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European energy and environmental law and its ability to regulate the specific challenges of unconventional gas extraction

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This paper is a summary of the research as described in the abstract. It does not include the complete assessment and is hence to be characterized as work in process. Comments and remarks can be addressed to leonie.reins@law.kuleuven.be

Contents

1. Introduction

To adapt to newly emerging environmental and energy challenges, European environmental and energy law has undergone many revisions and changes throughout the past 30 years.[2] The successful regulation of all environmental aspects of human activities, and the interaction between environmental and energy priorities, has proven to be challenging.[3]

[1] The author has contributed to a Commission study into the regulatory framework for shale gas. Publication of this study is subject to Commission approval. The current paper therefore does not quote from or refer to this study.

[2] See for example Hey, Christian, 'EU Environmental Policies: A short history of the policy strategies', in: European Environmental Bureau, *EU Environmental Policy Handbook*, 2005, 17-31.

[3] Especially regarding the areas of climate, air, land, biodiversity, waste or water. See European Commission, DG Environment, 'Energy and environment', available at http://ec.europa.eu/environment/integration/energy/index_en.htm [22.06.2013].

One emerging subject in both such areas of law, which is testimony to this challenge, is the extraction of unconventional gas resources, such as shale gas, which is a possible response to both increasing energy demand in the European Union and dependence on gas imports from third countries such as Russia. The large scale and manipulative nature of hydraulic fracturing techniques elicits a mixed response due to a large realm of unknowns, not only about externalities but also concerning the ability of the technology to deliver. Characterised by uncertainties and promises to address climate change, shale gas extraction raises several technical, ethical and legal issues. Recent media coverage[4] of shale gas has focused on the geo-political impacts, rather than on the regulatory site. Shale gas exploration inherently has to two different angles to it: one of energy exploration, and the associated external policy implications; and one of environmental concerns.

The aim of the paper is to establish how a conceptual approach of coherent regulatory regime of unconventional gas activities might look like. This will be derived on the basis of the current regulatory regime and from exercise of and regulatory approaches to other areas. Therefore, this paper will, firstly give an overview of the main gaps of the current regulatory regime in place to then, secondly, analyze other cross cutting issues of energy and environmental law, such as mining, the waste material versus waste product approach and Carbon Capture and Storage (CCS). All these issues also affect several environmental elements and it remains to be seen if they are regulated in a coherent way.

To enhance the readability of this paper, a brief outline of the process of the shale gas exploitation and production and its impacts on the environment will be given, to then provide a (short) working definition of a "coherent" regime and further continue with the analysis of the key aspects, as described above.

2. Shale gas extraction and environmental impacts

2.1. Process and environmental impacts

Shale gas is natural gas which is primarily composed of methane and is trapped in compressed fine-grained sedimentary rock formations, the exact geochemistry differing from shale to shale. The exploitation process of shale gas can be divided into three stages: the discovery phase (planning gathering knowledge of reservoir), the drilling phase (operational phase, applying techniques and optimizing output) and the production phase (hydraulic fracturing).[5] The shale must either have natural fractures, or fractures must be created in the rocks to release the gas through the hydraulic fracturing method

[4] See for example in Germany 'Umstrittene Bohrmethode: Fracturing wird zum Wahlkampf-Aufreger',written by Lazar Backovic, Michael Kröger and Annett Meiritz, Spiegel online, 11.02.2013, , available at: http://www.spiegel.de/politik/deutschland/umstrittene-gasfoerderung-fracturing-wird-zum-politischen-zankapfel-a-882634.html, in Belgium 'Ontginning schaliegas in ons land?' De Redactie, Het journaal 7, 06.02.13, available at http://www.deredactie.be/cm/vrtnieuws/mediatheek/programmas/journaal/2.26578/2.26579/1.1542650 [22.06.2013], in France 'Gaz de schiste : Hollande rouvre la porte', La Tribune, 13.11.2012, available at http://www.latribune.fr/entreprises-finance/industrie/energie-environnement/20121113trib000730727/gaz-de-schiste-hollande-rouvre-la-porte-.html [22.06.2013], in the United Kingdom 'Gas fracturing: Ministers approve shale gas extraction', BBC.com, 13.12. 2012, written by Roger Harrabin, available at http://www.bbc.co.uk/news/uk-20707574 [22.06.2013]

[5] Phases adopted after Halliburton Energy Services, 'U.S. Shale Gas: An Unconventional Resource. Unconventional Challenges', 2008, p. 2.

(fracturing).[6] In order to release the gas, water is injected with high pressure into the shale formation. Mixed with sand and other fracturing fluids[7] it keeps the fractures open and thus increases the permeability so that the gas can flow.[8]

The US EPA defines hydraulic fracturing as follows: [9]

> *Fluids, commonly made up of water and chemical additives, are pumped into a geologic formation at high pressure during hydraulic fracturing. When the pressure exceeds the rock strength, the fluids open or enlarge fractures that can extend several hundred feet away from the well. After the fractures are created, a propping agent is pumped into the fractures to keep them from closing when the pumping pressure is released. After fracturing is completed, the internal pressure of the geologic formation cause the injected fracturing fluids to rise to the surface where it may be stored in tanks or pits prior to disposal or recycling. Recovered fracturing fluids are referred to as flowback. Disposal options for flowback include discharge into surface water or underground injection.*

The shale gas hydraulic fracturing process prima facie impacts considerably on the environment.[10] It affects amongst others water resources, freshwater wetlands, ecosystems and wildlife, air quality, the noise level, the seismicity of the rocks and has visual impacts on the side.[11] Three brief examples of shale gas' environmental impact illustrate the challenge: Firstly, concerns exist regarding air pollution.[12] Shale gas extraction has a larger carbon footprint than the production of coal and conventional gas.[13] Not to be disregarded are also the emissions resulting from the transport of waste, equipment and materials.[14]
Secondly, water resources are impacted by water extraction, waste water treatment and disposal, water and chemicals used in the drilling and fracturing phase and water pollution through crude oil, flow-back and produced water and drilling fluids, as well as surface spills, leaks in pits and drinking water supply.[15]
The hydraulic fracturing process does not only change the nature of the rock formation but also requires between 30 and 45 millions liters of fresh water per well, which - depending on the area - can have

[6] Deloitte, 'Shale gas- A strategic imperative for India', 2010, p. 3; for further and more detailed information about the definition, geology and geochemistry on shale gas see Halliburton Energy Services, note 5 above, p. 2.
[7] For further information on fracturing fluids and its use see Arthur, J.D. et al, 'An overview of modern shale gas development in the United States', ALL Consulting, p. 14f.
[8] Bailey, A. 'The Fayetteville Shale Play and the Need to Rethink Environmental Regulation of Oil and Gas Development in Arkansas', 63 *Arkansas Law Review* 848, 2010, (815-848), 819ff.
[9] EPA, Hydraulic Fracturing Background Information, available at http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_hydrowhat.cfm [22.06.2013].
[10] See Bailey, A., note 8 above, 819ff, also for further impacts on the environment.
[11] For a detailed analysis of the factors see Department of Environmental Conservation, New York State, 'Chapter 6, Potential Environmental Impacts in: Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program- Well Permit Issuance for Horizontal Drilling And High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs', 2009, p. 1-163, as well as Bartis, J. et al., note 13 below, p. 35ff.
[12] Cady, M., note 15 below, p. 146f.
[13] see Bartis; J., LaTourrette, T., Dixon, L. et al. 'Oil Shale Development in the United States : Prospects and Policy Issues', RAND Corporation, 2005, p. 40.
[14] See Bailey, A., note 8 above, p. 819ff.
[15] Cady, M., 'Drilling into the issues: A critical analysis of urban drilling´s legal, environmental and regulatory implications', 16 *Texas Wesleyan Law Review*, 2010, p. 138f, as well as Department of Environmental Conservation, note 11 above, p. 3f.

significant impact on the local water capacity and lead to an over- use of local water resources.[16] The fracturing process results in large amount of waste water, either flow back water from the treatment itself, or produced water, which is highly concentrated subterranean saltwater from the rock formation brought to the surface during the drilling process.[17] The flow back water that returns to the surface after the treatment is mixed with the fracturing fluids and thus highly contaminated with chemicals.[18] Thirdly, methods of the waste and drilling water treatment depend on the individual shale, however range between three options: underground injection, treatment and discharge or recycling.[19] Each has its own challenges and (environmental as well as economic) drawbacks.

2.2. Shale gas in the EU

The extraction of unconventional gas in the European Union is at a very early stage of development compared to the United States where shale gas extraction has been promoted as a "game changer"[20] for energy supply. Shale gas became commercially profitable in the US though the use of the hydraulic fracturing method in 2005. The United States are consequently by far the biggest producer of shale gas, having extracted 5,336 billion cubic feet in 2010 alone,[21]and serve as the point of reference for most other countries, regarding technical expertise, but also of the (gaps of) legal regulation of the process.

However prospection and explorations are underway in several EU Member States, too. The EU belongs to the key players in the worldwide arena, having big amounts of shale gas resources, after the United States and China.[22] Some Member States are overall in favour of shale gas extraction, namely Poland, Hungary and Lithuania. A recent KPGM study states that "*in general, these countries' political and legal environments present a fairly stable atmosphere in which investment risk is not a primary concern"*[23] regarding unconventional gas activities. Especially Poland is considered to be a "*test case for European shale gas development*" and will determine the further process in the EU.[24] One reason for the strong political interest is the fact that the Eastern European countries are more dependent on energy imports from third countries, especially Russia. One the other hand, other Member States such as Germany and France are rather hesitant. France imposed a ban on the exploration and exploitation of hydrocarbons using hydraulic fracturing[25], whilst in Germany, several States ("Laender") such as North Rhine

[16] See Bailey, A., note 8 above, p. 819ff.
[17] Ibid, 140f, as well Arthur, J.D. et al., note 7 above, p. 19.
[18] For more information see Cady, M., note 15 above, p. 140f.
[19] See Bailey, A., note 8 above, p. 819ff.
[20] So for example General Electrics CEO Jeff Immelt, available at http://www.reuters.com/article/2013/02/07/ge-shale-idUSL1N0B7BGQ20130207 [22.06.2013],
[21]US EPA, 'Natural Gas- Shale gas production,' available at http://www.eia.gov/dnav/ng/ng_prod_shalegas_s1_a.htm. [22.06.2013].
[22] International Energy Agency, 'World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States', available at http://www.eia.gov/analysis/studies/worldshalegas/ [22.06.2013].
[23]KPGM, 'Central and Eastern European Shale Gas Outlook', 2012, p.58.
[24] Meißner, F., Naumenko, D., 'Non-Conventional Gas Regulation in Europe: Implications for Ukraine', *Policy Paper Series [PP/03/2011]*, Institute for Economic Research and Policy Consulting, Berlin/Kyiv, 2011, p. 9.
[25] Act 2011-835 of 13 July 2011*(Loi n° 2011-835 du 13 juillet 2011 visant à interdire l'exploration et l'exploitation des mines d'hydrocarbures liquides ou gazeux par fracturation hydraulique et à abroger les permis exclusifs de recherches comportant des projets ayant recours à cette technique).*

Westphalia imposed a moratorium on the activities, until a federal decision on shale gas is reached.[26]

Emerging citizen initiatives[27] show public concern with environmental, climate change and health related issues. In addition, the European Commission published the result of their stakeholder consultation on the "Unconventional fossil fuels (e.g. shale gas) in Europe" in the beginning of June 2013.[28] One key finding of the stakeholder participation is that a "*large majority of respondents agree on the lack of adequate legislation, the need for public information and the lack of public acceptance of unconventional fossil fuels (e.g shale gas)*" and that "*doing nothing at EU level" is the least favoured option*".[29] These results can be interpreted as a call upon the European Institutions to take action and are in the same time a strong indicator that a European position will be established in the (near) future. It is just the question of how this action will look like: in the form of best practice examples; guidelines or, as a strongest indication for a European regulatory framework a green paper for a legislative proposal. This paper contributes to this discussion as it draws conclusions from regulatory frameworks of other cross-cutting issues as explained above.

3. Working definition of a "coherent" regulatory regime

The concept or principle of "coherence" is not in itself and primarily a legal concept but can be used in various disciplines. In the legal context however, Wintgens describes coherence as "*the principle of justification of external limitations from the perspective of the legal system as a whole. A legal system is not a static chain of external limitations: It is on the contrary a complex and dynamic set of intertwined propositions concerning what ought to be done and how it ought to be done*."[30] In relation to "consistency", he concludes that "*some would say that consistency is a matter of all or nothing. Coherence in its turn is a matter of degree. On this view, consistency is a logical requirement while coherence refers to "making sense as a whole*."[31]

In line with this definition, one important aspect of a coherent regulatory approach to shale gas activities is, that it makes "*sense as a whole*"[32], rather than being blinkered about every aspect of regulation. A similar perception of the concept is applied by Rescher's „*network model of coherence*."[33] As shale gas and other analyzed issues like CCS and mining demonstrate, as established above, impacts on the environment are cross-cutting in their nature, affecting several elements of the environment at the same time. Therefore, these issues do not fit into the classical model of coherence, where one element is based

[26] Joint decree of the Ministries of Economics and Environment, (V B 1 – 47-03/IV-5-3052-37727).
[27] For example 'Gegen Gasbohren' in Germany available at http://www.gegen-gasbohren.de/ [22.06.2013]; 'Fracturing Free Ireland' in Ireland and the Your voice consultation on the European Union level available at http://ec.europa.eu/yourvoice/ipm/forms/dispatch?form=SHALEGAS [22.06.2013].
[28] Presentation of the stakeholder participation on "Unconventional fossil fuels (e.g. shale gas) in Europe", available at http://ec.europa.eu/environment/integration/energy/pdf/Presentation_07062013.pdf [22.06.2013].
[29] Ibid., p.6.
[30] Wintgens, L.J., 'Legisprudence as a New Theory of Legislation' 19 *Ratio Juris*. 1, 2006 (1–25), p. 15.
[31] Ibid.
[32] Ibid.
[33] Rescher, N., 'Foundationalism, Coherentism, and the Idea of Cognitive Systematization', 71 *Journal of Philosophy*, 1974, (695-708).

or founded on another.[34] Rather, the network model sees a system as "*a family of interrelated theses not necessarily of hierarchical arrangement, but rather linked among one another by an interlacing network of connections*".[35] Instead of a hierarchical structure where one element is based on another, a "cyclistic" structure is needed in order to cope with multiple environmental impacts where the various elements are interrelated with each other. This definition of an overall regime "*making sense as a whole*" and being "*linked among one another"* will serve as a basis for the this paper.

4. The current European regulatory regime in place and its ability to regulate shale gas extraction activities

Since there is no overall "Shale Gas Regime" or "Shale Gas Directive" in the European Union, the regulation of shale gas exploitation and its impacts on environmental elements fall under general energy and environmental laws. With shale gas exploitation impacting on several environmental elements, it is subject to diverse legislation, including the Drinking Water Directive[36], the Water Framework Directive[37], the Groundwater Directive[38], the Waste Directive[39], the Mining Waste Directive[40], the Air Quality Directive[41], the Noise from Outdoor Equipment Directive[42], the Habitats Directive[43], the Wild Birds Directive[44] and the Hydrocarbon Directive.[45] Until now, the existing literature focuses on the analysis which Directives are applicable to the activities rather than on the question if their content is actually fit to regulate the impacts that come along with pursuing shale gas drilling and extraction. The literature on the issue mainly consists of studies commissioned by the European institutions and carried out by consultancies. For instance, the European Parliament has issued a draft report on "the environmental

[34] The classical "Euclidean Model" is also described in Rescher, N., ibid., 698f.
[35] Ibid. 699.
[36] Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, OJ L 330, 5.12.1998, p. 32–54
[37] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, OJ L 327, 22.12.2000, p. 1–73.
[38] Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration, OJ L 372, 27.12.2006, p. 19–31.
[39] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, OJ L 312, 22.11.2008, p. 3–30.
[40] Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC - Statement by the European Parliament, the Council and the Commission, OJ L 102, 11.4.2006, p. 15–34.
[41] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, OJ L 152, 11.6.2008, p. 1–44.
[42] Directive 2005/88/EC of the European Parliament and of the Council of 14 December 2005 amending Directive 2000/14/EC on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors, OJ L 344, 27.12.2005, p. 44–46.
[43] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, OJ L 206, 22.7.1992, p. 7–50.
[44] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, OJ L 20, 26.1.2010, p. 7–25.
[45] Directive 94/22/EC of the European Parliament and of the Council of 30 May 1994 on the conditions for granting and using authorizations for the prospection, exploration and production of hydrocarbons, OJ L 164, 30.6.1994, p. 3–8.

impacts of shale gas and shale oil extraction activities"[46], which assesses more than 30 Directives and Regulations and their applicability to regulate shale gas activities. The study concludes that especially the Directives on mining are crucial to the regulation of shale gas activities.[47] Further it identifies that the current EU framework as applicable to hydraulic fracturing has a considerable number of gaps.

The Commission has released three studies so far on the issue[48], for example of the impact on the climate from hydraulic fracturing[49] concluding that for shale gas activities occurring in the EU, there is no transparency of emissions of methane from specific fugitive or vented sources or from specific activities on the site. Thus, the Commission has already started assessing the EU environmental '*acquis*' in view of its application to unconventional gas practices.[50]

One of the main gaps of regulation associated with shale gas activities is that the activity is not covered by the EIA Directive.[51] Annex I No. 14 of the Directive defines the threshold at 500000 cubic metres/day in the case of natural gas extraction for commercial purposes and thus renders the activity subject to the screening and scoping procedure of the individual Member States. The Commission published a guidance note on the application of the Directive in relation to projects related to the exploration and exploitation of unconventional hydrocarbons[52] as a first step towards guaranteeing a safe and sound application of the Directive and its screening and scoping requirements.

Further, another main concern is the potential impacts on the ground, surface and drinking water, especially regarding the question if the provisions of the Water Framework and Groundwater Directive are suited to also address the challenges of unconventional gas activities.[53]

A third major insecurity in regulation is the issue of "fracturing fluids". The exact composition and quantity of the chemicals used for the hydraulic fracturing process fall under the category of a "trade secret".[54] The currently voluntarily disclose mechanisms as existing in the United States and as under discussion to also be established for the EU[55], give an indication on the composition of the fluids[56] but do

[46]DG for Internal Policies European Parliament, 'Impacts of shale gas and shale oil extraction on the environment and on human health', Brussels: European Parliament, 2011.
[47] DG for Internal Policies European Parliament, note 46 above, p. 49.
[48] See for all three studies http://ec.europa.eu/environment/integration/energy/studies_en.htm [22.06.2013].
[49] AEA, 'Climate impact of potential shale gas production in the EU', Report for European Commission DG CLIMA, AEA/R/ED/57412, 30.07. 2012.
[50] See note 48 above.
[51]Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment, OJ L 26, 28.1.2012, p. 1–21.
[52]See European Commission, 'Guidance note on the applicable EU environmental legislation to unconventional hydrocarbon projects using advanced technologies such as horizontal drilling and high volume hydraulic fracturing', 2009; as well as European Commission 'Guidance note on the application of Directive 85/337/EEC to projects related to the exploration and exploitation of unconventional hydrocarbon', 2011, available via http://ec.europa.eu/environment/eia/pdf/Annexe%202.pdf [22.06.2013].
[53] For a detained discussion see Reins, L., The Shale Gas Extraction Process and Its Impacts on Water Resources. 20 *Review of European Community & International Environmental Law* 3, 2011, (300-312).
[54] DG for Internal Policies European Parliament, note 46 above, p. 61.
[55] See Shepherd, E., 'Shale gas – an EU analysis', 2012, available at http://www.shale-gas-information-platform.org/areas/the-debate/shale-gas-an-eu-analysis.html [22.06.2013].
[56] As for example in the United States the website "FracFocus", available at http://fracfocus.org/ [22.06.2013].

not require full disclosure. Further some scholars argue that the REACH Regulation would require a disclose[57], which is in fact not exactly the case. Yes, manufacturers and importers of chemicals in the European Union are obliged to register each substance which is manufactured of imported into the European Union in a yearly quantity of one tone or more. However, this threshold implies that there is no control mechanism if the substances are imported in lower quantities. Further Article 118 of the Regulation requires that the disclosure of certain information includes details of the full composition of a preparation, its use and the quantities manufactured or placed on the market. However it does not require the disclosure of the exact composition and concentration and mixture of the chemicals used in the fracturing activity. A study by AEA confirms that the Regulation allows for commercially sensitive information to be withheld from the public under certain conditions.[58]

5. Cross cutting issues of energy and environmental law

The following section analyses three other cross-cutting issues of energy and environmental law. Whereas shale gas is most likely the first issue where the changes of division, co-ordination and interaction of the energy and environmental title in the TFEU after Lisbon is playing out in practice, the challenge of regulating and balancing energy and environmental matters in a coherent way has always been a key challenge for lawmakers.[59]

In the European Union legal order, there are generally three ways of regulating an activity through secondary law: firstly, by amending Directives to include a specific activity (for example the activities included in the Annexes of the EIA Directive) or establishing a specific tool of regulation (as for instance the Water or Waste Framework Directive). Certainly, a mixed form is possible as well (as for example the CCS Directive). Three issues have been chosen for a comparison, all of these issues being subject to a different form of regulation and thus presenting three different modules possible as a conceptual framework of regulation for shale gas activities:

The Carbon Capture and Storage strategy envisages the storage of CO^2 in deep geological formations, deep in the ocean or in mineral carbonates. Within the EU, the storage form applied is mostly the storage of gas in deep geological formations, salines and former oil and gas fields. A specific Directive has been drafted in order to regulate the activity.[60]

Contrary to the regulation of CCS activities, there is no overall piece of legislation regulating mining activities. As opposed to for example the Water Framework Directive or the Waste Framework Directive, no Mining (Framework) Directive exists. The mining activity is regulated through various Directives

[57] See for example Keating, D. in his blogpost 'Fracking chemicals remain secret, for now' , 29.03.2013, available at http://www.europeanvoice.com/page/european-voice-blogs-dave-keating/3554.aspx?blogitemid=1710 [22.06.2013].
[58] AEA, 'Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe', final report submitted to DG ENV, 2012, p. 115.
[59] See also note 3 above.
[60] Directive 2009/31/EC of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006, OJ L 140, 5.6.2009, p. 114–135.

which are applicable to a specific aspect of the activity. In addition, the mining sector is still to a large extent subject to Member States regulation, which is most of the time rather historical and does not reflect today's requirements.[61] This is an interesting point of comparison since the current shale gas regulatory regime is established on the Member States level and is to a large extent based on mining legislation.[62]

The Waste Material versus Waste Product approach will illustrate how a regulatory attempt or idea failed in practice. The EU waste policy has for a long time employed, and is still applying a waste product approach: it regulates waste cars, waste electric and electronic equipment, waste batteries, mining waste, packaging waste, etc. The waste products approach means that one material, e.g. PVC, is regulated differently, depending on the product in which it ends up. This would not seem coherent, and the EU has been studying ways to remedy this and to turn it into a waste material approach which would treat waste according to its material and not the product it is used in. However, for reasons further explained below, this approach did not break through to a practical application.

5.1. The mining regulatory framework in the European Union- fragmented integration?

Mining legislation in the European Union has a long history and outstanding position, considering the fact that the founding ancestor of what we call today the "European Union", was actually the "European Coal and Steal Community" established by the Treaty establishing the European Coal and Steel Community in 1951.[63] Regardless of this standing, there is no comprehensive mining framework existing at the European Union level.[64] Especially the regulation of mineral groups and mining rights, as well as the issuing of prospection, exploration and exploitation permits[65] and taxes and fees fall traditionally within the regulatory competences and framework of the Member States.[66] Parallel to the European regime, also on a national level different legislation and authorities interact. In addition to the main basic law related to mining activities also environmental, spatial planning, employment, as well as commercial and financial law applies.[67]

On a Union basis, only two of the activities directly associated with mining are addressed: As established above and as its title suggests, the Mining Waste Directive is applicable to waste generated by the mining activities and further two directives have been established for the extraction industry under the framework of the Directive introducing measures to encourage improvements in the safety and health of workers at work.[68] These are Directive 1992/104/EEC on the minimum requirements for improving the safety and

[61] Thiess, G., *Legal Basis of Mineral Policy in Europe – An overview of 40 countries*, Springer Wien New York, 2011, p.7.
[62] DG for Internal Policies European Parliament, note 46 above.
[63] Treaty establishing the European Coal and Steel Community (1951)
[64] Safak S., Discussion and Evaluation of Mining and Environment Laws of Turkey with regard to EU Legislation, 2010, available at http://www.belgeler.com/blg/lgt/discussion-and-evaluation-of-mining-and-environment-laws-of-turkey-with-regard-to-eu-legislation-turk-maden-ve-cevre-kanunlarinin-avrupa-birligi-mevzuatiyla-karsilastirilmasi-ve-degerlendirilmesi [22.06.2013], as cited in DG for Internal Policies European Parliament, note 46 above, p. 48.
[65] Except for the prospection, exploration and production of hydrocarbons, where the Hydrocarbons Directive establishes a general framework.
[66] Thiess, G., note 61 above, p.7.
[67] Thiess, G., note 61 above, p.9.
[68] Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work, OJ L 183, 29.6.1989, p. 1–8.

health protection of workers in surface and underground mineral- extracting industries[69] and Directive 1992/91/EEC concerning the minimum requirements for improving the safety and health protection of workers in the mineral-extracting industries through drilling.[70] Further, the Hydrocarbons Directive establishes conditions for granting and using authorizations for the prospection, exploration and production of hydrocarbons.[71] General legislation not preliminary aimed at regulating the mining activity but also applicable to specific aspects is environmental legislation, especially the horizontal Environmental Impact Directive[72],waste management legislation as the Waste Framework Directive, water and risk management legislation, as well as pollution control regulation.[73]
Thus, contrary the regulatory framework of CCS activities (further assessed below), the mining activity is no regulated through one specific piece of legislation covering the entire life cycle thereof. In that way, the interplay of Member States and Union competences might fragment the regulatory regime since especially the permitting and technical requirements and standards applicable to a mining site vary considerably amongst Member States. This might result in an incoherent regime with the application of different health and safety but also environmental standards in the Member States to a similar activity. As established above, shale gas activities are mainly regulated though national and European mining legislation[74], thus as a consequence, a coherent regulation of this activity amongst the individual Member States might at all not be possible because of the incoherent approach to mining legislation alone.

In addition, as stated above, the legislation on the national level is fragmented as well throughout several authorities and legislative disciplines. Furthermore the mining legislation is rather historical and does not reflect today's requirements of a sustainable and integrated activity.[75] Arguably the failure to establish a coherent and integrated regime on a Member State level cannot be compensated through national legislation: if the regulatory regimes are not capable to regulate general mining activities in a coherent and modern approach, it is certainly not capable of addressing the challenges of unconventional gas activities such as shale gas.

Further, the mining regulatory framework in the European Union illustrates an example of where specific legislation exists in respect of the treatment of mining waste, a result of a past experience. The accident in Romania (Baia Mare) in 2000 led the EU to revise its existing legislation, and to the adoption of the Directive 2006/21/EC on the management of waste from extractive industries. Not only does the Directive contain provisions applicable to the generated mining waste, it also contains specific rules to prevent the worsening of water quality. The waste management plan, which operators need to establish, should contain "measures for the prevention of water status deterioration in accordance with Directive 2000/60/EC (WFD)". Having regard to the fact that a large realm of unknowns exist about shale gas

[69] Council Directive 92/104/EEC of 3 December 1992 on the minimum requirements for improving the safety and health protection of workers in surface and underground mineral-extracting industries (twelfth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC), OJ L 404, 31.12.1992, p. 10–25
[70] Council Directive 92/91/EEC of 3 November 1992 concerning the minimum requirements for improving the safety and health protection of workers in the mineral- extracting industries through drilling (eleventh individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC), OJ L 348, 28.11.1992, p. 9–24.
[71] Note 45 above.
[72] Directive 85/337/EEC, as codified by Directive 2011/92/EU, note 51 above.
[73] For a detailed overview of the European *aquis* applying to mining activites see Hamor, T., 'Sustainable Mining in the European Union: The Legislative Aspect' in: 33 *Environmental Management* 2, 2004, (252-261), p.253ff.
[74] DG for Internal Policies European Parliament, note 46 p. 48.
[75] Thiess, G., note 61 above, p 4f, as restated in DG for Internal Policies European Parliament, note 46 p. 48.

activities and especially the effects on the environment, the background history and origins of the Mining Waste Directive serve as an example of a failure of the application of the precautionary and the preventive principle. There principles are two of the key environmental principles included in Article 191 TFEU. The precautionary principle applies to *potential* risks, thus risks which cannot be qualified or quantified as yet because of a lack of scientific data or knowledge. By contrast, the prevention principle is referred to in situations where the likelihood that a risk occurs is quantifiable; it is just not clear how and when the damage or impact will occur.[76]

Applying this to shale gas activities, this would seem as a call to learn from the past lessons and, in line with the principles, establish a regime managing the activity coherently on beforehand rather than having to face the environmental consequences of spills/leakages or migration of wells in retrospect.

Lessons to be learned from the mining regulatory framework in the European Union

The lessons to be learned from the mining legislations are quite straight forward:
Firstly, the division of competences in the area of energy and environment[77] between the Union and the Member States is crucial for guarding the national sovereignty and autonomy. However, this division can be a hurdle to guarantee a coherent regulation of an activity. It does not have to be the case in all subject matters (for example it is not regarding the regulation of CCS activities, as established below) however it is for mining activities. A possible explanation might be the fact that mining policy and legislation has such an outstanding position within the history of the Union, and that mining activities historically were (and in some countries still are) the key to economic growth.[78] However, regarding unconventional gas extraction and the special characteristics thereof, it is in important lesson that the mining framework applicable to the shale gas activity is fragmented both, in the sense that European legislation only exists for waste and health and safety aspects of the activity and also that the national legislation is not suited to meet today's requirement of a modern and sustainable regulation.[79]

The second lesion tells us that prevention and precaution is better than rectification; the background history of the origins of the Mining Waste Directive, shall teach the lesson of applying these guiding principles in beforehand: the scientific uncertainties coming along with shale gas actifities require strict application of these principles and thus a coherent regulatory approach to regulation, tackling all issues in an integrated manner.

[76] Van Calster, G., Reins, L. (2013). EU Environmental Law. Cheltenham: Edward Elgar.
[77] Article 4 (2) (e) and (i) Treaty on European Union ['TEU'], OJ C 326, 26.10.2012.
[78] International Council on Mining and Metals (ICMM), 'The role of mining in national economies', 2012, p. 8ff.
[79] Thiess, G., note 61 above, p 4f, as restated in DG for Internal Policies European Parliament, note 46 p. 48.

5.2. The waste product versus waste material approach- reflections from a coherency point of view

Whereas special legislation on waste has been existing since the start of the environmental era in the seventies,[80] at the latest since the issuance of the Sixth Environmental Action Programme[81] where waste has been listed as a "key environmental priority"[82], the area of waste has received increasing attention also from a policy making perspective[83] besides the legal aspects and is waste is increasingly seen as a valuable resource for industry.[84]

The "Thematic Strategy on the prevention and recycling of waste" of 2005[85] is one of seven thematic strategies adopted under the 6th EAP and has been reviewed in 2011. It outlines the current (regulatory) situation at that time and specifies the aims of an evolving EU policy on waste, as well as actions to reach this aim[86]. Nearly at the same time, the Commission published a "Thematic Strategy on the Sustainable Use of Natural Resources"[87]. The aim of this strategy is to achieve "improved resource efficiency, together with a reduction in the negative environmental impact of resource use, so that overall improvements in the environment go hand in hand with growth"[88]; thus to improve resource productivity and on the same time reducing impacts on the environment. The 2008 Sustainable Consumption and Production Action Plan[89] tackles the issue from the consumption and production perspective and sets a "dynamic policy framework for smarter consumption and better products[90]", addressing the issue that "most product legislation addresses only specific aspects of a product's life-cycle. "[91] The most recent policy document is the Roadmap to a Resource Efficient Europe[92] combining the abovementioned strategy and action plan focuses to a path leading to resource efficient and sustainable growth in 2050.[93]

All these above mentioned (and many more waste related) policy documents have in common - besides their overarching aiming of a better and more integrated regulation of waste within the Union - that they approach the topic from a waste product approach rather than from a waste material approach. This means

[80] For example Council Directive 75/439/EEC of 16 June 1975 on the disposal of waste oils, OJ L 194, 25.7.1975, p. 23–25.
[81] Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme, [6th EAP], OJ L 242, 10.9.2002, p. 1–15.
[82] Article 1(4) 6th EAP.
[83] See also Van Calster, G. *Handbook of EU Waste Law*, Richmond, 2006, p.1f.
[84] Commission Communication, 'Taking sustainable use of resources forward: A Thematic Strategy on the prevention and recycling of waste', Brussels, 21.12.2005, COM(2005) 666, p.3f., as restated by the Roadmap to a Resource Efficient Europe, Commission Communication, 'Roadmap to a Resource Efficient Europe', Brussels, 20.9.2011, COM(2011) 571.
[85] COM(2005) 666, note 84 above.
[86] See COM(2005) 666, note 84 avobe, p.4ff.
[87] Commission Communication, 'Thematic Strategy on the sustainable use of natural resources', Brussels, 21.12.2005,COM(2005) 670.
[88] COM 670 (2005), note 87, p. 5.
[89] Commission Communication, 'Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan', Brussels, 16.7.2008, COM(2008) 397.
[90] COM(2008) 397, note 89 above, p. 3.
[91] Ibid.
[92] COM(2011) 571, note 84 above.
[93] COM(2011) 571, note 84 above, p. 3.

that they are focusing rather on the waste streams and the question of how these streams can be regulated in an overarching and coherent manner.

What is true for the policy side also applies to the regulatory aspect of the subject matter. The Waste Framework Directive[94] and the Waste Shipment Regulation[95] (literally) create the overall regulatory framework. The new Industrial Emission Directive[96] (recasted the former Waste Incineration Directive[97]) and the Landfill Directive[98] are examples of Directives addressing the treatment of waste. Lastly, there are a multitude of Directives addressing the individual waste streams, as for example the PCB/PCT Directive[99], the end-of life vehicles Directive[100], the packaging and packaging waste Directive[101], the batteries and accumulators Directive[102], as well as the ROHS[103] and WEEE[104] Directives.[105]
The overall problem with this policy and legislative approach is that it does not reflect the nature of the product, more precisely the product material. This means, that, as established above, a material is treated differently, depending on the product it is used in. A waste material approach would regulate the material (PVC, glas, etc.) instead of the individual waste streams (batteries, cars, etc.).[106] The Commission has been studying ways to remedy this[107], however even if the issue seems clear and coherent in theory, it has proven to be challenging to be applied in practice. The core problem with establishing the material approach in practice it that it is difficult to implement. The product approach allows to control the up- and downstream chain of a product along its life cycle: it can address amongst others manufacturers and importers. This is not possible regarding the waste material since it dissolves and diffuses in different products and in addition might, though chemical processes, be turned into another material. Especially the downstream chain is difficult to tackle for these reasons. Another layer of complexity to the waste material approach is its application to recycling activities. For new products formed from recycled material it is not possible to address the initial producers of the material since it diffused into different

[94] Note 39 above.
[95] Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste, OJ L 190, 12.7.2006, p. 1–98
[96] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), OJ L 334, 17.12.2010, p. 17–119.
[97] Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste, OJ L 332, 28.12.2000, p. 91–111.
[98] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, OJ L 182, 16.7.1999, p. 1–19.
[99] Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT), OJ L 243, 24.9.1996, p. 31–35.
[100] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles, OJ L 269, 21.10.2000, p. 34–43.
[101] European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, OJ L 365, 31.12.1994, p. 10–23.
[102] Note 95 above.
[103] Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, OJ L 174, 1.7.2011, p. 88–110.
[104] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE), OJ L 197, 24.7.2012, p. 38–71.
[105] For an overview of the specific legislation on waste streams see EC, DG Environment; 'European Union legislation on specific waste streams', available at http://ec.europa.eu/environment/waste/legislation/c.htm [22.06.2013]; as well as for the regulation of the individual waste streams EC, DG Environment, 'Waste Streams', available at http://ec.europa.eu/environment/waste/index.htm [22.06.2013].
[106] Van Calster, G., note 83, p. 5.
[107] Van Calster, G., Vandenberghe, W. 'Waste',in: Vaughan D., Robertson A., Eleftheriadis P. (Eds.), *Law of the European Union (looseleaf)*. Oxford: Oxford University Press, 2008, p. 1-223.

products. Recycled materials already pose a problem for the product approach, for example regarding to the registration, evaluation, authorization and certification requirements under the REACH Regulation since the original product characteristics are not applicable anymore.

Hence, it can be concluded, that the waste material approach would lead to a more coherent and integrated regulation of the waste streams, however its practical application fails on grounds of regulatory design reasons.

Lessons to be learned from the waste product versus waste material approach

The application of these aspects to shale gas activities might at first sight seem farfetched. However, the different approaches illustrate a new angle of the coherency of a regulatory regime: the practical application. The policy and regulatory approach has to also be workable in practice. Along the shale gas value chain (see individual steps as established above), from site preparation, over exploration and drilling to extraction using the hydraulic fracturing method a multitude of different waste streams will emerge. Notwithstanding the waste resulting from transport and construction activities, especially the drilling phase and the hydraulic fracturing phase result in considerable waste streams. Waste drilling cuts using mud drilling result in an increase of solid waste. Further the cuttings can contain naturally occurring radioactive material (NORM) and brine.[108] Further, the waste generated during the hydraulic fracturing activity itself consists mainly of waste or flowback water which commonly includes salts, heavy metals, radionuclides and the chemical substances from the fracturing fluids[109], thus a broad range of different waste materials combined in one waste stream (flowback water).

The challenge is to regulate the waste generated by the shale gas activities in a coherent and integrated way, paying regard to the individual components of the drilling cuts and the flowback water.

Assessing this challenge on the background of the waste product versus waste material approach as discussed and concluded on above, it can be derived that just focusing on the material of the waste streams, thus the individual components (salt, heavy metals, etc.) in order to regulate the waste from the activity in a coherent way is not possible due to the problem to determine the individual steps of the downstream chain and that the individual materials have been integrated to on waste stream or, applying the term in reference to the above the product of flowback water. This product is generally regulated though the Mining Waste Directive[110] meaning that it is subject to management in specialised facilities in compliance with specific rules and the best available technique (BAT).[111] However, as discussed above, the MWD provides a general framework for mining waste but does not pay regard to the special characteristics of the shale gas activities and the characteristics of the waste associated therewith. For example, until now, no specific BAT is existing for the activity.

[108] See also note from the Environmental Commissioner Potocnik to the chairman of the environmental committee of the European Parliament Matthias Groote, 26.01.2012, p. 2, available at http://ec.europa.eu/environment/integration/energy/pdf/legal_assessment.pdf [22.06.2013].
[109] Ibid.
[110] Note 40 above.
[111] See Article 4 MWD, note 40 above.

The application of the waste material approach failed on an European Union level due to regulatory design reasons and hence, even if the approach is not in itself workable to regulate waste streams in a coherent way, it still can be learned that a consideration of the individual components of the waste product as such (here flowback water and drilling cuttings) in regard of treatment, disposal and recycling would mean a more coherent approach to the subject matter.

5.3. The Carbon Capture storage- an integrated approach to regulation?

In a brief and very simplified way, the technology aims at capturing CO_2emissions from fossil fuels and, after sequestration, transporting it to geological storage sites, where the carbon gets compressed and is stored in the ground. The capturing takes place either prior or after the combustion process. The main issues associated with the technology is carbon leakage into the atmosphere and the scientific uncertainties and knowledge gaps regarding long-term security of the geological storage sites[112]. On the other hand is the technology promoted as a bridging technology towards a low carbon society[113] and as an important climate change mitigation tool. In the European Union, it is estimated that in 2030 the CCS technology could foster 15% of the carbon emission reductions required.[114]

Even if the technology to a large extent differs from the shale gas extraction activities, both technologies have in common that they effect several elements of the environment, for example, air, water resources and the geological formations. Further, regarding both technologies, scientific uncertainties prevail. Ex ante determination of the risks is not possible, especially as to the long term consequences involved. However, for CCS, the European Commission itself promotes that "*although the components of CCS are all known and deployed at commercial scale, integrated systems are new, and a clear regulatory framework is required. The EU's CCS Directive provides this*."[115]

The aim of this paper is not to review and assess the regulatory framework applicable to CCS in an exhaustive manner, but to see if the framework provides parallels and regulatory approaches which are transferable to shale gas activities. Hence, it departs from the presumption that the Commission's statement, if maybe not a 100% accurate, contains some truth and the Directive indeed creates a clear and integrated legal framework for the activity. The existence of several guidance documents explaining the provisions of the Directive, for example on "CO2 Storage Life Cycle Risk Management Framework"[116],

[112] For a detailed explanation of the process, as well as a review of the environmental challenges and scientific uncertainties of this activity see Intergovernmental Panel on Climate Change (IPPC), 'Special Report on the Carbon Capture and Storage, Summary for Policymakers', available at http://www.ipcc-wg3.de/special-reports/.files-images/SRCCS-SummaryforPolicymakers.pdf [22.06.2013].

[113] European Commission, 'Carbon Capture and Geological Storage (CCS) in emerging developing countries: financing the EU-China Near Zero Emissions Coal Plant project' press release, IP/09/1022, Brussels, 25 June 2009, p. 2.

[114] See recital 5 CCS Directive, note 60 above.

[115] See European Commission, DG CLIMA, 'Ensuring safe and environmentally sound CCS', available at http://ec.europa.eu/clima/policies/lowcarbon/ccs/index_en.htm [22.06.2013].

[116] European Communities, 'Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide Guidance Document 1 - CO 2 Storage Life Cycle Risk Management Framework', 2011, available at http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf [22.06.2013].

"Characterisation of the Storage Complex, CO2 Stream Composition, Monitoring and Corrective Measures"[117], "Criteria for Transfer of Responsibility to the Competent Authority" [118] and "Financial Security (Art. 19) and Financial Mechanism (Art. 20)"[119] underlines this assumption that for CCS activites such an integrated regime is existing.

The Directive further amends the Environmental Impact Assessment Directive[120], the Water Framework Directive[121]; the Directive on the limitation of emissions of certain pollutants into the air from large combustion plants[122]; the Environmental Liability Directive[123], the Waste Framework Directive[124]; the IPPC (now IED) Directive[125] and the Waste Shipment Regulation.[126] Thus, the Directive is creating a specific regulatory regime for CCS activities by establishing an overall and general framework of the activity, and in addition making use of the existing legal tools, such as the Environmental Impact Assessment and the Environmental Liability regime.

The main provisions of the Directive under the light of the "shale gas loupe"

Directive 2009/31/EC on the geological storage of carbon dioxide establishes a legal framework for the environmentally safe geological storage of carbon dioxide to contribute to the fight against climate change. The purpose of environmentally safe geological storage of CO2 is permanent containment of CO2 to prevent and eliminate as far as possible negative effects and any risk to the environment and human health. [127]

The Directive gives clear definitions of the key terms and principles as applicable to CCS activities. Regarding CCS, these key terms are amongst others "geological storage of CO2" and "storage site" which are of a specific importance to CCS. Regarding shale gas activities, no common and overall definitions exist so far. The regulatory regimes of the Member States use different terminology for similar/same activites, specially the use of the terms "extraction", "exploration", "exploitation", "liscence" and "permit", etc. Also, there is no official definition of the hydraulic fracturing activity itself. A common

[117] European Communities, 'Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide Guidance Document 2 - Characterisation of the Storage Complex, CO 2 Stream Composition, Monitoring and Corrective Measures', 2011, available at http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd2_en.pdf [22.06.2013].
[118] European Communities, 'Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide Guidance Document 3 - Criteria for Transfer of Responsibility to the Competent Authority', 2011, available at http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd3_en.pdf [22.06.2013].
[119] European Communities, 'Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide Guidance Document 4 - Article 19 Financial Security and Article 20 Financial Mechanism', 2011, available at http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd4_en.pdf [22.06.2013].
[120] note 72 above.
[121] Note 37 above.
[122] Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants, OJ L 309, 27.11.2001, p. 1–21.
[123] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage, OJ L 143, 30.4.2004, p. 56–75.
[124] Note 39 above.
[125] Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control, OJ L 24, 29.1.2008, p. 8–29.
[126] Note 95 above.
[127] Article 1 CCS Directive, note 60 above.

determinator for these key terms is a requirement in order to be able to regulate the activity in an integrated and coherent manner amongst the individual Member States. The CCS Directive contains definitions on these terms, which are –after some specifications- also workable for shale gas activities. "Exploration" as defined in the CCS Directive as "the assessment of potential storage complexes for the purposes of geologically storing CO2 by means of activities intruding into the subsurface such as drilling to obtain geological information about strata in the potential storage complex and, as appropriate, carrying out injection tests in order to characterise the storage site" could be amended for shale gas activities as "the assessment of potential hydraulic fracturing complexes for the purpose of shale gas extraction by means of activities intruding into the subsurface such as drilling to obtain geological information about strata in the potential fracturing complex and, as appropriate, carrying out injection tests in order to characterise the site". The definition of an "exploration permit" meaning " a written and reasoned decision authorising exploration, and specifying the conditions under which it may take place, issued by the competent authority pursuant to the requirements of this Directive" could be directly copy pasted for shale gas activities. Similarly, the definitions of a "storage permit" (drilling permit); "substantial change", "closure" and post-closure" do only need little amendment.

The CCS Directive provides for a cradle to grave approach of CCS regulation. Chapter 2 provides provisions for the selection of storage sites and exploration permits. It thereby grants the Member States the right to select the sites, establishing characterization and assessment criteria for the complex and surrounding area in Annex I. Accordingly, the assessment shall be carried out in three phases: data collection, building a three- dimensional statistic geological earth model and lastly the actual characterization of the dynamic behavior, sensitivity characterization, risk assessment. The geological formation can only be selected, if no significant risk of leakage, and if no significant environmental or health risks exist.[128] As discussed above, shale gas activities also impact the geological formations. However, no overall risk assessment and site selection criteria exist; if existent, criteria are derived form the national legislation applicable to general mining activities, which do not take the specific risks applicable o shale gas activities in account.[129]

Similarly, the CCS Directive explicitly states that even for exploration of a storage site, an exploration permit is necessary, where required with monitoring obligations regarding injection tests. Even if in most Member States such a permit is required under the general mining legislation, these do not require injection monitoring.[130] In addition to the exploration permit, a storage permit is required under Article 6 of the CCS Directive. For shale gas activities, an extraction permit is required besides the exploration permit, however parallel to a specific permit for storage activities, a permit regulating the hydraulic fracturing activities including specifications on construction requirements and the sub-steps of hydraulic fracturing, as well as requirements regarding the application procedure[131] would be required to establish a uniform approach. Some characteristics, such as the total quantity and composition of material to be injected; the injection rates and pressures, and the location of injection facilities; as well as description of measures to prevent significant irregularities; a proposed monitoring plan and a corrective measures and a provisional post-closure plan and the proof of a financial guarantee which are required to be submitted for

[128] Article 4 (4) CCS Directive, note 60 above.
[129] See section 5.1. above.
[130] The UK considers establishing a 'traffic light' monitoring system, more information see note 141 below.
[131] As included in Article 7 CCS Directive for storage activities, note 60 above.

the application of a storage permit and are integrated in the content of the permit[132], shall be required also for shale gas extraction facilities. The permit is only to be granted if the operator is financially sound and technically competent and reliable to operate and control the site, as well as after receiving and opinion of the European commission of the draft permit.[133]

The latter requirement of an integrated permitting system is certainly interesting as in general mining legislation, the permitting process remains entirely under the national authorities discretion. Even if the Commission is only required to draft a non-binding opinion, it engages in this traditionally "Member States only" domain. This requirement replies to the specific characteristics and scientific uncertainties regarding the CCS activity and adds an additional layer to ensure an environmentally safe handling of geological storage of carbon dioxide. Even if the competent national authority is not bound by the Commission's opinion, it still has to inform the Commission of the reasons if it departs from the opinion.[134] Regarding shale gas activities, a similar requirement would have the same effect.

Further, the Directives requires operators to inform the competent authority of changes planned. Article 11 of the Directive states further incidents where the competent authority shall review and update or withdraw the permit.
Chapter 4 of the Directive contains operation, closure and post-closure obligations. Monitoring is of special importance, especially regarding the detection of significant irregularities, migration, leakage and significant adverse effects for the surrounding environment, including in particular on drinking water, for human populations, or for users of the surrounding biosphere; as well as assessing the effectiveness of any corrective measures.[135]

Annex II of the Directive includes requirements for a specific monitoring plan, providing details of the monitoring to be deployed at the main stages of the project, including baseline, operational and post-closure monitoring. Further, under the CCS Directive, operators are required to submit at least once a year the monitoring results, quantities and properties of the stored carbon dioxide and a proof of the maintenance and existence of the financial security.[136] A system of routine and non- routine inspections ensure the checking and promoting compliance of the operators with the monitoring but also other requirements of the Directive. The timeframe of these inspections is established by the legislator: routine inspections are to be carried out at least once a year until three years after closure and every five years until transfer of responsibility to the competent authority has occurred. In addition non- routine inspections are carried out for example in cases of leakages, after complaints and previous incidents of non- compliance.[137]

As shale gas activities are anticipated with a large realm of unknowns and scientific uncertainties, detailed requirements for monitoring are inalienable, not only to guarantee a safe and sound regulation, but also as a tool to generate further information on the special characteristics of the activity and thus to close

[132] Article 9 CCS Directive, note 60 above.
[133] Article 8 CCS Directive, note 60 above
[134] Article 10 CCS Directive, note 60 above.
[135] Article 13 (1) CCS Directive, note 60 above.
[136] Article 14 CCS Directive, note 60 above.
[137] Article 15 CCS Directive, note 60 above.

existing knowledge gaps. Especially the division of the monitoring phases in baseline, operational and post-closure monitoring enable to compare and assess the reaction of and the effects on the environment. Reporting of the information collected and assessed, as well as regularly inspections are the other site of the coin. Especially also inspections after closure of the drilling site are of necessity regarding shale gas activities since these, as established above, guarantee notification of incidents even after the site is closed and add on closing the large realm of unknowns.

Closure and post closure obligations, as well as obligations regarding the transfer of responsibility frame the last part of the cradle to grave approach and aim at ensuring long-term safety of the site and detailed provisions thereon are also of crucial importance for shale gas activities. In this regard, also the provision of an adequate financial security by the operator is one tool of ensuring the sound application of the regulatory regime of CCS but also for shale gas activities, especially regarding post closure obligations but also regarding the permitting process. The CCS Directive requires the financial security to be valid and effective before commencement of injection and also after closure of the site until after the transfer of the responsibility is carried out and a contribution to a financial mechanism is adopted[138].

Lessons to be learned from the CCS regulatory framework

Even if the technologies are different in themselves, and the only obvious similarity may be that they are both happening underground, they affect several elements on the environment. Further, as explained above, both are subject to a large realm of unknowns and thus, the application of the precautionary principle is if crucial importance. The main difference in the regulatory approach is, that one activity is regulated by a "*clear regulatory framework"*[139], as the legislator itself proclaims, the other is not (yet ?).

As the first, preliminary, assessment of the CCS Directive under the shale gas loupe proofs, the activities may not be so different after all. In essence, the structure of the Directive in the parts along the production or value chain "selection of storage sites and exploration permits", "storage permits", "operation, closure and post- closure obligations", etc., obviously with a replacement of "storage" by "hydraulic fracturing" provides a suitable regulatory division also for shale gas activities. On a content level, as established throughout the previous section: the activites and concerns addressed by this Directive are the same as currently in question or criticism for shale gas activities. This is firstly the missing definitions of the key terms such as exploration (and extraction), an harmonized terms for the permitting procedure (currently "liscence"; "permit", "authorization" and "approval" are used interchangeably or differently by the Member States) and a clear definition of other key terms such as leakage, migration, closure and post-closure. Secondly, this relates to a harmonized application procedure regarding permits and consequently harmonized conditions for the approval of a permit and the content thereof. So far, Member States also have different requirements in this regard. Further, the fact that the Commission, as a superordinated authority has some kind of say in the issuance of such permits pays regard to the application of the precautionary principle and the existing scientific uncertainties, however it might also just generate the erroneous impression of further safety.

[138] See also for more detailed information, European Communities, note 119 above.
[139] See EC, DG CLIMA, note 115 above.

As established above, the operation, closure and post-closure phase is the crucial phase regarding shale gas extraction activities. There is not a lot of practical experience as yet[140], thus the exact impacts and possible main challenges to regulation are still to a large extent of a theoretical manner. However, it is undisputed that monitoring and reporting is the key to a save and sound regulation.[141] Thus, detailed provisions regarding monitoring of the activity on all levels, including baseline, operational and post-closure monitoring of characteristics specific to the hydraulic fracturing activity is not only the key to a save and sound regulation but also a crucial indicator for assessing compliance with the regulatory framework and reducing knowledge gaps. Reporting and announced and unannounced inspections are two other tools for ensuring this purpose and shall be further key components for an effective regulation of shale gas activities.

The financial security and mechanism active from the start of the exploration until after the transfer of responsibility for storage sides as included in the CCS Directive, is on the one hand another instrument ensuring compliance with the regulatory regime, but also an instrument of making the polluter pay in case leakage, spills, accidents, etc. Regarding shale gas activities, it has to be insured that the scope of this financial security is broad so that it is insured that the operator, and not the public is bound to pay in case of undesired incidents in relation to the activity. In that line, it has to be ensured that the operator is held liable for such incidents.

The CCS Directive is one of the three selected examples, where an integrated approach of regulation is applied on a European level, without interfering in the Member States rights, for example in terms of storage site collection and assessment. It is a positive example of how an activity can be regulated in line with the precautionary and polluter pays principle, even if scientific uncertainties are still existent.

6. Conclusion

The analysis of the cross- cutting issues on mining, the waste product versus waste material approach and carbon capture and storage illustrates lessons to be learned from each regulatory approach for shale gas activities. A coherent regime as "*a family of interrelated theses not necessarily of hierarchical arrangement, but rather linked among one another by an interlacing network of connections*"[142] has not been established for all of these issues. However, taking into account the individual lessons these regulatory approaches teach of and applying and combining them to shale gas activities, such a coherent regulatory framework does not seem so impossible to achieve after all. It remains to be seen if and how the Commission tackles this issue.

[140] In fact, until today, no shale gas extraction activities are undertaken on a commercial basis so far and are not expected to happen until 2015 in Poland. See Shale Gas Europe, 'Poland' available at http://www.shalegas-europe.eu/en/index.php/resources/shale-opportunities-in-europe/poland [22.06.2013].

[141] This is a key finding for example in the report of the Royal Society and The Royal Academy of Engineering, 'Shale gas extraction in the UK: a review of hydraulic fracturing', 2012, p. 4,5ff and 49. One key suggestion is to employ a traffic light system based on ground motions, focusing on peak ground acceleration and velocity in conjunction with frequency, as further explained on p. 45.

[142] Rescher, N., note 34 above, p. 699.