback is subject to requirements under legislation on extractive waste and on wastewater. Where the residues are radioactive, sludge and deposits fall under legislation on radiation protection, except where compliance with legally defined monitoring limits is assured. Flowback is both liquid extractive waste and wastewater, since flowback – recovered water – contains both (unaffected) formation water and injected water that has been affected via human use through the addition of additives, injection, mixing with formation water and extraction.

No information was available and/or no position stated from the competent authorities from the other countries covered under this study.

- *Waste facility*

In the UK (England and Wales), following receipt of guidance from the Commission in December 2011, to the effect that flowback fluid from HVHF should be considered under the Extractive waste Directive, the regulatory position statement was changed, and any new activities were required to obtain a permit under the Extractive waste Directive. This approach has been applied at the Preston New Road and Roseacre wood sites. In each case the EA permit covers the management of extractive waste and includes a below-ground non-hazardous waste facility (the accumulation of injected hydraulic fracturing fluid which will remain in the underground target formation and has become waste) and

[33] https://www.umweltbundesamt.de/sites/default/files/medien/461/publikationen/4346-1.pdf

an above-ground hazardous waste facility (the temporary deposit and accumulation of hazardous drill cuttings coated with residual Low Toxicity Oil Based Muds (LTOBM), hazardous scale and hazardous spacer fluid in storage containers, and which can be carried out on the site).

In Poland, none of the examined sites were considered by permitting authorities to include any "waste facilities" as defined under the Extractive Waste Directive. Remaining underground structures are not considered as a waste facility, either as it is considered in Poland that residues of hydraulic fracturing are not extractive waste.

In Spain, the current EIA documents prepared by operators do not mention that the remaining underground structure will be considered as a waste facility.

No information was available and/or no position stated from the competent authorities from the other countries covered under this study.

- *Extractive waste legislation applied to underground injection of waste for disposal*

In Poland, in the case studies assessed, the extractive waste legislation was not applied to the underground injection of waste for disposal. In one of the case studies, part of the flowback was injected underground into a depleted gas deposit at a different site. In Spain, underground injection of waste for disposal is not foreseen in the environmental documents submitted by the operator for the sites assessed. In the UK, no underground injection of flowback water for disposal has been carried out. However according to competent authorities, since hydraulic fracturing fluids remaining in the underground are considered extractive waste, the extractive waste legislation would also apply in such situation. No information was available and/or no position stated from the competent authorities from the other countries covered under this study.

4.3 Directive 2000/60/EC (Water Framework Directive)

In Germany the proposed law mentions that the injected fluid must be classified as non-hazardous to water (in case of fracking activities) or as low hazardous to water (in case of flowback and produced water coming out of the well and injected underground for disposal).

In Hungary, the competent authorities consider that HVHF would need a permit in view of Article 11(3)(j) of the Water Framework Directive. In case of HVHF, the competent authorities will determine a minimum protection zone between the groundwater bodies and the fracturing zone. The activity shall be carried out under controlled conditions, including the establishment and operation of a monitoring network and data supply including the integrity of wells and the changes of the underground fracture network.

In Poland, in the sites covered by the study, it was considered by permitting authorities that the geological and hydrological structure of the license areas would ensure sufficient protection of the groundwater. It is therefore considered that hydraulic fracturing products are not injected into groundwater at any of the considered sites. Therefore the exemption related to the prohibition of direct discharges of pollutants into groundwater was not deemed necessary at the examined sites.

In Spain, according to operators' information for all the sites selected, there are no foreseeable impacts in aquifers, so such authorisation would not be required either. No further information on the competent authorities' point of view on the interpretation of the application of this EU requirement was available.

At UK selected sites, as there were not to be any direct discharges to groundwater at any of the sites reviewed, the operator in each case has not had to rely on the exemption under Article 11(3)(j) of the Water Framework Directive . At the Preese hall site, prior to restoration work commencing on site, the applicant was to provide the EA with additional information to identify any fluids remaining either within the vertical well bore or within the rocks from the fracturing process, together with a risk assessment to confirm that any such fluids do not present a risk to any groundwater. The information submitted was to include details of any potential processes which could result in fluids discharging into a groundwater bearing strata. The EA has confirmed that as part of the decommissioning process (in which the HSE was also involved) the operator provided this information, together with a risk assessment to confirm that any such fluids would not present a risk to groundwater.

In Scotland in relation to the injection of the fracturing fluid, the available SEPA guidance states that this must meet the appropriate exemption under the Water Framework Directive. Article 11(3)(j) of the Water Framework Directive prohibits the direct discharge of pollutants into groundwater, subject to certain exemptions (not specified). SEPA considers that existing guidance by Commission services does not discuss the applicability of Article 11(3) (j) with respect to the initial injection of fracking fluid or the re-use of flowback as an injection fluid in fracturing operations, rather than for disposal.

No information was available and/or no position stated from the other countries covered under this study.

5 Main findings from stakeholders consultation

5.1 EU stakeholders' interviews

- *Effectiveness of the Recommendation*

The federation of oil and gas producers (IOGP) considers that it is too early to judge the effectiveness of the Recommendation in view of the small extent of shale gas exploration in Europe. The chemicals industry federation (CEFIC) considers that it is difficult to distinguish the effect of the Recommendation from the effect of other EU and national legislation in relation to environmental management, waste management and hydrocarbon exploration/production. CEFIC thinks that the purpose of the Recommendation has been achieved, as it has led to changes at the permitting level and has served as the starting point of many debates (plenty of which are still ongoing).

The non-governmental organisations (NGOs) Food and Water Europe (FWE) and Friends of the Earth Europe (FOEE) commented that the non-binding nature of the Recommendation means that it is not effective in resulting in new national measures, or in alleviating public concern. These organisations and the NGO Health and Environment Alliance (HEAL) consider that HVHF should be banned in Europe, and also highlighted aspects of the Recommendation that they consider have not been widely implemented e.g. SEAs.

HEAL mentions that there will be difficulties in applying the REACH Regulation to the shale gas sector, and expressed some concerns about certain points of the Recommendation stressing that they were not adequate to provide protection of health and the environment (i.e. the reference to minimised use of chemical substances, the ability of treating fluids to be considered during the selection of chemical substances, dissemination of information on chemical substances, minimum vertical separation distance, and monitoring requirements).

- *Transparency and access to information*

All stakeholders underline that informing the public is essential. CEFIC does not find that the Recommendation has helped alleviate public concern – shale gas is still a very emotional issue. The crucial question according to CEFIC is what will help alleviate public concern. According to this organisation, dialogue and communication at local level is vital. . BusinessEurope considers that the Recommendation contributes to transparency. CEFIC supports the disclosure of chemical use on a well-by-well basis with the underlying principle that commercial confidentiality issues are taken into account when chemical information is disclosed

FWE/FOEE stress that information remains difficult to obtain, and the Recommendation does not appear to have resulted in an improvement in this regard. HEAL raises concerns that exposure scenarios developed under REACH are not available to the public. The European Federation of Bottled Water (EFBW) comments that transparency is essential for industries such as the bottled water industry to retain consumer confidence.

- *Should the Recommendation be revised*

The oil and gas federation (IOGP) finds that the Recommendation constitutes a thorough checklist/best practice guide that does not need to be revised. This view is shared by other stakeholders from the industry (i.e. CEFIC, BusinessEurope) which consider that

the Recommendation is effective in providing a flexible approach for Member States to adjust their legislation and permitting practices. .

The federation of drilling contractors (IADC) suggests that there is no need for a Recommendation, as many Member States already have national legislation in place and HVHF is not radically different to existing operations. IADC and CEFIC also consider that the current EU and national legal framework is sufficient. CEFIC considers that the purpose of the Recommendation has been achieved, and there is no need for further changes.

In contrast the water industry (EFBW and EUREAU) suggest a range of specific measures (e.g. prohibiting the use of HVHF in drinking water catchment areas and more detailed requirements on waste water, risks of spillage during transportation) to increase protection of water resources. The NGO HEAL also proposes to further detail and develop the principles related to the use of chemicals. FWE/FOEE comment that it would be helpful to widen the scope to include similar activities which do not meet the threshold for HVHF (coalbed methane, tight gas, conventional oil and gas) and to tailor certain principles that sometimes only restate the applicable EU requirements.

- *Should the Recommendation be replaced by legally binding provisions*

IOGP mentions that in Europe, shale gas exploration is at an early stage. According to this oil and gas industry federation, new legally binding provisions would make the initial development phase too difficult and is likely to "kill the shale gas industry" in Europe before it gets a chance to even assess the real potential for Europe. In the same vein, the chemicals industry (CEFIC) does not consider further EU regulation on shale gas necessary and stresses that the current EU regulatory framework, supplemented by national requirements and industry is sufficient.

In contrast, the water industry (EUREAU) commented that not all relevant Member States are active in regulating HVHF, which suggests that legally binding provisions may be needed, potentially via amendment or clarification of existing legislation. EFBW agree that legally binding provisions would be beneficial for the water industry. In the same vein, the NGOs FOEE and FWE mention that the development of legally binding provisions is necessary. They point out that the current EU legislation is not adequate to regulate environmental impacts of HVHF and the application of certain EU environmental legal texts (e.g. Mining Waste Directive, Water Framework Directive) are subject to different legal interpretations.

- *Investor Confidence and Costs*

CEFIC and IOGP consider that regulatory stability is an important step towards increasing investor confidence. If the operating environment is made too hostile, operators can be expected to leave Europe. BusinessEurope considers that the Recommendation contributes to investor confidence.

FWE/FOEE consider that the non-binding nature of the Recommendation, and non-specific measures mean that it is not implemented consistently across Europe. IADC points out that investor confidence is low because it is not clear whether shale gas could be profitable in Europe. CEFIC considers that a lack of investment in shale gas could result in a shift in chemicals production out of Europe.

IOGP and BusinessEurope note that creating a level playing field for the shale gas industry is a matter of proper implementation and enforcement at the Member State level. The administrative permitting processes at Member State level could be improved, e.g. following the Canadian permitting model. FWE/FOEE also highlight inadequacies in implementing the regulatory processes at Member State level.

IADC mentions that local authorities typically do not have the expertise required to issue permits, and some authorities set unduly restrictive limits, to put a practical barrier in place of projects. According to IADC, permits should be granted nationally rather than at local level. EFBW mentions that investor confidence in the water supply industry could potentially be affected by HVHF. Investor confidence would be improved by more stringent environmental controls, and this would be expected to place additional costs on the HVHF industry.

5.2 Online survey

Replies were received from stakeholders coming from seven of the eleven Member States surveyed, with the majority of responses from stakeholders located in Spain and the UK. No valid responses were received from Austria, Hungary, Lithuania or Romania. Over half of all responses came from the oil and gas industry, with a further one-third of responses from NGOs. In general, responses were aligned more closely to the priorities of the organisation responding, rather than along national lines. In the responses to many questions, a clear divergence of opinion between oil and gas industry respondents and NGOs is noticeable. The opinion of the geological surveys is mostly aligned with that of the oil and gas industry, while the water industry generally aligns with NGOs.

Respondents from the oil and gas industry considered that the principles of the Recommendation were already reflected in national legislation and applied in practice. A minority of respondents (mainly NGOs in DK, DE, PT, UK) are of the opposite opinion. For example, one respondent from Germany commented that an environmental impact assessment is not compulsory for most activities involving fracking. Respondents from Portugal and the UK suggested that the adoption of the Recommendation may have resulted in changes in regulation of activities involving hydraulic fracturing – this is discussed further in Section 6 on the cost analysis. No other changes in planning, licensing or permitting resulting from the Recommendation were highlighted by respondents.

Because of the perceived existence of adequate national legislation, oil and gas industry respondents considered that the purpose of the Recommendation is already partly or fully achieved. On the contrary, NGOs considered that the Recommendation does not achieve its objectives because the safeguards identified in the Recommendation are not sufficient for protection of health and the environment.

A majority of respondents (mostly industry representatives) considered that the Recommendation has not achieved a level playing field for industry operators, and has not improved investor confidence, mainly because of uneven implementation, and increased costs, legislative burdens and delays. An oil and gas industry respondent suggested that attention should be focused on the application of existing national regimes There is a consensus among respondents (oil and gas industry, NGO, water industry and geological surveys) that the Recommendation has not alleviated public concerns (two-thirds of respondents) or only partly alleviated concerns (one-third of respondents). There was a consistent view that improved information and trust among members of the public are important to alleviate concern. Similarly, almost all respondents (except for two oil and gas industry respondents) considered that the Recommendation contributed to the dissemination of information only partly, or not at all.

Views on implementation of the Recommendation were divided, with industry respondents considering that the principles of the Recommendation were already applied effectively at national level, and the Recommendation does not need to be updated or made legally binding. In contrast, NGOs considered that the principles of the Recommendation were not applied effectively, and that updating is required in a wide range of aspects. NGOs generally considered that the Recommendation should be made

legally binding, with one respondent commenting that a legally binding document would improve certainty and hence investor confidence.

6 Main findings from the cost analysis

The economic assessment identified a number of potential sources of economic cost impacts which could be associated with the implementation of the Recommendation.

Survey respondents in Spain indicated that there were substantial delays in the approvals process for applications to carry out exploratory drilling for unconventional hydrocarbons. Some respondents linked these delays to the Commission Recommendation. However, analysis of the situation in Spain found no evidence that any costs resulting from delays in determining exploratory applications were associated with the application of the Recommendation and were more likely to be due to existing national law and other circumstances. Additionally, it is difficult to be certain of the significance of the delays experienced. Further, even if causality is clear, from the consultee responses it is uncertain what the time delay would have been in the absence of the Recommendation. In view of this, it was concluded that there was no strong evidence for costs resulting from delays to the regulatory processes in Spain, and if any such delays had risen, there was no robust evidence on which the costs of any such delays could be estimated.

As regards the cost of implementing the Recommendation, industry respondents highlighted mainly the costs for exploration projects of baseline studies and administrative costs and delays. Other respondents were not able to provide specific feedback on costs. While respondents highlighted administrative costs and delays, several respondents noted that it is difficult to relate these delays specifically to the Recommendation.

Reviewing the eleven Member State reports, no examples of changes in relation to planning and permitting for HVHF activities were identified in eight Member States as a direct result of the application of the Recommendation (Austria, Denmark, Germany, Hungary, Netherlands, Poland, Romania and Spain). In three Member States, the national expert reports and stakeholder survey indicated that implementation of the Recommendation may have resulted in changes, which may in turn have associated costs.

Firstly, there has been an ongoing legislative programme in **Lithuania** of measures relevant to HVHF. Those measures implemented following the publication of the Recommendation were investigated. It was found that most of the legal developments in Lithuania do not result from the Commission Recommendation, although they are in some cases relevant to the issues raised by the Recommendation. Nevertheless, a limited evaluation was carried out of the potential costs associated with monitoring requirements put in place in Lithuania which may have arisen from the Commission Recommendation. This indicated that the costs associated with specific measures ranged from minimal (administrative costs only) up to almost €150,000 per well pad in the case of hydrogeological monitoring if a deep borehole is required. Provision of information on wastes produced could also potentially carry a significant cost due to cost of characterisation of drilling muds, flowback water and produced water. A cost/benefit analysis was not within the scope of this study, although this would be necessary for a thorough analysis.

Secondly, an Infrastructure Act was passed in the **UK** in 2015. This Act contained a number of measures relevant to the Commission Recommendation, although the UK authorities do not acknowledge a link between the Infrastructure Act and the Commission Recommendation. The evidence of the Act's development seems to indicate that these measures were not linked to the Recommendation, but resulted from other initiatives. The definition of "associated hydraulic fracturing" used in the Infrastructure Act is similar (although not identical) to the definition of "high-volume hydraulic fracturing" used in the Commission Recommendation. It is possible that this definition was influenced by the Recommendation, but it was not formally acknowledged in any document or interview. It

was noted that the UK Government carried out a cost-benefit assessment of the Infrastructure Act which indicated that the Act would deliver a benefit of £135 million to £1940 million over a 20 year period.

Thirdly, two changes have been implemented in **Portugal** as a result of the Recommendation. A website has been set up to provide for the dissemination of information on activities involving HVHF, in accordance with the principles of Recommendation Article 15(b). The cost to the regulatory authority associated with setting up the database was estimated to be in the range €900 to €3,000 at 2015 prices. The costs to industry of providing the data for this website were estimated to be in the range €230 to €2,400 per report, at 2015 prices. However, HVHF has not been carried out at any site in Portugal, and hence no costs associated with the provision of information have yet been incurred.

EIAs are now mandatory for exploratory drillings (*sondagem*) and/or extraction of hydrocarbons by unconventional methods (including hydraulic fracturing)" in Portugal. This requirement could potentially incur a cost for any projects which would require an EIA under this new law. It was estimated that the costs of carrying out an EIA for a project involving HVHF could be of the order of €250,000 at 2010 prices. The time required to carry out, submit and evaluate an EIA could be expected to be over one year. As there is currently no shale gas development in Portugal, any such cost is speculative at present.

A cost/benefit analysis was not within the scope of this study, although this would be necessary for a thorough analysis.

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