ResAGorA
Governance framework
for Responsible Research
and Innovation

Case Study
Fracking in Austria

Alexander Lang
Institute for Advanced Studies Vienna

Contact: Alexander Lang: lang@ihs.ac.at

Preparation date: March 2014
Document version: final

Introduction

Climate change and sufficient energy supply are repeatedly addressed as two of the key challenges of our time. The promotion of shale gas is seen by some as an opportunity to meet both of these challenges while stimulating economic growth. The production of shale gas requires the implementation of hydraulic fracturing or »fracking«, which is the topic of an ongoing controversy in many countries. There are uncertainties and discussions about the actual risks and benefits of this approach.

The case study on fracking in Austria contributes to the Res-AGorA project by shedding light on the societal dynamics surrounding the introduction of a technology that is still under development and thereby provides insight on (1) how different actor groups frame and act towards this technology, (2) what governance arrangements were applicable, (3) how responsibility was facilitated regarding research and development (R&D) and the implementation of fracking, and (4) lessons to be learned for RRI governance of technologies of this type.

The study at hand provides an example of a technology that carries high expectations and that is a topic of global debate while at the same time directly affecting a local population. R&D on a clean fracking approach is crucial because it has the potential to reduce negative effects.

However, the development process itself poses a risk to the local environment due to large scale in-situ testing.

The pilot-case study is based on comprehensive desk-based research (document analysis, media analysis, etc.) and participant observation. Furthermore, problem-centered interviews with relevant actors in Austria and a comparative analysis of fracking in Austria and the United Kingdom will be conducted in the next months.

Key findings of the study on fracking and the governance of Responsible Research and Innovation (RRI) are:

- The assessment of fracking by societal actors differs depending on the temporal alignment, the spatial orientation, and their level of confidence in the compliance of the actors with regulations and best practices.
- It is one of the biggest challenges for an RRI governance framework to consider and to bring together these different interests, perspectives, and worldviews in regards to research and innovation (R&I) and to find a way of dealing with (apparently) incompatible positions.
- A certain level of trust is important to convey information and facilitate a dialogue in negotiation processes. In order to facilitate trust, it would be beneficial to increase transparency of decision-making process, implement participatory approaches (e.g. pTA), and provide information by independent organizations, which assesses opportunities and risks of technologies in a non-partisan manner.
- At the same time, public and political controversies can be important factors in initiating legislative efforts that promote RRI.
- Adaptation of existing governance arrangements, like EIA legislation, might be appropriate and practical concerning R&D in certain areas. However, in the case at hand, no EIA was conducted. Therefore, its effectiveness is uncertain.
- Prevailing societal conditions (such as the actor and media landscape, political circumstances, civil society, and general attitudes towards technology, the environment, etc.) seem to be crucial and have to be considered, but further research is necessary to better understand their effects.

Hydraulic Fracturing – »Fracking«

Fracking is a technique that is (foremost) employed in the process of drilling for and extracting natural gas. Though fracking has also been used for stimulation of conventional gas wells,

fracking is essential for mining *unconventional gas*[1] reservoirs where "the gas is tightly stored in the rock itself [whereas] in conventional gas reservoirs, the gas is stored in pore spaces between individual grains" (Sjolander et al. 2011: 1). Through the high-pressure insertion of *fracking fluids* into a well, rock formations are broken up, i.e. fractures are produced that enable the trapped gas to flow, which is then captured. In most cases, the fracking fluid primarily consists of water[2], various compositions of chemical additives (IEA 2012: 33; Boling 2012: 263-264; 3LegsResources 2011), and sand that acts as a proppant and keeps the fractures open so that they provide a constant stream of gas (Montgomery and Smith 2010: 27-30; Robbins 2013: 1143-1147; Sjolander et al. 2011),. Overall water consumption is relative to the size of the fracked area as well as other geological factors. Estimations of water consumption vary[3]. The chemical additives have different functions. They can act as a friction reducer, anticorrosive, biocide, stabilizer or dissolvent (EPA 2012: 197-228). When the pressure after injection declines, a part of the fracking fluid (*flowback*) and other liquids/substances (*produced water*) are pushed back to the surface over time. These *wastewaters*[4], which are stored in dumps or tanks on the drilling site, can be reused for further fracking or have to be treated, recycled or permanently stored in a deposit (EPA 2012: 18; Sjolander et al. 2011: 5; IEA 2012: 33). Estimations of the total volume of recovered fracking fluids vary[5] (McIlvaine and James 2010: 17; Sjolander et al. 2011:5; EPA 2012:19; Olsson et al. 2013).

Fracking is not an entirely new technology, but it has gained importance in the last years. The idea of stimulating wells can be traced back to the mid-19th century, when wells were »shot« with explosives (Montgomery and Smith 2010). Since the first implementation of hydraulic fracturing (i.e. using fluids for stimulation) in the 1940s, several technical developments were made that altered the characteristics and effects of this technology; these include developments in: the pumping and blending of fracking fluids and proppants, the fracking treatment design (computer calculations, imaging/mapping technology), the monitoring of and ability to adjust the process, and the improvement of fracking fluids. Furthermore, horizontal drilling is seen as playing an important role in the rise of fracking (Montgomery and Smith 2010; Sjolander et al. 2011; Robbins 2013: 1144-1146). Horizontal drilling is credited with making

---

[1] Although one type of unconventional gas is coalbed methane (IEA 2012: 18) we will focus on fracking used in the process of mining shale and tight gas.

[2] Data varies slightly between ">98%" (3LegsResources 2011), "over 99%" (IEA 2012: 33), "98%-99,5%" (Boling 2012) and 99,5% (Sjolander et al. 2011: 5).

[3] 3.800-34.100m³ (Sjolander et al. 2011: 4), up to 30.300m³ (Robbins 2013: 1143), 3.800-18.900m³ (IEA 2012: 30) or 17.000m³ for "a typical well" (3LegsResources 2011) are indicated in the literature.

[4] For a comprehensive overview of chemicals found in wastewater see EPA (2012: 240-243).

[5] 25% "in the first few days" (McIlvaine and James 2010: 17); "8 to 10% of stimulation fluids […] in the first 30 days" and "a large percentage […] over the next several months" but it "is still unclear what percentage remains unaccounted for" (Sjolander et al 2011: 5; example of wells in Pennsylvania, USA); Olson et al. (2013) analysed samples of wells in Germany with 31% of the flowback being fracking fluid and 69% water from the formation.

fracking efficient enough to be profitable. Although the "first recorded true horizontal well" (Energy Information Administration 1993: 7) dates back to 1929 and although horizontal wells were drilled in several countries in the following decades (Joshi 1991: 7-12; King 2012: 2-3), "little practical application occurred until the early 1980's" (Energy Information Administration 1993: 7) when new drilling technology (i.a. down hole drilling motor) was developed (ibid. 7; DOE 2009: 3). Other techniques that changed the process of fracking and its outcome include the injection of high volumes of fracking fluids (*massive hydraulic fracturing*) and multi-stage fracking (Fitzgerald 2013: 1340).

Fitzgerald (2013: 1338) cuts right to core when he describes today's fracking as "a distillation of advances made over several decades". Today, fracking and its related technologies are constantly developing, resulting in corresponding changes in their practices and effects.

A number of factors have been identified that promoted the rise of unconventional gas (*shale gas revolution* or *boom*) in the USA over the last decade. Besides the previously mentioned technical developments, additional contributing factors include: tax credits for unconventional gas, state funding of R&D in this area (Stevens 2012: 9; Wang and Krupnick 2013: 6), the high market price of gas in the 2000s (Wang and Krupnick 2013: 15-29), the absence of legal regulations on fracking[6] (Boling 2012: 265-267; Robbins 2013), private land and mineral rights ownership, the beneficial geological conditions, disposability of large amounts of water, pre-existence of infrastructure (Wang and Krupnick 2013), low population density in the surrounding area, and a tradition of oil and gas production (ibid.; IEA 2012: 122; Vidic et al. 2013: 1235009-6; Kinnaman 2011: 1243).

Assessment of Fracking

The assessment of fracking is complex and revolves around several intertwined issues. Fracking cannot be discussed in isolation. It combines several technologies, each of which is associated with different risks and benefits that not only sum up but also produce new impacts. It is not possible to give a definitive definition of fracking. Fracking a vertical well with nitrogen to eliminate obstructions is different from fracking several stages of a horizontal well several times with a fracking fluid with a complex composition.

The evaluation of future technological developments and their implementation (e.g., water treatment technology, environmentally friendly fracking fluids), level of confidence in the management of the operations by oil and gas companies (e.g. compliance with regulations and best practices), estimation methodology (e.g. for calculating energy output), the data used and its interpretation (e.g. on leaked gas) are crucial in the assessment of fracking. Some assessments employ best-case scenarios, some worst-case scenarios and others build upon a combi-

[6] Exemption from the Safe Drinking Water Act and the Resource Conservation and Recovery Act.

nation of alternative scenarios. In the face of uncertainty, different authors abide by the precautionary principle and call for strong regulatory oversight or even a moratorium; others determine that the existing regulations are sufficient and call for fracking operations to proceed with ongoing monitoring, evaluation, and R&D.

The fact that some studies are directly or indirectly financed by the oil and gas industry has to be mentioned, although this does not necessarily mean that their results are categorically misleading since most of them are peer-reviewed. Examples of such studies include the work of Stephenson et al. (2011) for Shell Global Solutions and Molofsky et al. (2013) for GSI Environmental Inc. (Texas, USA), which has clients such as British Petroleum America, ExxonMobil, and Schlumberger, or for the Cabot Oil and Gas Corporation. The fracking-critical work of Howarth et al. (2011), on the other hand, is also accused of partisanship by proponents of fracking because of financial sponsoring by the "anti-fracking" Park Foundation (Entine 2012).

Environmental Pollution

One of the most debated issues surrounding the production of unconventional gas through fracking is that of groundwater and drinking water pollution (Kargbo et al. 2010: 5681; Rahm and Riha 2012: 13). Potential risks can arise from the chemicals added to the fracking fluid and the substances released from the fracked formation (Rozell and Reaven 2012; Gregory et al. 2011: 183). There are several documented cases of contamination as a result of case-leakages or spilling accidents (Bamberger and Oswald 2012: 56-59). However, there is only one documented case of "direct groundwater pollution resulting from injection of hydraulic fracturing chemicals" (Vidic et al. 2013:6). Such migration of polluted water between rock-formations is generally assessed as being unlikely (IEA 2012: 35-38; Rozell and Reaven 2012). But because there are often many wells within close proximity to each other, "cumulative impacts […] that develop so slowly that they are hard to measure" (Vidic et al. 2013: 6) cannot be ruled out.

Besides the fracking fluid itself, the produced water is crucial because, even with a non-toxic and harmless composition of the fracking fluid, the recovered water will contain potentially hazardous substances (Bamberger and Oswald 2012: 52; Kargbo et al. 2010: 5681). "*Technologically-enhanced naturally occurring radioactive material*", that exceeded regulatory guideline values by more than 800 percent, was found in open pits near drilling sites (Rich and Crosby 2013: 124). At the moment, processing and reuse of flowback for further fracking is constrained by technical requirements for fracking fluids (e.g. viscosity) and adequate treatment of non-reusable fluids is limited by factors such as technical possibilities, economic viability, infrastructure, geology, etc. (Gregory et al. 2012: 184; Olsson et al, 2013).

There are also concerns about the contamination of drinking water with methane. This potential effect of fracking also garnered much public attention due to its depiction in the 2010 documentary movie *Gasland* (Robbins 2013: 1148). Higher methane concentrations were detected in water wells near (<1km) active fracking sites than in other wells in the same region, most probably as a result of case-leakages (Osborn et al. 2011). These results are challenged by some (Davies 2011; Schon 2011; Saba and Orzechowski 2011; Molofsky et al. 2013), i.a. stating

that contamination instead correlates with "topography and groundwater geochemistry" (Molofsky et al. 2013: 347). These results have also been defended (Osborn et al. 2011a) and affirmed (Jackson et al. 2013).

In defense of fracking it is claimed that some of the discovered toxins originate from sources other than the oil and gas industry, like agriculture, and that the direct connection between fracking and water pollution has not been scientifically proven (King 2012: 7-9, 33-35). Furthermore, it is said that chemicals only account for 1% to 2% of fracking fluids and that efforts (R&D in this area) are being made to make fracking fluids even cleaner (Eaton 2013: 161; King 2012: 7-9). For example, there have been attempts to replace water with liquid-CO_2 in horizontal fracking. This approach could make fracking more efficient because of the chemical dynamics between CO_2 and shale (Ishida et al. 2012) and cleaner by reducing produced wastewater and offering the possibility of CO_2 storage (Bullis 2013; Godec et al. 2013).

Greenhouse Gas Emission

Unconventional gas is promoted as a way of reducing carbon emissions because it is assessed as a cleaner form of energy than coal, thus buying time while efficient renewable energy technologies are developed (Tour et al. 2010). However, there are different estimates of how much unconventional gas (production and consumption) contributes to overall greenhouse gas (GHG) emissions compared to other sources of energy (especially conventional gas, coal, and oil).

A key issue in this regard is how much methane (a gas with a greater greenhouse effect but shorter lifespan in the atmosphere than CO_2) is emitted during production, transportation, and use of unconventional gas. There are different ways in which gas may be emitted: purposeful venting, fugitive (e.g. through leaks in pipelines) or incidental emissions (e.g. rupture of equipment) might occur and, eventually, the gas is not burned completely (IEA 2012: 38-42).

A study conducted by Howarth et al. (2011: 687) concludes that, over a "20-year horizon, the GHG footprint for shale gas is at least 20% greater than and perhaps more than twice as great as that for coal when expressed per quantity of energy available during combustion" and "over the 100-year frame […] comparable to coal". These results are challenged due to alleged methodological flaws (e.g., the use of heat content instead of produced electricity as variable), conclusions based on false assumptions (e.g. amount of leaked methane), and overall weak data (Cathles et al. 2011). Nevertheless, Howarth et al. (2012) insist on their results.

Several other studies (Burnham et al. 2012; Hultman et al. 2011; Jiang et al. 2011; Stephenson et al. 2011; O'Sullivan and Paltsev 2012) arrive at the result that unconventional gas has a lower GHG impact than coal. Reviewing some of these studies, Weber and Clavin (2012: 5893) point out that the research design (e.g. the timeframe analyzed, the gas basin, the technology used, the variables measured, etc.) and the underlying assumptions have severe effects on the results. A lack of data (e.g. on fugitive emissions, venting or flaring) is seen as a major problem (Burnham et al. 2012: 625-626; Howarth et al. 2011: 688; Hultman et al. 2011: 8; Weber and

Clavin 2012: 5893). However, the difficulty may be more profound. In this regard, the statement by the International Energy Agency (IEA 2012: 39), that "by their very nature, these emissions are difficult to quantify", is telling.

Furthermore, the possibility remains that a market driven dynamic can reduce the positive effect of unconventional gas on the global carbon footprint. As coal is substituted by natural gas in the US, it will become cheaper on the international market and be used to a greater extent in other regions, like Europe. In combination with a price decrease of CO_2 certificates, the financial incentives to invest in sustainable sources of energy may degrade (Bräuninger et al. 2013: 26-27).

Public Health

Negative effects on public health resulting from fracking might derive from water, air, noise, or light pollution as well as from social stress due to rapid changes in societal structures (Korfmacher et al. 2013). A negative impact on health might result from direct exposure (air) or intake (water) as well as indirect intake, e.g. of food produced in contaminated areas (Rich and Crosby 2013: 125-126). These issues are closely linked to the question, whether or not there are emissions and leakages from unconventional gas production and how waste is treated and disposed.

Several substances contained in fracking fluids (Riedl et al. 2013; Tyndall Centre 2011: 56; Colborn et al. 2011) as well as different radionuclides found in wastewater (Rich and Crosby 2013: 125-127) have been identified as potentially harmful to living organisms as well as to human and animal health. However, there is currently a lack of understanding of the mechanisms by which radionuclides are transferred from contaminated pits to plants, animals, and humans (ibid. 131). The impact of methane in drinking water on human health is not clear yet either (Osborn et al. 2011: 8176). The US Department of Energy (DOE 2009: 70-71) assesses the general risk of radiation from oil and gas operations as "negligible" (ibid. 71), taking into account the regulations that are in place, practices in the oil and gas industry, low levels of radiation, and fact that the "general public does not come into contact with oilfield equipment for extended periods". But, Rich and Crosby (2013:128-131) point to several holes and exemptions in state and federal regulations.

Regional air pollution from fracking and unconventional gas production operations is also identified as a problem (Perry 2013: 40). Such air pollution could lead to a higher risk of sub-chronic diseases and/or cancer for people that live near wells (McKenzie et al. 2012). Determinate findings are limited due to factors such as a lack of data and risk assessments of several toxins (ibid. 86). Acknowledging the air pollution resulting from gas production, the DOE (2009: 77) states that, "[gas] field emissions are controlled and minimized through a combination of government regulation and voluntary avoidance, minimization, and mitigation strategies".

Studies have recorded the health problems of humans and animals living close to unconventional gas production sites (Bamberger and Oswald 2012; Steinzor et al. 2013). However, the

ability of these to establish a link between health problems and gas drilling activities are limited due to a lack of data (e.g. pre-drilling contamination), small sample sizes, and non-systematic approaches (ibid. 55, 70).

Besides the possible negative impacts, there might also be positive impacts of fracking and unconventional gas production on public health. Economic growth associated with the rise of fracking might lead to better health care provision and nutrition (Korfmacher et al. 2013: 15).

Economic Impact

Fracking and unconventional gas production are seen as drivers of the economy: jobs are created in the gas industry and in supplying branches (e.g. construction, trade, transportation), governmental tax revenue is increased, and the gas price is lowered, thus promoting other branches of the economy and providing cheap energy to households (i.a. Gold 2012; DOE 2009: 3-4). Considine et al. (2009: 31) come to the conclusion that in 2008, the gas industry in Marcellus Shale created "a total economic impact of $2,3 billion, 29.000 jobs, and $240 million in state and local tax revenue". It is expected that these numbers will further increase over a ten-year timeframe (175.000 jobs, $13 billion added value, and $12 billion tax revenue).

Unconventional gas production is also seen as a way of getting closer to independency from foreign sources of energy and therefore as way of strengthening the political position of a country against other countries (McGowan 2012: 8-9).

Several studies with very positive assessments of fracking (directly or indirectly) that were financed by the gas and oil industry (e.g. Considine et al. 2009) are criticized for methodological shortcomings, deficient cost-benefit-models, and unrealistic assumptions of financial flow that lead to an overestimation of the net benefit of unconventional gas drilling for a region or state (Kinnaman 2011). Furthermore, "overly optimistic gas reserve and production assumptions were used" (Barth 2013: 86). The non-consideration or underestimation of externalities, such as environmental pollution, wear of infrastructure, etc., is another problem of these studies. There is even a suspicion that productivity and total amount of unconventional gas resources are intentionally overestimated by the industry in order to attract investors (Urbina 2011).

Barth (2013) identifies three factors that might affect the regional net benefit of unconventional gas production and are excluded in many estimations: (1) the *natural resource curse*, which describes a negative correlation between the wealth of a country in terms of natural resources and its economic growth; (2) long-term negative economic effects that may follow a boom (cycle of boom and bust); and (3) negative local socio-economic effects (poverty, inequality). These tendencies can be met by business diversification, investments in education, etc. Looking at the economic development of drilling counties in the Barnett Shale region between 2003 and 2010, there is a lower increase in GDP per household and there are higher levels of unemployment than in other Texan counties (ibid.).

Further concerns – especially worries about the effect on tourism – over the impact of fracking are linked to its impact on the flora and fauna as well as to the alteration of the landscape in general. Fracking is not only accompanied with visual and audible disturbances but also with increased road traffic. Fracking might therefore have a negative effect on an existing local economy that depends on an unspoiled or peaceful countryside. Even if there is no or just little pollution, the image of a region can be compromised by gas mining. These opportunity costs have to be taken into consideration when estimating the net benefits of unconventional gas production, but are often omitted (Rumbach 2011; Barth 2013: 93).

Due to the importation of workers from other regions, there may be an increase in social service costs as well as maintenance costs for infrastructure due to intensified use. There are also indications that property values decrease due to negative environmental impacts and that it can become more difficult to find insurance. Negative health effects – as discussed above – might lead to higher public health care costs and result in a loss of value of agricultural properties (Barth 2013: 94-96). Still there "are many uncertainties regarding the long-term impacts on local and regional economies" (ibid. 92).

Other impacts

In general, production of unconventional gas by means of fracking has a bigger effect on the landscape than conventional drilling because of the higher well density in an area (IEA 2012: 19-20).

The water consumption of fracking is another concern, especially in generally dry regions (Kargbo et al. 2010: 5681). The water consumption of fracking has increased over the past due to longer horizontal wells and a rising number of hydraulic fracturing stages (Nicot and Scanlon 2012: 3582). Compared to conventional gas, tight and shale gas production have higher water consumption (per terajoule of output). To some extent, the associated water consumption lies within the range of conventional oil production (IEA 2012: 31). King (2012: 40) states that, "volumes of water used for fracturing are low in comparison to agricultural, municipal, recreation and other industrial use, but large volume well development in an arid area can produce water shortage" (King 2012: 40). The DOE (2009: 64-66) makes a similar assessment and points to strategic water management that can decrease the input of local water supply and the possibility of treating and recycling used water to the extent that "additional water resources for drought-stricken or arid areas" are provided (ibid. 70).

Other concerns relate to unknown long-term effects on the biosphere, both negative (pollution, loss of habitat, biomass and biodiversity, etc.) and positive (creation of new habitats) (Kiviat 2013). Zero-loss management and the reduction of the number of well pads could minimize the negative effects of gas production on animals and the environment (e.g. for chemicals) (Ladlee and Jacquet 2011). However, it is unlikely that they will be fully eliminated (Kiviat 2013: 9).

Another environmental issue that is linked to fracking is the topic of earthquakes caused by fracking operations and related practices such as subsequent wastewater injection. Hydraulic fracturing generally induces imperceptible micro-earthquakes. However, there are several cases where bigger earthquakes have been attributed to fracking operations. Studies have linked the rise in the number of earthquakes in the USA to an increase in deep-water injections (Ellsworth 2013; Elst et al. 2013). The wastewater injection, for disposal after the fracking and production of unconventional gas is done, has been identified as the main cause of these earthquakes. Others (King 2012: 45-49) deny the correlation between fracking and stronger earthquakes because no statistically significant correlation has been found between larger earthquakes and the introduction of fracking.

Fracking in Austria

Emergence of the Topic (2010-2011)

The first public accounts on shale gas test drillings conducted by the OMV in the Vienna Basin can be found in January 2010 (Wiener Zeitung 2010) and in the following months (Die Presse 2010; Kurier 2010). Most of these form small parts of reports on the success-story of shale gas in the USA. The notion of Russia as having been overtaken by the USA in gas production (i.a. Kurier 2010; Der Standard 2010) and the hope of gaining independence from Russian gas through shale gas production in Europe are recurring themes (i.a. Die Presse 2010; Der Standard 2010b). The latter issue remains present in media coverage of shale gas over the next years.

At this time, there are also first comments on the potential limitations of unconventional gas production in Europe and Austria. The chairman of the OMV states that production and especially drilling costs for shale gas are higher in the Vienna Basin because the shale gas deposits lie deeper than in US plays (Kurier 2010). Others point to further limitations of shale gas production in Europe when compared to the USA, like higher ecological awareness, population density, and concentration of biodiversity (Die Presse 2010).

In mid-2010, the topic of shale gas emerges in the media once more. Now, the process of shale gas production is described in more detail than before, including horizontal drilling and hydraulic fracturing. Potential benefits as well as risks are discussed. Poland's attempt to become a major gas producer, and thus becoming more independent from Russia, takes center stage (Der Standard 2010a; Die Presse 2010a). Fracking also appears in association with market prognoses that predict a price increase for natural gas in the wake of an economic recovery following the financial and economic crisis (Wirtschaftsblatt 2010a).

In late-2010, there are reports on first operations in Poland by different competing companies (Wirtschaftsblatt 2010b, 2010c) and elsewhere in Europe. First remarks are made about the lack of information on these operations provided by oil companies (Wiener Zeitung 2010a). Over the next months, there are several articles on the gas price and market, which mention shale gas production as an important economic factor (i.a. Wirtschaftsblatt 2011, 2011a; Wiener Zeitung 2011; Oberösterreichische Nachrichten 2011).

Throughout 2011, shale gas production and fracking remain recurring topics in the Austrian media. Especially the issues of gaining independence from foreign – especially Russian – oil and gas (Wirtschaftsblatt 2011b; Wiener Zeitung 2011b; Die Presse 2011), the German nuclear power phase out (Wirtschaftsblatt 2011c), the proclamation of the "golden age of gas" by the IEA (IEA 2011; Wiener Zeitung 2011c; Wirtschaftsblatt 2011d), and shale gas as bridge technology to renewable sources of energy (Die Presse 2011a) are picked up. Positive coverage, however, is always accompanied by indications of the potential negative environmental impacts, like groundwater pollution, negative health effects and methane emission.[7]

Up to this point in time, there is no sign of public resistance against the test drillings or the topic in general in Austria.

Beginning of Controversy (November 2011)

The issues of unconventional gas production and fracking in Austria gain momentum in November 2011, when exploration by the OMV in the Vienna Basin definitively reveals a shale gas deposit below the *Weinviertel* (*Wine District*) in Lower Austria. This is presumed to have the potential to supply Austria's demand for natural gas for about 30 years. At that time, the OMV states that they want to conduct information events for the local population and to develop and test a new approach to make fracking environmentally friendly; clean fracking is introduced by Gerhard Thonhauser, a professor from Mining University of Leoben (MUL), but not explained in detail. Thonhauser only states that a clean fracking method could be developed by 2013 (Kurier 2011, 2011a). At this time, first tests are planned for the end of 2012. The commercial production of shale gas is not expected before 2020 (Der Standard 2011; Kurier 2011g)

The first reaction of the mayors of Poysdorf and Herrnbaumgarten, the two towns affected by the OMV's plans, is positive. They say that they see no environmental risk due to the regulations in place, want to support further development of this technology, and predict positive economic impacts on the region such as job creation and increased tax revenue (Kurier 2011b).

[7] There are also articles only dealing with environmental risks, referring i.a. to the study on GHG emissions by Howarth et al. 2011 (Wirtschaftsblatt 2011e; Wiener Zeitung 2011a).

But there is also instant opposition to the plans of the OMV. Environmental protection groups (Greenpeace, Global 2000) criticize shale gas production because of its associated environmental and health risks (Kurier 2011a; Kronen Zeitung 2011; Global 2000 2011). Nikolaus Berlakovich (Austrian Peoples' Party - ÖVP), the Austrian Minister of Agriculture, Forestry, Environment and Water Management (*Ministry of Life*) argues against shale gas production and in support of environmental protection as well as an energy strategy that promotes renewable energy rather than fossil energy (Der Standard 2011; Kurier 2011c). The Green Party demands an amendment to the Austrian Mining Law in order to regulate fracking operations. They also call for greater investments in renewable energy rather than gas production (Kurier 2011e) and for the OMV to act transparently (Die Grünen im NÖ Landtag 2011). Only the Freedom Party of Austria (FPÖ) takes up a slightly positive position; they want to wait and see what the technological development brings (Krone 2011b; Kurier 2011f). In just a few days, even the before mentioned mayors of the affected towns strike a more critical tone, demanding environmental protection to be the top priority while not rejecting the possibility of future operations completely. Similar to the FPÖ, they now hinge this possibility on the applied technology: "As long, as there is no clean technique, production will not be accepted in our community" (Kronen Zeitung 2011a).

At the end of November 2011, one week after the discussion was initiated, new information about the OMV's clean fracking method is revealed: the fracking fluid is going to consist of water, starch, and sand without further chemical additives. To keep the fluid free of bacteria that could impair its functionality and damage the drilling-pipes, ultraviolet rays will be used (Kurier 2011g). OMV president Gerhard Roiss places the topic of shale gas and fracking in the broader frame of Austria's economic development. On the one hand, he requests a political decision on the topic, on the other hand, he states that the OMV wants to act transparently and to produce shale gas with fracking only if it is economically viable and environmentally friendly. He estimates that the chance that mining shale gas in Austria actually happens is 20% (Kurier 2011h; Die Presse 2011b).

Critics do not believe the OMV's promises of an overall clean fracking method; Greenpeace refers to an "eco-fairytale" as well as to supposedly unsuccessful attempts by ExxonMobil and Halliburton to produce shale gas in an environmentally friendly manner (Greenpeace 2011). Concerns that are publically addressed include soil and water pollution with toxins, methane migration into drinking water, earthquakes, increase in traffic, CO2 emission, and space consumption of drilling sites and gas pipelines (profil 2011; Kurier 2011i). The latter aspect is seen as crucial because the protection of the landscape is important for other branches of the local economy such as tourism and wine growing (Wiener Zeitung 2011e). The topic is also an issue at the local council where a resolution is passed that addresses the state government. It demands the prohibition of shale gas operations in the region. This demand is backed up by references to the associated risk of environmental pollution, consequential negative health impacts as well as to sustainability, referring to an enacted energy strategy. Furthermore, an official injunction to the OMV is passed, demanding transparency and public participation on the topic (Gemeinderat Mistelbach 2011: 66-68).

In December 2011, a citizen's initiative is founded (*BI SCHIEFESgas*[8]). Its initiator explains that it aims to provide more information from "independent experts" to the local population than the OMV does (Wiener Zeitung 2011e). Beyond that, they start a petition against shale gas production and fracking in Austria in general (Kurier 2012) and conduct an information event in cooperation with Greenpeace on 22 December 2011 (Greenpeace 2011a).

According to the mayor of Poysdorf, the OMV conducted an information event at the municipal council. This may have had a positive effect on the attitudes of some policymakers towards shale gas production in Lower Austria (Wiener Zeitung 2011e). On 23 January 2012, the OMV starts to hold public information events for the local communities, reassuring the public that they want to produce shale gas with a newly developed, clean fracking technique and that they are going to recycle the fracturing fluid in order to save water. The OMV's business executive and the head of the department for deep-gas refer to shale gas as a bridge energy and point to the OMV's 60-year-long engagement in this region. Nonetheless, statements from the audience – consisting of locals and environmental activists (Kurier 2012b) – remain skeptical of or negative towards fracking (Wiener Zeitung 2012; Kurier 2012a).

In the following weeks, the issue of fracking remains on the political agenda; the Green Party now demands a mandatory EIA (*Umweltverträglichkeitsprüfung* - UVP) with local residents having the status of a party and thus allowing them to raise an objection against drilling and fracking operations. Together with members of citizen's initiatives (SCHIEFESgas, *Risiko-Gas*), members of the Green Party also deliver a petition against fracking to the President of the Austrian Parliament (Wiener Zeitung 2012c; Windbüchler-Souschill et al. 2012). At that time, drilling operations are not subject to authorization by the environmental ministry but by the ministry of economics. The OMV states, that they already conducted fracking – or at least "parts of it" (NÖN 2012) – in the past for conventional, vertical oil and gas drilling (Wiener Zeitung 2012a; Der Standard 2012; Der Standard 2012a). This disclosure provokes further outrage by opponents of fracking.

In February 2012, the governor of Lower Austria (Erich Pröll, ÖVP) also demands a change of legislation, i.e. an amendment to the UVP in order to regulate and control shale gas production and fracking (Kurier 2012c). The topic is discussed at the *Landtag* (Provincial Council) of Lower Austria (NÖ Ltg 2012) and an urgent resolution is passed that requests an amendment of the UVP and speaks out against fracking given its uncertain impacts (NÖ Ltg 2012a). For some, a mandatory UVP is not enough. The Austrian Environmental Umbrella Organization (Umweltdachverband) and citizens' initiatives demand a general ban on fracking (Der Standard 2012a; Salzburger Nachrichten 2012).

[8] This is wordplay: *Schiefergas* is German for *shale gas* and at the same time, *schief* means *crooked*.

Backpedaling, Regulating, Abandonment of Plans (March-December 2012)

At beginning of March 2012, the OMV declares that for the time being there will be no attempts to use fracking and to produce shale gas in Austria. They explain that they have made this decision in response to public concerns over fracking. Simultaneously, they state that the objective of finding an environmentally friendly way of mining shale gas in Austria will remain on their agenda (Der Standard 2012b). In the following months, the president of the OMV repeatedly expresses the need for a European strategy regarding shale gas production (Kurier 2012e; Wirtschaftsblatt 2012; Die Presse 2012).

In May 2012, the Minister of Life (Berlakovich, ÖVP) tables an amendment to the UVP law that i. a. makes a UVP mandatory for fracking and gives NGOs a voice in the process[9], while also abbreviating the overall proceeding (UVP-G Novelle 2012a). Berlakovich sees this as a step to promote renewable energy, also because small green energy facilities are exempted from assessment (Kurier 2012f). On 5th July 2012, the ruling parties – the Social Democratic Party of Austria (SPÖ) and ÖVP - pass the amendment to the UVP. Now, fracking – even for exploratory and test drilling – is subjected to a preceding EIA and environmental organizations have party status in the determination procedure. For members of the Green Party this is not enough; they further demand that not only NGOs but also local residents be granted the right to initiate a UVP and that fracking be banned entirely. On the opposite, members of the FPÖ fear that the new UVP will have negative effects on the Austrian economy. Generally, the parliamentarian opposition agrees that the consultation process on the UVP-G amendment was too short, leaving little time for negotiation and assessment (Österreichisches Parlament 2012a).

In September 2012, the OMV announces that they will abandon the plan to produce shale gas in Lower Austria. They explain that in this situation – referring to the amendment of the UVP law – and for the time being, shale gas production and fracking would not be economically viable. But they also state, that there is interest in their development of clean fracking internationally (Der Standard 2012d). According to a researcher at the MUL, they are working on a clean fracking method in the laboratory and are not yet able to test it on a larger scale (derStandard.at 2012a).

In an Interview in December 2012, the OMV's president Gerhard Roiss states that the cooperation with the MUL to develop a clean fracking approach has come to an end because of the need for an environmental assessment even prior to any testing of this new technique (Die Presse 2012a). Nonetheless, research continues on a fracking method with liquid-gas instead of water that will not be tested in Austria (Kurier 2013c). In an interview, another researcher

[9] This is also necessary because there is an EU-directive (85/337/EWG) that has to be implemented.

explains that work on "[identifying and developing] materials, techniques and processes that are entirely harmless"[10] (Kurier 2013d) is ongoing.

Current situation

Although the OMV has said that it has no plans to conduct hydraulic fracturing in Austria, locals and opponents of fracking remain distrustful. This distrust is fueled by operations of Halliburton in the Weinviertel, which are a part of conventional oil production according to the OMV. These operations are observed and documented by citizens' initiatives (derstandard.at 2013).

There are several actors who take a positive stand regarding shale gas production and even deem it as necessary, especially for economic development. The head economist of the International Energy Association (IEA), Fatih Birol, regards environmentally friendly shale gas production in Europe as essential and profitable, despite all intervening factors, if conducted properly, i.e. according to the "golden rules" (Kurier 2013b). The Austrian Minister of Economy states that the economic circumstances will make it necessary to produce shale gas by means of fracking. In this regard, acceptance by the public is crucial for him (Die Presse 2013a). International competition is a prevailing topic because the voestalpine – an Austrian steel company – makes a large capital investment in Texas – and thus not in Austria – in order to build and run an iron facility, i. a. because of the low gas price (Salzburger Nachrichten 2013; Kurier 2013, 2013e).

Shale gas production remains present in the Austrian media. On the one hand, articles highlight the false expectations regarding the potential of shale gas (Salzburger Nachrichten 2013a; Der Standard 2013) and its negative environmental impact (Vorarlberger Nachrichten 2013; Der Standard 2013a). On the other hand, they also point to its potential to stimulate the economy (Format 2013) and to reduce GHG emissions (Die Presse 2013b). As of September 2013, citizens' initiatives are still active, e.g. conducting information events. Furthermore, a theater play dealing with fracking is on tour in Austria (Schwarzer Veltliner[11] online), which presents a critical view on fracking and its proponents, but also highlights the double standards of its opponents (OBS 2013a).

[10] "Materialien, Techniken und Prozesse zu identifizieren oder zu entwickeln, die nachweislich völlig unbedenklich sind"

[11] Green Veltliner is a sort of wine grape cultivated specially in Austria. "Schwarzer Veltliner", "Black Veltliner", the title of the play, links drilling and fracking activities with potential environmental pollution, turning the normally white wine black.

RRI Governance Arrangements

In the following section, several governance arrangements are elucidated that may be applicable to hydraulic fracturing as well as developments in this area and that have the potential to promote RRI. Later on we will have a closer look at how RRI governance has actually taken place.

The identified governance arrangements are of different types. There is hard law (EIA-Act, MinroG) and soft law (Austrian Energy Strategy - AES, OMV CSR strategy) as well as curricular arrangements at the University of Leoben, where R&D on fracking takes place.

The governance instruments can also be distinguished based on their temporal orientation: whereas the legal acts (EIA-Act, MinroG) address immediate objectives, like the protection of the environment from effects of concrete projects, the strategy papers have more far-reaching purposes, like the transformation of the Austrian energy system (AES).

Environmental Impact Assessment (UVP-G 2000)

When the topic of fracking was introduced in Austria, the EIA was the instrument that was at the center of discussions about its governance.

In Austria, EIAs are regulated in the Environmental Impact Assessment Act 2000 (UVP-G 2000[12]). Its predecessor was passed in 1993 – after a long and conflict-filled process that started in the 1970s (Tálos and Kittel 2001: 211) – in order to adapt the Austrian regulatory framework to the directive by the European Community (85/337/EWG) (Umweltausschuss 1993: 1). It has since been adapted several times, partly because of new directives by the European Union (e.g. 97/11/EG), partly due to practical experiences (UVP-G 2000a; Baumgartner/Petek 2010). Since the 2012 amendment, hydraulic fracturing is subsumed under the EIA-Act.

The law making process of the EIA-Act fits into the general picture of the legislative process in Austria. In most cases, the government prepares laws and law making processes tend to be quite closed (Griessler 2012: 72-73). When it comes to environmental policy, however, the ignition spark for change frequently comes from civil society (Tálos and Kittel 2001: 206-208) or from bodies of the European Union (Pesendorfer and Lauber 2006: 674).

The EIA-Act was (partly) initiated by pressure from the outside (EU, civil society). It was prepared by the government, the executive branch to be exact, and passed by the governing parties in parliament in 1993 and since amended several times. The process was similar for the EIA-Act amendment of 2012, where the government acted because of (i.a.) public and political pressure in the wake of the protests against fracking in Lower Austria, as well as a reasoned

12 In its current form (August 2013).

opinion by the European Commission against Austria – because of the partial non-implementation of an EU-directive (2011/92/EU).

The purpose of the EIA is to identify, describe and assess the direct and indirect effects of a project on humans, animals and plants, on their habitat, on the environment (soil, water, air, climate, landscape) and on cultural assets involving public participation on a basis of professional knowledge. Furthermore, better alternatives that reduce or minimize negative effects have to be examined and the effects if the project is not conducted have to be estimated (§1 UVP-G 2000). As the competent authority, the Ministry of Life defines precaution, comprehensiveness and integration, improvement of project planning, integration of environmental concerns into decision making, transparency and involvement of the public as objectives of the EIA (Lebensministerium 2012). It has also been characterized as being informative, precautionary, coordinating and pacifying (Ritter 1995: 51-52).

The EIA is a consolidated development consent procedure, i.e. only one application has to be submitted, which is then evaluated and ruled on according to different laws in one process. It is possible to initiate a voluntary preliminary procedure by the project applicant. With that, an outline of the project and the environmental impact statement are submitted to and checked by the authorities that then give an opinion on deficits before the EIA process itself is started (§4).

An EIA is mandatory for projects from different areas, but sometimes only when they exceed certain thresholds (in scope, size). There are 88 project types in three categories listed that have to undergo an EIA. For projects from the first and second category an EIA is required in each and every case, whereas for those from the second category a simplified procedure[13] is applied. For projects from the third category, an EIA (simplified procedure) is necessary under defined conditions after a preceding case-by-case review. If projects do not meet the specified criteria for an EIA, the authorities have to decide, if a simplified procedure is necessary nonetheless (§3 (2)). Hydraulic fracturing is included under the first category and no threshold value is set, an environmental impact assessment is therefore obligatory in every case, even for testing purposes.

Public participation is one key objective of the EIA. Several actor groups have the right to participate, to appeal, and the right of action; these include: neighbors, parties stipulated by the administrative provisions, municipals, citizens' initiatives, the ombuds-office for environmental protection, the water management planning body, and environmental organizations (§19 (1)).

However, participation might be hindered by a lack of financial and personal means (Neger 2011: 229-231) or inclusion might happen too late in the process (ibid. 225-227). Furthermore,

13 This does not require an environmental impact statement, but only a summary assessment of environmental impacts.

there is ongoing critique by the European Commission, that Austria does not fulfill article 11 of directive 2011/92/EU[14].

The EIA -Act 2000 is not aimed at research and innovation per se but rather at (bigger) construction projects. The list of executed environmental impact assessments in Austria supports this estimation (Umweltbundesamt web). Since there are R&D areas like geo-engineering, that need to test their work on a larger scale in situ, it is nonetheless a policy instrument that has the capability to guide research and innovation in a certain – more environmentally friendly – direction. As the case of fracking in Austria shows, a continuous adaptation of the legislation to the technological development is necessary.

In the end, no EIA on fracking was conducted in Austria in the case of fracking. The OMV claimed that its decision to stop R&D and their shale-gas plans in Austria was made because it is not economically viable. At the same time, they refer to an obligatory environmental impact assessment that "reassured" their decision. The mere necessity to conduct an EIA, together with the prospect of citizens' protest, seems to have discouraged the OMV from implementing this potentially risky technology.

Regarding fracking, the instrument of EIA might be a suitable form of RRI governance. It builds upon existing legislation and would only need to be modified. For politicians who want to reconcile the interests of different groups, this is a way of finding consent without taking the side of one of the conflicting parties since the final decision on approval or rejection is made in a multilayered process that includes experts and stakeholders. It is a procedure to reconcile diverging different societal needs (e.g. sound environment and economic growth) and safety issues. Thus, it might be an instrument to manage contestation. On the downside, the EIA approach comes into effect relatively late in the whole process, when R&D is already conducted in the laboratory and fracking has to be implemented on a larger scale for testing purposes.

MinroG – Mineral Raw Material Act

The aspect of land and mineral rights ownership is important in the case of fracking and shale gas production, as well as to the development of new techniques (Wang and Krupnick 2012). The International Energy Agency (IEA) indicates that "state ownership of oil and gas rights can […] reduce the incentives for communities to accept development of local unconventional gas resources" (2012: 122).

14 According to an opinion by the EC from October 2013 sent to Austria (not published), the EC is not satisfied with the amendment of the EIA-Act in 2012, but demands further changes regarding the right of the public (individuals, general public, citizens' initiatives) to intervene in the EIA procedure.

In Austria, property rights regarding and regulation of exploration and production of mineral resources are regulated in the Mineral Raw Material Act (MinroG - "Mineralrohstoffgesetz"). According to the MinroG, hydrocarbons – like natural oil and gas (including shale gas) – are not owned by the landowner, but are federally owned (§4 (1) (2)). The Federal government can explore and produce these resources itself (§68) or allocate those rights to others (natural or legal persons or partnerships) for a mineral royalty (§69). The authority charged with the enforcement of this act (including authorization of mining) is the Federal Ministry of Economy, Family and Youth (§170) or in some cases the district administrative authority or the governor of the province (§171).

The approval of the property owners has to be obtained and agreement on compensation has to be found (§ §147 and 148). Land can also be confiscated if there is a substantial public interest in mining on the property or for safety reasons (§150). Among others, the obligation to protect life and health of persons, the environment and the surface is prescribed in the MinroG, for example in implementing state of the art technology (§109). The act also refers to other laws (i.a. UVP-G) that extend these requirements (§221a). As of January 2013, the OMV and the RAG[15] hold the right for exploration, production and storage of hydrocarbons in Austria (BMWFJ 2013: 34).

Looking at the framing of fracking by different actors it becomes clear, that even actor groups like local citizens initiatives' that prioritize environmental integrity over pursuit of profit have economic interests. But whereas higher tax revenue and the generation of jobs in the region are brought forward as arguments for fracking and shale gas, direct financial benefits are not held out in prospect in the debate on fracking in Austria.

But further inquiry into the actual impact of property rights is necessary to understand its effects on the societal assessment of fracking operations. A comparison of countries that differ in this regard – where minerals are properties of the landowner or monetary incentives for the authorization of fracking operations are granted – would be helpful.

Austrian Energy Strategy

In 2009, the Ministry of Economy and the Ministry of Life published the Austrian Energy Strategy (AES), also due to pressure from the EU in the form of its Climate and Energy Policy 20/20/20 targets. The AES resulted from a participatory process, including actors from the federal and state governments, as well as stakeholders from science, business, environment and society (NGOs, *Sozialpartner*, special interest groups, etc.). Besides the responsible ministries, the Austrian Economic Chamber (WKO) and the Chamber of Labor (AK) – both important *Sozialpartner* – were central actors in this process (Pezenka 2010: 137-147).

15 „Rohöl-Aufsuchungs Aktiengesellschaft" – Raw Oil Exploration Corportation.

The AES has three strategic pillars: energy efficiency, renewable energy, and security of supply. Its focus is to stabilize final energy consumption at the level of 2005. The core objective is to develop a sustainable energy system that secures energy supply, is environmentally compatible, cost efficient, socially compatible and competitively viable (BMWFJ and BMLFUW 2010: 4-12).

The strategy contains concrete provisions in order to reach its objectives. These are comprehensive measures like adaptation of legislation (climate protection laws, ecologic tax reform, spatial planning laws, etc.), financial funding of R&D (energy efficiency, renewable energy, etc.), public awareness-raising, funding of and tax incentives for building and infrastructural measures, etc. (ibid. 42-96). In order to secure the energy supply, the stabilization or even increase in the domestic production of conventional sources of energy, like natural gas, as well as the expansion of infrastructure (pipelines) are deemed important – also to reduce dependencies on imports (ibid. 90-92, 118).

The two main purposes of the AES are noticeable and interlinked: climate protection and economic performance. However, these do not seem to be given equal importance. Climate protection is depicted as an important task that has to be pursued due to obligations towards the EU (ibid. 18) and ecological reasons., but in the end, measures that are environmentally friendly and sustainable, including R&D, are represented as a necessary vehicle for economic growth, competitiveness and prosperity (i.a. BMWFJ and BMLFUW 2010: 5). This correlates with the observation by Fochler and Müller (2006: 15), that there is a strong conjunction between R&D and economic prosperity in Austrian policy documents.

Furthermore, the AES is described as a “vision” of a maximal self-sustainable or even autarkic national energy system (BMWFJ and BMLFUW 2010: 5). This (explicitly and implicitly) refers to the ongoing debate about dependency on foreign (Russian) oil and gas.

In regards to fracking, the AES provides a normative framework that has the potential to guide research, development and innovation in the area of energy, e.g. through financial funding. More generally, it also offers orientation in assessing the implementation of certain technologies. In the case of fracking, the Green Party referred to the AES, highlighting that shale gas is not a part of it (Der Standard 2012). Thus, it provides a rating scale for political decisions that can be used for criticism. The need for a determined strategy, to which decisions and activities can be linked and by which these can be justified, is brought to the fore when the OMV calls for an international shale gas strategy.

RRI at the Mining University of Leoben

RRI governance is not only facilitated by the government but also by different actor groups and organizations, for example at the Mining University of Leoben (MUL) where research on a new clean fracking approach is being conducted.

The MUL highlights sustainability as their major objective for the future in every item of the value chain (Montanuniversität Leoben 2012a: 5-6). In their development plan, the utilization of unconventional gas and shale gas are explicitly named as promising areas for R&D (ibid. 14-15)

In the curriculum for the study of *Petroleum Engineering*, the „responsibility towards the human society“[16] as well as the environment are emphasized. Professional petroleum engineers are described as being empathetic, aware of the risks linked to their work, and acting in accordance with ethical standards. It is claimed that there are no designated lectures on ethical or ecological issues in the curriculum due to factual constraints (time limitations set by statutory provisions). Nonetheless, lecturers are advised to integrate ethics related issues and aspects in their regular teaching. Furthermore, students are encouraged to choose lectures with a focus on ethical and ecological issues as optional subjects (Montanuniversität Leoben 2013: 3-4).

The MUL also plans to open a research, security, and teaching center at the Erzberg mine (Research@ZaB), an open mine located in Styria. It plans to conduct teaching and R&D, including testing under real circumstances, also in the field of Petroleum Engineering (Montanuniversität Leoben 2012a: 24-25; Schibany et al. 2013: 63). This could potentially provide a way of reducing the risks of testing processes because there is a greater distance from local residents and the conditions are more controllable.

The integration of reflections on the wider societal aspects of R&D in the training of new researchers can be seen as a first attempt of responsibilisation. However, it is up to the individual lecturers and students to include these considerations into the education process. Later, in practice, it is the responsible engineer that ensures that operations are conducted in a responsible manner. Overall, responsibility seems to be individualized.

The question remains, is this system of actual use regarding RRI governance or does there have to be a stronger implementation of measures in the curriculum (e.g. lectures on ecological issues) and a more systemic approach to responsibilisation (e.g. mechanisms that ensure the integration of societal and ecological considerations into the R&D process)? Another aspect is that of “window dressing”; in other words, are these measures serious attempts to responsibilise future engineers and researchers or to pacify conflicts with other societal and political actors? Further inquiry in this regards is necessary.

16 “Verantwortung gegenüber der menschlichen Gesellschaft”.

CSR Strategy of the OMV

The concept of Corporate Social Responsibility (CSR) deals with the societal, ecological and economic responsibilities of companies. Furthermore, CSR strategies are self-imposed guidelines that should safeguard the implementation of measures to exercise these responsibilities (i.a. Bassen et al. 2005). Therefore, CSR is also relevant to the concept of RRI.

The OMV determines their core values, strategies and guidelines for promoting corporate social responsibility (CSR) in several documents; these include a general code of conduct (OMV 2011), a HSSE[17]-policy (OMV 2012b), their concept of *Resourcefulness* (OMV 2012), a code of conduct for lobbyists (OMV 2013b), and a brochure on business ethics (OMV 2012a). Furthermore, the OMV is a member of the Global Compact Network (web) and acknowledges the Austrian Corporate Governance Codex (Österreichischer Arbeitskreis für Corporate Governance 2012).

The reason for the OMV to develop a code of conduct and begin CSR activities was public pressure and criticism by NGOs because of their operations in Sudan during its civil war (Friesl 2008: 104-105)

The OMV defines their primary objective as the "production of oil and gas and the supply of millions of people with energy"[18] (OMV 2011: 4) by implementing a "sustainable company-policy" that includes "economy, ecology and societal responsibility". As their "driving values" (OMV 2012: 8) they identify the integration of "social and environmental awareness" in decision-making, the promotion of CSR and sustainability, and being a partner to all affected groups.

There are several focus areas in their *Resourcefulness* strategy, but regarding the case of fracking, the part on eco-efficiency seems especially important because it includes carbon management (reduction of CO2 emissions), water management (reduction of water use, less environmental impact), and the promotion of gas as the "cleanest fossil fuel" (OMV 2012: 13). Regarding "environmental management", the OMV states that their "approach is based on precautionary, proactive management to minimize environmental impact" (ibid. 40). In their sustainability report, they list several activities to minimize environmental impact and risks deriving from operations; these include the increasing use of "integrated environmental and social impact assessment", group wide implementation of standard processes to promote HSSE and compliance with legal regulations, improvement of energy management, decrease in air emission, increase in water management activities (efficient use, disposal, recycling), leakage prevention, waste reduction, etc. (ibid. 39-52).

---

17 Health, safety, security and environment.

18 „Die primäre Aufgaben des OMV Konzerns sind die Förderung von Öl und Gas und die Versorgung von Millionen von Menschen mit Energie."

It is difficult to assess to what extent operations comply with all of these strategies and whether they yield the desired effect. For example, the OMV admits to the leakage of 306,000 liters of hydrocarbons, that was "mostly caused by corrosion of aging infrastructure" (ibid. 47) but also present strategies to prevent such accidents from happening again.

Overall, their top priority seems to be to make a profit. The Resourcefulness concept is described as an *enhancement* to their profitable growth strategy. Even in their sustainability report, their profitable growth strategy is described before (ibid. 7) their driving values and their concept of Resourcefulness (ibid. 9). This can be seen as an indication of the OMV's priorities.

Actor Landscape

A variety of actors have been involved in the controversial debate over fracking in Austria. The actor landscape can be roughly divided into proponents (OMV, researcher) and opponents (environmental groups, Green Party, citizens' initiatives) of fracking. The Federal Government occupies an intermediate position but is itself divided between the Ministry of Life (opponents) and the Ministry of Economy (proponents). Besides these, other actors (parties, regulatory bodies, companies, scientists, etc.) were involved in the discussions around fracking to a lesser extent and therefore will not be described in detail.

The Actors

OMV

The OMV is a stock corporation and the biggest listed industrial company in Austria. It was founded in 1956[19] as a state owned enterprise, but was privatized and restructured (to a stock-company) in two steps in 1987 and 1989 (OMV 2013). In Austria, the OMV operates gas stations, pipelines, and a refinery. It has been producing oil and gas for 50 years now and in 2012 covered about 10% of oil and 15% of Austrian gas consumption. The Austrian Industry-Holding Stock Corporation (ÖIAG), which is responsible for managing investments of the Republic of Austria and privatizations of nationalized companies, owns 31,5% of OMV stocks. The ÖIAG is state owned and controlled by the Federal Ministry of Finance. In 2012, the OMV paid a dividend of 124 million Euros to the ÖIAG and 1,77 billion Euros in taxes; it also invested 332 million Euros in the Austrian economy (ÖIAG 2012: 26-27). Hence, the OMV is important for the Austrian economy and the federal government. There have been several personal links be-

[19] As *Austrian mineral oil administration* („Österreichische Mineralölverwaltung"). Weber (2012: 197) points to the organizational basis of the OMV that was built earlier, during the time of the Nazi regime, using forced labor.

tween the OMV and the Austrian party system, but the current president of the OMV is not politically classifiable (Korom 2011; Die Presse 2009).

The OMV carries out political lobbying, although the exact form that these activities cannot be determined. From January to July 2011, the OMV spent between 250.000 and 300.000 Euros for lobbying work at the European Union. In 2012, the OMV had two lobbyists at the European Parliament (Weis 2012: 14) and from mid 2013 to mid 2014, the OMV has three registered lobbyists (European Commission 2013). The OMV is also a member of different industry associations that conduct lobbying at the European level. In Austria, there are five lobbyists that are officially registered (September 2013) for the OMV. The financial scale of lobbying activities, however, is not declared[20]. The actual purpose of lobbying activities cannot be assessed because the relevant entries are not publicly accessible. Further lobbying activities by the OMV are not documented.

As a big corporation, the OMV follows the logic of the economic system and has an obligation towards its stockholders to maximize its profit (Weber 2012: 197). This logic is present in its self-portrayal, for example, in their 2021 strategy that is titled "Profitable Growth" (OMV 2011a). It is also present throughout their sustainability report 2012, which portrays their concept of *Resourcefulness* (OMV 2012). The OMV explicitly states that they want to secure environmental protection in their operations. They determine this goal in CSR documents and put it forth in the debate around fracking. It is difficult to assess the extent to which statements by the OMV regarding their concept of Resourcefulness are credible or just a way to improve its corporate image or to gain public trust so that operations can be conducted without a public outcry – and in the end increase profit. Regarding the case of fracking in Austria, the attempt to develop a cleaner form of the technology has to be acknowledged as attempt to implement their CSR strategy.

Researcher at the Mining University of Leoben

Research on and development of a new and allegedly clean fracking method is conducted at the MUL, which is located in the province of Styria and is the only university of its kind in Austria. At the moment, the OMV is funding R&D as well as teaching in the area of petroleum engineering. This is partly the case because the OMV will need more qualified employees in the future. It is therefore investing 10 Mio Euros over a three-year-period[21]. In the past, the OMV has also funded teaching and R&D at the MUL, e. g. with 2 Mio Euro from 2006-2010[22].

Compared to other Austrian universities, external funds represent quite a high proportion of the MULs' budged and an above average number of employees are financed mainly through

[20] http://www.lobbyreg.justiz.gv.at; accessed 20 September 2013.

[21] http://www.unileoben.ac.at/content/view/3006/245/lang,en/; accessed 10 October 2013.

[22] http://www.petroleumengineer.at/pe-scientific/pepe-and-its-projects.html; accessed 10 October 2013.

external funds (Elias and Pöchhacker-Trötscher 2012: 26-27). In 2012, 461 out of 1.158 employees (39,81%) were externally funded (Montanuniversität Leoben 2012: 45). Regarding the issue of fracking, two researchers from the Department for Mineral Resources and Petroleum Engineering appear in public: Gerhard Thonhauser and Herbert Hofstätter.

Thonhauser is the director of a company located in Leoben that provides "data management and decision support tools for the petroleum industry"[23]. At the University of Leoben, he holds a chair in deep-hole-drilling. Furthermore, he published a number of research reports on shale gas production, several of which were on the Ukraine, and co-authored a report on the market impacts of shale gas for the European Commission (EC JRC 2012). As early as 2010, he held presentations on best practice in unconventional gas production and on building a shale gas industry in Europe[24].

Hofstätter worked in the oil industry for 27 years before returning to MUL. He holds several patents for drilling systems and methods[25] and is professor for petroleum and geothermal energy recovery (derStandard.at 2012a).

Work on fracking can bring the researchers economic benefits on several levels. Thonhauser, as director of a supplying company for oil and gas production, could benefit from the implementation of fracking in Austria as subcontractor. And for the MUL, cooperation with the OMV is necessary because they rely on external funding. Furthermore, the prospect of income from patents on a new fracking approach may be another incentive, although Hofstätter has on several occasions stated, that he would prefer this technology to be available for everybody without license fees so that more companies conduct environmentally friendly fracking (Agitano 2012). A greater reputation in the scientific field might also be convertible into financial capital (research funding). But the researcher working on the clean fracking method says that his main motive is to conduct operations that are safe for the environment, because of his own role as father and his considerations regarding the future of his children. His interest in environmental protection is also noticeable in his claim of not patenting the clean fracking approach in order to make it more accessible for others, thus making fracking operations worldwide cleaner.

[23] http://www.tde.at/index.php?id=4; accessed 1 September 2013.

[24] https://online.unileoben.ac.at/mu_online/voe_main.PersVoes?pAnzeige=VPW&pPersonNr=149550&pSiteNr=1014220&pPageNr=1; accessed 20 September 2013.

[25] According to the European Patent Register, https://register.epo.org.

Federal Government

When the issue of fracking was highly debated in Austria (2011-2012), a grand coalition between the Social Democrats (SPÖ – 29,3% of votes) and the Conservatives (ÖVP – 26,0%) was in power[26]. The SPÖ did not interfere much in the discussion on fracking in Austria, whereas certain actors from the ÖVP were at its center.

In the debate on fracking and associated processes, two federal ministries were especially active: the Ministry of Agriculture, Forestry, Environment and Water Management (Ministry of Life) and the Ministry of Economy, Family and Youth (Ministry of Economy). Although one major aspect regarding the introduction of fracking in Austria was the development of a clean fracking technology at an Austrian university, the Federal Ministry of Science and Research remained silent on the issue.

At the time of the debate on fracking, the Federal Ministry of Economy was led by Reinhold Mitterlehner, who is a member of the Austrian People's Party (ÖVP). The ÖVP is known for its close relationship to the Austrian Federal Economic Chamber and the Austrian Chamber of Agriculture. These are important actors (so-called *Sozialpartner/Social Partners*) in the neo-corporatist landscape in Austria (Pelinka 2009: 628-630; Tálos and Kittel 2001: 64-69). Mitterlehner himself was general secretary for the Economic Chamber from 1992 to 2000 and deputy to the general secretary from 2000 to 2008.

The Ministry of Economy is the responsible authority for granting oil and gas drilling permits in Austria according to the MinRo-G. Before the UVP-G amendment of 2012, they would have also been responsible for giving permission to the OMV to conduct hydraulic fracturing. With the amendment that made an EIA mandatory for fracking, the Ministry of Agriculture is now a competent authority as well.

Like the Ministry of Economy, a member of the ÖVP, Nikolaus Berlakovich, led the Ministry of Life. The Ministry has been under attack several times because it made decisions in favor of farmers rather than the environment (Die Presse 2013).

The economic interest of the Federal Government, including the involved Ministries, seems to have many facets. On the one hand, they have an interest in promoting the national economy, which might be made possible by lower energy prices as a result of fracking. Furthermore, as a shareholder of the OMV, the Federal Government might also be interested in increasing their revenue. On the other hand, fracking could be harmful to local branches of business (tourism, agriculture) that also contribute to the economy. In the end, politicians rely on being re-elected by the population, so their public image is crucial to them.

26 http://wahl08.bmi.gv.at/; accessed 20 October 2013.

Green Party

Between 2008 and 2013, the Green Party was the third largest opposition party in the parliament. With 10,4% of votes, it was behind the right-populist Freedom Party (FPÖ, 17,5%) and the right-populist Alliance for the Future of Austria (BZÖ, 10,7%)[27]. In Lower-Austria, where fracking operations should have taken place, the Green Party received 8,0% of votes in the national elections and 6,9% of votes in the state elections[28].

The Green Party defines ecology, solidarity, self-determination, direct democracy, non-violence, and feminism as their core values (Die Grünen 2001: 6-10) and describes the promotion of renewable energy as one of their goals (ibid. 24). In 1986, the Green Party entered the National Council for the first time, but the social movement out of which the Green Party emerged already started in the 1970s as a protest movement against *Zwentendorf* (Lower Austria). This nuclear power plant was built but never activated due to public protests that were supported by the media and led to a plebiscite in 1978; Griessler (2012: 75) describes the topic of nuclear energy as a "major taboo in Austrian science and technology policy". Another important factor regarding the emergence of the Green Party and an active civil society in general was the protest against the construction of a large hydroelectricity facility within an untouched floodplain near *Hainburg* by the Danube in Lower Austria in 1984 (Foltin 2004; Jordan 2011; Pesendorfer 2007).

The Green Party was among the first to react to the OMV's fracking plans; it demanded more information and the adaption of existing regulation (EIA). Later on, they intensified their claims and are now insisting on a total ban of fracking and shale gas production. The Green Party functioned as a link between civil society and the political system, e.g. by supporting and submitting a petition to the National Council, and as actors from inside the political sphere by tabling the issue in state and national assemblies.

Non-governmental Organizations (NGOs)

The main NGOs that have dealt with the topic of fracking and shale gas in Austria are *Global 2000* and *Greenpeace* (Austria). Both campaign for a clean environment by means of nonviolent public activism, lobbying and outreach work. They are mainly financed by donations (Global 2000: 64% donations, 21% revenues, 12% funding[29]). To campaign against a technology like fracking, which (presumably) has very explicit effects – e.g., burning tap water – might be a strategy that supports their positive image, publicity and revenues from donations.

---

27 http://wahl08.bmi.gv.at/; accessed 20 October 2013.

28 http://www.noe.gv.at/Politik-Verwaltung/Wahlen/Landtagswahl-2013.html; accessed 1 January 2014.

29 Unspecified. Financial data from 2011, www.global2000.at/finanzdaten-2011; accessed 10 September 2013.

In regards to fracking in Austria, the NGOs published press releases conveying their critical opinion about the technology and its possible implementation in this particular case and in general. Their concerns were also picked up by and distributed through the media. They also tried to inform the local population by conducting information events, thereby cooperating with citizens' initiatives (Greenpeace 2011a). At other opportunities (e.g. information events by the OMV), they conducted and/or supported protest rallies.

Citizens' Initiatives

Citizens' initiatives (Bürgerinitiativen - BI) emerged soon after the OMV's announcement of its shale gas plans in Lower Austria. Citizens' initiatives were located in communities potentially affected by shale gas production. Two of these were especially prominent in the discussions: BI Risiko-Gas and BI SCHIEFESgas. The focus will be on the latter because of its more extensive (internet) presence.

The BI SCHIEFESgas describes itself as "non-partisan platform, which campaigns for a liveable wine district"[30] by providing information from independent experts[31]. In general, there is a noticeable distrust in the statements made by the OMV and other organizations and/or experts that speak out in favor of shale gas production. Activists from the initiatives also regard media organizations as biased because they rely on money from companies and organizations. Thus, searching for non-partisan information and asking critical questions are essential for them. In this regard, they assess the internet and local information events as important.

Persons engaged in the citizen initiative BI SCHIEFESgas and other activists come from various backgrounds. An account for donations exists but no direct financial support by companies or organizations can be found. For some of their activities, the citizens' initiatives cooperated with each other, NGOs, as well as with members of the Green Party. Furthermore, they gathered endorsements for their cause from known artists, authors and intellectuals (see Bürgerinitiative SCHIEFESgas web).

The citizens' initiatives conducted information events – even before the OMV held its own events –, submitted a petition to the National Council to prohibit hydraulic fracturing in general with support of the Green Party (Windbüchler-Souschill et al. 2012), initiated an ongoing signature collection against fracking, started other forms of symbolic action (protest rally, planting a resistance-tree) and have been active on social media and the internet (Bürgerinitiative SCHIEFESgas web).

Economic, environmental, and personal interests can all be identified as coming into play on the part of the citizens' initiatives. Tourism and viticulture are important economic pillars of the region. Hydraulic fracturing and shale gas production pose a risk to these sources of in-

[30] http://www.weinviertelstattgasviertel.at/page8/index.html; accessed 10 September 2013.

[31] I.e.experts that have no direct or indirect affiliation with the oil and gas industry.

come because of the potential destruction of the landscape and damage to the positive image of the region. Thus, the local population and its citizens' initiatives have an economic interest in averting fracking and other gas producing operations. This is diametrically opposed to the interests of the gas producing company. The conservation of the value of their properties (houses, land) might be another factor, although no actual statement in this regard can be found. Another form of direct economic concerns can be identified: one of the speakers at their information event in July 2013 was the general manager of a company that builds wind, solar, biomass, photovoltaic and water power plants[32]. He seems to be exempted from the critique of pursuing his own financial interests by the members of the initiatives, whereas other actors (OMV, politics) are accused of doing so. In this regard, a distinction is made between short-term and long-term benefits of the energy technology, with gas production as a non-sustainable energy classified as a short-term-solution that imposes environmental risks (OBS 2013).

The environmental interests of the citizens' initiatives are closely linked to their economic, but also to their personal interests. They want to protect their immediate surrounding from dangerous chemicals and toxins (e.g. contamination of cropland), thus maintaining sources of income and protecting their health from potential toxins in the air, water and soil. They are talking about their "own" region, their "own" drinking water and their "own" children that would be affected by fracking. In this regard, the notion of the "future of our children" (Bürgerinitiative SCHIEFESgas web; OBS 2013) is especially prevalent.

[32] http://www.oekoenergie.com/index.htm; accessed 10 September 2013.

Framing of Fracking and Shale Gas

The issue of fracking is inevitably linked with the issue of shale gas (or unconventional gas in general), the framing and assessment of this technology is therefore always linked with the assessment of shale gas as a source of energy. The framing of fracking, its assessment and the solutions different actors provide for problems raised by this technology are closely related to each other.

Table 1 Framing of Fracking and Shale Gas

		Proponents	Fed. Government	Opponents
Positive	Security of Supply			
	Independence			
	Economic Growth			
	Bridge Energy			
	Lower GHG Emissions			
Negative	Environmental Risks			
	Negative Economic Impact			
	Non-sustainability			
	Dependence			
	Higher GHG Emissions			

As depicted in Table 1, the framings of fracking and shale gas by proponents and opponents are strictly opposing, with the federal government being in an intermediate position. This is due to the split between the Ministry of Economy and the Ministry of Life; they adopt different positions towards the issue, but in the end take up the same (consensual) standpoint, which finds its expression in legislation (UVP-G amendment).

Security of Supply

A major concern and argument in favor of fracking concerns the security of energy supply. While the production of conventional oil and gas is declining, shale gas is described as a way of satisfying energy demand. This aspect is especially pushed by the OMV (i.a. profil 2012), but also by researchers (i.a. Wiener Zeitung 2011d) and the Ministry of Economy. The issue of security of supply is also closely linked to that of independence from foreign sources of oil and gas.

National Independence

Proponents claim that intensifying European production of gas could solve or at least ease the problem of dependence on foreign energy supplies – especially gas from Russia. This argument has to be considered in the context of repeated and politically motivated gas supply shortages caused by conflicts between Russia and the Ukraine and the other attempts by the OMV to

solve this problem, like the *Nabucco* pipeline (i.a. Kurier 2009, 2009a; Der Standard 2009, 2009a, 2009b; Wiener Zeitung 2012b).

Economic Prosperity and Growth

Proponents depict shale gas production as a driver of the economy. Whereas in the USA and China the gas price has been declining and the economy has been stimulated because of shale gas, Europe is left standing and jobs – especially in the industry – are getting lost ("stagnation", "downturn"). For the president of the OMV, the crucial question is not if a country wants to produce shale gas but if it wants to remain competitive (Der Standard 2012c; Kurier 2012e; Die Presse 2012; News 2012). Shale gas is therefore regarded as necessary to meet factual constraints. Researchers similarly describe the situation and see shale gas as a way of promoting economic growth and reducing national debt (Kurier 2011g). In line with this, the Minister of Economy even describes the energy price as more crucial for competitiveness than wages. Furthermore, an increase in domestic production would strengthen Austria's position in negotiations with foreign oil and gas suppliers (Die Presse 2013a). To emphasize the need of shale gas for competitiveness, voestalpine is named as an example by some. This Austrian steel company made a large capital investment in Texas (USA) because of the lower energy prices in the US (Kurier 2013b).

Bridge Energy

Natural gas is depicted as the cleanest and most important fossil fuel for the future, which is also emphasized in the OMV's 2021 strategy (OMV 2011a) and by researchers from the MUL. It is presented as a solution to bridge the time gap until enough renewable sources of energy are available to meet energy demand and energy infrastructure can manage energy from such sources (profil 2012; Wiener Zeitung 2011d).

Greenhouse Gas Emissions

Closely linked to the aspect of shale gas as bridge energy, is the use of shale gas as a means to lower GHG-emissions. The proponents of shale gas and fracking argue, often in reference to the US example, that replacing coal with shale gas, as source of energy, can instantly lower GHG emissions. Shale gas production would thereby positively contribute to climate-change-targets.

The aim of lowering GHG emissions is also questioned by some. The Minister of Economy states that it might be not a good idea to sacrifice industry, and the general welfare of a society, in order to reach certain CO_2 emission targets (Die Presse 2013a).

Environmental Risks

NGOs, citizens' initiatives and the Green party all frame hydraulic fracturing as a technology that imposes high risks on the health of local populations. High water consumption, pollution of drinking and surface water, use of dangerous chemicals and ability to induce earthquakes are mentioned as possible risks of fracking (i.a. Global 2000 2011; Greenpeace 2011; Bürgerinitiative Schiefesgas web; Die Grünen im NÖ Landtag 2011a).

Members of the citizens' initiatives say that they do not want their homeland to become an "experimental laboratory" for a new fracking approach or themselves to become "human guinea pigs" (OBS 2013).

Negative Economic Impacts

Especially citizens' initiatives perceive their homeland and lifestyle as being at stake because of the potential negative effects of fracking on their health but also on tourism and agriculture (viticulture). They paint a picture of a region rugged by drilling rigs[33], supply roads and pipelines and contrast this construction with an idealized image of the landscape[34] (Bürgerinitiative SCHIEFESgas web)

Non Sustainability

Opponents of fracking consider shale gas to be a worse option than renewable and clean sources of energy like wind and solar power. Furthermore, they see the development of renewable energy as delayed by the international promotion of shale gas production (i.a. Global 2000 2013). Citizens' initiatives not only state that they want to develop their district in a sustainable manner but also that they do not want to support climate change by letting exploitation of fossil fuels happen (Bürgerinitiative SCHIEFESgas web; OBS 2013). They not only frame fracking and shale gas as a local but also as an international problem.

Dependence

Like the proponents of fracking, its opponents want to become more independent. While the proponents claim that producing shale gas is a way to become more independent from foreign oil and gas, opponents want to become independent from fossil fuels and from big energy companies. Members of the citizens' initiatives therefore seek to produce energy at a local level, using wind and solar power and temporally transforming energy-surplus into hydrogen or methane in order to save it (OBS 2013).

---

[33] http://www.weinviertelstattgasviertel.at/resources/Artikel/gas-bohrung-raster-mistelbach07.pdf; accessed 10 September 2013.

[34] http://www.weinviertelstattgasviertel.at/styled/index.html; accessed 10 September 2013.

Higher GHG-Emissions

Besides the general environmental risks imposed by fracking, NGOs, the Green Party and citizens' initiatives also see the risk of higher GHG-emissions produced by this technology as a result of methane leakage (i.a. Global 2000 2011; Greenpeace 2011; Bürgerinitiative SCHIEFESgas web).

How to deal with the »problem« of fracking?

The fact that different actor groups frame fracking in different ways does not mean that they neglect specific aspects and possible effects of this technology. But there is difference in how they assess and address these issues. In this regard, two contradicting points of view can be identified when it comes to the question of how to best deal with the issue of fracking and its possible effects: regulation or prohibition. For each position, different actors and actor groups are called upon to act responsibly.

Proponents of fracking claim that possible problems directly associated with fracking can be solved through R&D, the implementation of best practice and compliance with regulation. The government is called upon to regulate fracking and to formulate strategies that fit the assumed economic and factual constraints. Companies are called upon to comply with existing rules and implement state of the art technology.

Proponents depict the risk of environmental pollution as foremost a technical problem that can be solved by companies and researchers. The president of the OMV stated that his company would only conduct fracking in an environmentally friendly manner several times (i.a. Die Presse 2011b; Kurier 2012e), thereby addressing environmental concerns while at the same time casting aside fears of its negative impacts. Proponents point to R&D efforts that will minimize risks and make fracking a clean technology. A researcher from the MUL states that to conduct fracking in a benign way, comprehensive research to develop harmless materials, techniques and methods are necessary on the one hand. But, on the other hand, responsible engineers to implement state of the art technology and best practice are also essential. This responsibility can be promoted by means of education – e.g. at universities (Kurier 2013d).

Besides technical aspects, there are also societal obstacles identified by proponents. The non-acceptance of fracking is not seen as a problem deriving from the technology itself or from differing societal values and objectives but instead as a communication and information problem. The president of the OMV states that, "the population has to be informed in an objective and serious way about the technology and the ecological effects" (Wirtschaftsblatt 2012) and that it is necessary to have a factual discussion (Kurier 2011h). The challenge of public acceptance is also crucial for the Minister of Economy (Die Presse 2013a). The companies and politicians involved are called upon to raise acceptance, also by informing the public.

Opponents of fracking do not believe the promise that a clean fracking solution can be found. They say that if an approach without chemical additives were possible and economically viable, then it would have already been used somewhere. Clean fracking is depicted as technically

impossible, e.g. because of the toxicity of produced water even if no chemical additives are used. In their view, direct environmental risks cannot be fully eliminated. Furthermore, a long-term environmental impact, as a result of GHG emissions from gas combustion for example, cannot be ruled out. Hence, they demand that the government minimize potential risks and dangers deriving from fracking by banning it entirely and call upon the OMV to stop their operations. They want the government to promote sustainable energy technologies (e.g. through R&D) instead of fossil fuels. Opponents of fracking do not address the researchers working on a clean fracking approach.

Members of the citizens' initiatives proclaim the necessity for alert and active individuals that take matters into their own hands, get unbiased information, and increase pressure on policy-makers. This individualization of responsibility seems to be linked to a general distrust in politics, companies, and the media.

Incompatible Positions

The positions of proponents and opponents of fracking in Austria seem to be incompatible. Both groups of actors consider themselves as being right and as acting responsibly under the given circumstances. The incompatibility of positions derives from (1) different assumptions about the technology, the possibility to further develop it, and associated risks, benefits and uncertainties; (2) adverse interests (e.g., maintaining local business models vs. boosting the national economy); and (3) different views on the general pace and manner of development (sustainable energy now vs. later). The incompatibility manifests itself in different regulatory approaches. On the one side, supporters of fracking want to regulate fracking in order to minimize risks without obstructing R&D, implementation and economic competitiveness. On the other side, opponents of fracking want to prohibit this technology entirely and eliminate this potential source of risk. Instead, they push for sustainable energy technologies and local branches of the economy.

In this situation, the federal government took a mediating position in tabling an amendment to the Environmental Impact Assessment (EIA) Act. On the one hand, this addresses opponents' concerns over environmental risks by making an EIA of hydraulic fracturing mandatory even for testing purposes. On the other hand, it leaves the door open for fracking to be conducted in the future. In the end, the parties to the dispute are not satisfied. (1) The OMV abandons its plan to develop and implement clean fracking in Austria but continues to call for a European shale gas strategy. Although the OMV's decision to stop fracking cannot be reduced to the amendment of the EIA, since there might be unknown underlying reasons, it seems that this was an important factor. (2) Opponents of fracking continue to speak out against fracking. For them, only a total ban can guarantee that no further attempts will be made by oil and gas companies to introduce fracking in Austria.

De facto Governance of RRI

As shown, governance of fracking in Austria was facilitated in a dynamic process. Although there were regulations in place that would have covered the OMV's testing of a new fracking approach (MinroG), critics argue that these would not have been sufficient to prevent the negative effects. Furthermore, different societal stakeholders would thereby not have been included in the decision making process. The adaptation of existing regulations (UVP-G) happened in an ad hoc manner after the technology had been introduced and protests had already started. The public and political controversy that was also spread by the media played a part in increasing the pressure on the OMV as well as the government. Given the incompatible positions of opponents and proponents of fracking, the Federal Government tried to strike a balance between their interests and suspended the actual decision on fracking. At the same time it made concessions; at least to some extent, public participation is now scheduled and a preceding review of the impact is mandatory. Although no actual EIA has been initiated, the mere prospect of such a procedure had an effect on decision making.

An assessment of whether or not RRI has been facilitated in the case of fracking in Austria depends on what is understood by *responsible*. Proponents of fracking might evaluate the outcome of the process as irresponsible because the security of gas supply and technological development are hampered. Opponents might see the mandatory EIA and the stopping of operations as a partial victory and responsible in regard to safety and sustainability.

From a sympathetic perspective, the OMV's initial attempt to improve fracking technology and to develop a clean approach could be regarded as being responsible behavior towards the environment and society. It can also be understood as an expression of CSR. The OMV stated that it wants to develop a clean solution, inform the public, and accomplish its goal of supplying Austria with fossil fuels. Besides the obvious economic motives, the OMV's strategy to invest in R&D on a clean fracking approach might also have come about as a result of the specific circumstances. In general, Austrians are rather skeptical towards (new) technologies. The results from the Eurobarometer 2010 show that Austria ranks last in terms of general optimism towards new technologies[35] compared to other European countries (Gaskell et al. 2010: 15). Throughout Austrian history, there are examples for protests against large-scale projects that affect the environment (*Zwentendorf*, *Hainburg*). The OMV may have wanted facilitate acceptance for their plans in the first place by anticipate criticism because of negative environmental impacts.

From a more critical perspective, the process was not an open one that involved different societal stakeholders. Rather, the public was informed in a top down manner and confronted with fixed plans and a technology already under development. This led to a defensive attitude and distrust on behalf of the affected population. The social movement that followed, which

35 Mean number of optimistic rated technologies out of eight is 3,8, mean number of pessimistic rated is 2,1, whereby in the EU27 these are 4,9 to 1,1.

consisted of civil society actors and opposing politicians, presented a solution to the problem that, given a negative and sceptic framing of the issue, appeared to be the only responsible option towards society in the long run.

Building upon the analysis conducted in this study, several conclusions for Res-AGorA as well as RRI governance can be made:

- The assessment of fracking by societal actors diverges depending on the temporal alignment, the spatial orientation, and the confidence in the compliance with regulations and best practices of the actors.
- It is one of the biggest challenges for an RRI governance framework to consider and to bring together these different interests, perspectives, and worldviews in regards to R&I and to find a way of dealing with (apparently) incompatible positions.
- A certain level of trust is important to convey information and facilitate a dialogue in negotiation processes. In order to facilitate trust, it would be beneficial to increase transparency of decision-making process, implement participatory approaches (e.g. pTA), and provide information by independent organizations, which assesses opportunities and risks of technologies in a non-partisan manner.
- At the same time, public and political controversies can be important factors in initiating legislative efforts that promote RRI.
- Adaptation of existing governance arrangements, like EIA legislation, might be appropriate and practical concerning R&D in certain areas. However, in the case at hand, no EIA was conducted. Therefore, its effectiveness is uncertain.
- Prevailing societal conditions (such as the actor and media landscape, political circumstances, civil society, and general attitude towards technology, the environment, etc.) seem to be crucial and have to be considered. Further research is necessary to better understand their effects.

Literature

3LegsResources (2011): An introduction to shale gas. http://www.3legsresources.com/wp-content/uploads/2013/06/A-guide-to-shale-gas.pdf; accessed 30 July 2013.

Bamberger, Michelle; Oswald, Robert E. (2012): Impacts of Gas Drilling on Human and Animal Health. New Solutions 22/1, 51-77.

Barth, Janette M. (2013): The Economic Impact of Shale Gas Development on State and Local Economies: Benefits, Costs, and Uncertainties. New Solutions 23/1, 85-101.

Bassen, Alexander; Jastram, Sarah; Meyer, Katrin (2005): Corporate Social Responsibility. Eine Begriffserläuterung. Zeitschrift für Wirtschafts- und Unternehmensethik 6/2, 231-236.

Baumgartner, Christian; Petek, Waltraud (2010): UVP-G 2000. Umweltverträglichkeitsprüfungsgesetz. Kurzkommentar. Wien: Verlag Österrreich.

Boling, Chris (2013): Hydraulic Fracturing and Chemical Disclosure: What you do not Know Could Hurt You! Loyola of Los Angeles Law Review 46, 257-291.

Bräuninger, Michael; Leschus, Leon; Pflüger, Wolfgang; Val, Joël (2013): Fracking. Berenberg, HWWI – Strategie 2030. Hamburg. http://www.hwwi.org/fileadmin/hwwi/Publikationen/Partnerpublikationen/Berenberg/2013_07_10_HWWI_Berenberg_Strategie2030_Fracking.pdf; accessed 2 August 2013.

Bullis, Kevin (2013): Skipping the water in Fracking. The push to extend fracking to arid regions is drawing attention to water-free techniques. MIT Technology Review. http://www.technologyreview.com/news/512656/skipping-the-water-in-fracking/; accessed: 11 July 2013.

Burnham, Andrew; Han, Jeongwoo; Clark, Corrie E.; Wang, Michael; Dunn, Jeniffer B.; Paou-Rivera, Ignasi (2012): Life-Cycle Greenhouse Gas Emissions of Shale Gas, Natural Gas, Coal, and Petroleum. Environmental Science & Technology 46, 619-627.

Cathles, Lawrence M.; Brown, Larry; Taam, Milton; Hunter, Andrew (2011): A commentary on "The greenhouse-gas footprint of natural gas in shale formations" by R.W. Howarth, R. Santoro, and Anthony Ingraffea. Climatic Change [online].

Colborn, Theo; Kwiatkowski, Carol; Schultz, Kim; Bachran, Mary (2011): Natural Gas Operations from a Public Health Perspective. Human and Ecological Risk Assessment 17m 1039-1056.

Considine, Timothy; Watson, Robert; Entler, Rebecca; Sparks, Jeffrey (2009): An Emerging Giant: Prospects and Economic Imacts of Developing the Marcellus Shale Natural Gas Play. Pennsylvania State University.

Davies, Richard J. (2011): Methane contamination of drinking water caused by hydraulic fracturing remains unproven. Proceedings of the National Academy of Sciences of the United States of America 108/43, E871.

Department of Energy (DOE 2009): Modern Shale Gas Development in the United States: A Primer. http://www.netl.doe.gov/technologies/oilgas/publications/EPreports/Shale_Gas_Primer_2009.pdf; accessed 10 August 2013.

Eaton, Timothy T. (2013): Science-based decision-making on complex issues: Marcellus shale gas hydrofracking and New York City water supply. Science of the Total Environment 461-462, 158-169.

Elias, Bernhard; Pöchhacker-Trötscher, Gerlinde (2012): Drittmittelfinanzierung universitärer Forschung in Österreich. Entwicklungen, Rahmenbedingungen und Ansatzpunkte zur Stärkung der Drittmittelforschung an österreichischen Universitäten. Pöchhacker Innovation Consulting GmbH im Auftrag des Rates für Forschung und Technologieentwicklung. http://www.rat-fte.at/tl_files/uploads/Studien/Studie%20Drittmittelfinanzierung%20universitaerer%20Forschung%20in%20Oesterreich.pdf; accessed 10 October 2013.

Ellsworth, William L. (2013): Injection-Induced Earthquakes. Science 341/6142, 1225942.

Elst, Nicholas J van der; Savage, Heather M.; Keranen, Katie M.; Abers, Geoffrey A. (2013): Enhanced Remote Earthquakes Triggering at Fluid-Injection Sites in the Midwestern United States. Science 341/6142, 164-167.

Energy Information Administration (EIA 1993): Drilling Sideways - - A Review of Horizontal Well Technology and Its Domestic Application. http://www.eia.gov/ftproot/petroleum/tr0565.pdf; accessed 31 July 2013.

Energy Information Administration (EIA 2013): Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States. http://www.eia.gov/analysis/studies/worldshalegas/pdf/overview.pdf; accessed 10 August 2013.

Entine, Jon (2012): Killing drilling with farcical 'sciences'. New York Post. http://www.nypost.com/p/news/opinion/opedcolumnists/killing_drilling_with_farcical_science_qxVUkyMRYQAwT8ovAYKAgJ; accessed 10 August 2013.

Environmental Protection Agency (EPA 2012): Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources. Progress Report. http://www2.epa.gov/sites/production/files/documents/hf-report20121214.pdf; accessed 30 July 2013.

European Commission Joint Research Centre (EC JRC 2012): Unconventional Gas: Potential Energy Market Impacts in the European Union. Ivan Pearson, Peter Zeniewski, Francesco Gracceva & Pavel Zastera (JRC). Christophe Mc Glade, Steve Sorrell & Jamie Speirs (UK Energy Research Centre); Gerhard Thonhauser (Mining University of Leoben). http://ec.europa.eu/dgs/jrc/downloads/jrc_report_2012_09_unconventional_gas.pdf; accessed 1 September 2013.

Fitzgerald, Timothy (2013): Frackonomics: Some Economics of Hydraulic Fracturing. Case Western Reserve Law Review 63/4.

Fochler, Maximilian; Müller, Annina (2006): Vom Defizit zum Dialog? Zum Verhältnis von Wissenschaft und Öffentlichkeit in der europäischen und österreichischen Forschungspolitik. ITA manu:script (ITA-06-04). http://epub.oeaw.ac.at/ita/ita-manuscripta/ita_06_04.pdf; accessed 26 October 2013.

Foltin, Robert (2004): Und wir bewegen uns doch. Soziale Bewegungen in Österreich. Edition Grundrisse. Wien: edition grundrisse.

Friesl, Christian (2008): Erfolg und Verantwortung. Die strategische Kraft von Corporate Social Responsibility. Wien: Facultas.

Gaskell, George; Stares; Sally; Allansdottir, Agnes; Allum, Nick; Castro, Paula; Esmer, Yilmaz; Fischler, Claude; Jackson, Jonathan; Kronberger, Nicole; Hampel, Jürgen; Mejlgaard; Quintanilha, Alex; Rammer, Andu; Revuelta, Gemma; Stoneman, Paul; Torgersen, Helge; Wagner, Wolfgang (2010): Europeans and biotechnology 2010. Winds of change? A report to the European Commission's Directorate-General for Research. http://ec.europa.eu/public_opinion/archives/ebs/ebs_341_winds_en.pdf; accessed 10 October 2013.

Godec, Michael; Koperna, George; Petrusak, Robin; Oudinot, Anne (2013): Potential for Enhanced Gas Recovery and CO2 Storage in the Marcellus Shale in the Eastern United States. International Journal of Coal Geology.

Gold, Russel (2012): Oil and Gas Boom Lifts U.S. Economy. The Wall Street Journal February 8. http://online.wsj.com/article/SB10001424052970204652904577195303471199234.html; accessed 16 August 2013.

Gregory, Kelvin B.; Vidic, Radisav D.; Dzombak, David A. (2011): Water Management Challenges Associated with the Production of Shale Gas by Hydraulic Fracturing. Elements 7, 181-186.

Griessler, Erich (2012): One size fits all? On the institutionalization of participatory technology assessment and its interconnection with national ways of policy-making: the case of Switzerland and Austria. Poiesis and Praxis 9, 61-80.

Howarth, Robert W.; Santoro, Renee; Ingraffa, Anthony (2012): Venting and leaking of methane from shale gas development: response to Cathles et al. Climatic Change 113, 537-349.

Howarth, Robert W.; Santoro, Renee; Ingraffea, Anthony (2011): Methane and the greenhouse-gas footprint of natural gas from shale formations. A letter. Climatic Change 106, 679-690.

Hultman, Nathan; Rebois, Dylan; Scholten, Michael; Ramig, Christopher (2011): The greenhouse impact of unconventional gas for electricity generation. Environmental Research Letters 6.

International Energy Agency (IEA 2011): Are We Entering a Golden Age of Gas. World Energy Outlook. Special Report. Paris: IEA/OECD. http://www.worldenergyoutlook.org/media/weowebsite/2011/WEO2011_GoldenAgeofGasReport.pdf; accessed 1 August 2013.

International Energy Agency (IEA 2012): Golden Rules for a Golden Age of Gas. World Energy Outlook. Special Report on Unconventional Gas. Paris: IEA/OECD. http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/WEO2012_GoldenRulesReport.pdf; accessed 29 July 2013.

Ishida, Tsuyoshi; Aoyagi, Kazuhei; Niwa, Tomoya; Chen, Youquin; Murata, Sumihiko; Chen, Qu; Nakayama, Yoshiki (2012): Acoustic emission monitoring of hydraulic fracturing laboratory experiment with supercritical and liquid CO_2. Geophysical Research Letters 39, L16309.

Jackson, Robert B.; Vengosh, Avner; Darrah, Thomas H.; Warner, Nathaniel R.; Down, Adrian; Poreda, Robert J.; Osborn, Stephen G.; Zhao, Kaiguang; Karr, Jonathan D. (2013): Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction. Proceedings of the National Academy of Sciences of the United States of America [ahead of print].

Jiang, Mohan; Griffin, Michael W.; Hendrickson, Chris; Jaramillo, Paulina; VanBriesen, Jeanne; Venkatesh, Aranya (2011): Life cycle greenhouse gas emissions of Marcellus shale gas. Environmental Research Letters 6.

Jordan, Gerhard (2011): Die Grüne Alternative: Woher sie kommt. Kurzer Abriss über die Vorgeschichte bis zum Einzug der Grünen in den österreichischen Nationalrat 1986. http://www.gruene.at/partei/chronik/ueberblick/vorgeschichte-der-gruenen.pdf; accessed 01 January 2014.

Joshi, Sada D. (1991): Horizontal Well Technology. Tulsa (Okla.): PennWell Publishing.

Kargbo, David M.; Wilhelm, Ron G.; Campbell, David J. (2010): Natural Gas Plays in the Marcellus Shale: Challenges and Potential Opportunities. Environmental Science & Technology 44, 5679-5684.

King, George E. (2012): Hydraulic Fracturing 101: What Every Representative, Environmentalist, Regulator, Reporter, Investor, University Researcher, Neighbor and Engineer Should Know About Estimating Frac Risk and Improving Frac Performance in Unconventional Gas and Oil Wells. Society of Petroleum Engineers Paper 152596.

Kinnaman, Thomas C (2011): The economic impact of shale gas extraction: A review of existing studies. Ecological Economics 70, 1243-1249.

Kiviat, Erik (2013): Risks to biodiversity from hydraulic fracturing for natural gas in the Marcellus and Utica shales. Annals of the New York Academy of Sciences 1286, 1-14.

Korfmacher; Katrina Smith; Jones, Walter A.; Malone, Samantha L.; Vinci, Leon F. (2013): Public Health and High Volume Hydraulic Fracturing. 23/1, 13-31.5

Korom, Philipp (2011): Wirtschaftseliten im neuen Austrokapitalismus. Sozialprofil und Personalverflechtungen. Dissertation. Graz: Karl-Franzens-Universität.

Ladlee, Jim; Jacquet, Jeffrey (2011): The Implications of Multi-Well Pads in the Marcellus Shale. Research & Policy Brief Series 43. Cornell University. http://cardi.cornell.edu/cals/devsoc/outreach/cardi/publications/loader.cfm?csModule=security/getfile&PageID=1016988; accessed 30 July 2013.

McGowan, Francis (2012): Regulating innovation: European responses to shale gas development. Environmental Politics.

McIlvaine, Robert; James, Ann (2010): The potential of gas shale. World Pumps 7, 16-18.

McKenzie, Lisa M.; Witter, Roxana Z.; Newman, Lee S.; Adgate, John L. (2012): Human health risk assessment of air emissions from development of unconventional natural gas resources. Science of the Total Environment 424, 79-87.

Molofsky, Lisa J.; Connor, John A.; Wylie, Albert S.; Wagner, Tom; Farhat, Shahla K. (2013): Evaluation of Methane Sources in Groundwater in Northeastern Pennsylvania. Groundwater 51/3, 333-349

Montgomery, Carl T.; Smith, Michael B. (2010): Hydraulic Fracturing. History of an Enduring Technology. Journal of Petroleum Technology 62/12, 26-32.

Neger, Thomas (2011): Die Öffentlichkeitsbeteiligung an UVP-Verfahren und ihre Auswirkung auf die Entscheidungen. Dissertation, Karl-Franzens-Universität Graz.

Nicot, Jean-Philippe; Scanlon, Bridget R. (2012): Water Use for Shale-Gas Production in Texas, U.S. Environmental Science & Technology 46, 3580-3586.

O'Sullivan, Francis; Paltsev, Sergey (2012): Shale gas production: potential versus actual greenhouse gas emissions. Environmental Research Letters 7, 044030.

Olsson, Oliver; Weichgrebe, Dirk; Rosenwinkel, Karl-Heinz (2013): Hydraulic fracturing wastewater in Germany: composition, treatment, concerns. Environmental Earth Sciences [online].

Osborn, Stephen G.; Vengosh, Avner; Warner, Nathaniel R.; Jackson, Robert B. (2011): Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. Proceedings of the National Academy of Sciences of the United States of America 108/20, 8172-8176.

Osborn, Stephen G.; Vengosh, Avner; Warner, Nathaniel R.; Jackson, Robert B. (2011a): Reply to Saba and Orzechowski and Schon: Methane contamination of drinking water accompanying gaswell drilling and hydraulic fracturing.

Pelinka, Anton (2009): Das politische System Österreichs. In: Ismayr, Wolfgang: Die politischen Systeme Westeuropas. 4., aktualisierte und überarbeitete Auflage. Wiesbaden: VS Verlag für Sozialwissenschaften, 607-641.

Perry, Simona L. (2013): Using Ethnography to Monitor the Community Health Implications of Onshore Unconventional Oil and Gas Developments: Examples from Pennsylvania's Marcellus Shale. New Solutions 23/1, 33-53.

Pesendorfer, Dieter (2007): Paradigmenwechsel in der Umweltpolitik. Von den Anfängen der Umwelt- zu einer Nachhaltigkeitspolitik: Modellfall Österreich? Wiesbaden: VS Verlag für Sozialwissenschaften.

Pesendorfer, Dieter; Lauber, Volkmar (2006): Umweltpolitik. In: Dachs, Herbert; Gerlich; Peter; Gottweis, Herbert; Kramer, Helmut; Lauber, Volkmar; Müller, Wolfgang C., Tálos, Emmerich (Hg.): Politik in Österreich. Das Handbuch. Wien: Manzsche Verlags- und Universitätsbuchhandlung, 663-674.

Pezenka, Dominik (2010): Verschränkte Systeme? Eine Netzwerkanalyse zu den Schnittstellen von Energieforschung und Energiepolitik in Österreich. Diplomarbeit. Wien: Universität Wien.

Rahm, Brian G.; Riha, Susan J. (2012): Toward strategic management of shale gas development: Regional, collective impacts on water resources. Environmental Science & Policy 17, 12-23.

Rich, Alisa L.; Crosby, Ernest C. (2013): Analysis of Reserve Pit Sludge from Unconventional Natural Gas Hydraulic Fracturing and Drilling Operations for the Presence of Technologically Enhanced Naturally Occuring Radioactive Material (TENORM). New Solutions 23/1, 117-135.

Riedl, Janet; Rotter, Stefanie; Faetsch, Sonja; Schmitt-Jansen, Mechthild; Altenburger, Rolf (2013): Proposal for applying a component-based mixture approach for ecotoxicological assessment of fracturing fluids. Environmental Earth Sciences [online].

Ritter, Markus (1995): Umweltverträglichkeitsprüfung und konzentriertes Genehmigungsverfahren nach dem UVP-G. Wien/New York: Springer-Verlag.

Robbins, Kalyani (2013): Awakening the Slumbering Giant: How Horizontal Drilling Technology Brought the Endangered Species Act to Bear on Hydraulic Fracturing. Case Western Reserve Law Review 63/4, 1143-1166.

Rozell, Daniel J.; Reaven, Sheldon J. (2012): Water Pollution Risk Associated with Natural Gas Extraction from the Marcellus Shale. Risk Analysis 32/8, 1382-1393.

Rumbach, Andrew (2011): Natural Gas Drilling in the Marcellus Shale: Potential Impacts on the Tourism Economy of the Southern Tier. Southern Tier Central Regional Planning and Development Board. http://www.stcplanning.org/usr/Program_Areas/Energy/Naturalgas_Resources/STC_RumbachMarcellusTourismFinal.pdf; accessed 2 August 2013.

Saba, Tarek; Orzechowski, Mark (2011): Lack of data to support a relationship between methane contamination of drinking water wells and hydraulic fracturing. Proceedings of the National Academy of Sciences 108/37, E663.

Schon, Samuel C. (2011): Hydraulic fracturing not responsible for methane migration. Proceedings of the National Academy of Sciences of the United States of America 108/37.

Sjolander, Scott A.; Clark, James; Rizzo, Dana; Turack, John (2011): Introduction to Hydrofracturing. Water Facts #31. Penn State Extension. http://extension.psu.edu/natural-resources/water/marcellus-shale/hydrofracturing/introduction-to-hydrofracturing; accessed 11 July 2013.

Steinzor, Nadia; Subra, Wilma; Sumi, Lisa (2013): Investigating Links Between Shale Gas Development and Health Impacts Through a Community Survey Project in Pennsylvania. New Solutions 23/1, 55-83.

Stephenson, Trevor; Valle, Jose Eduardo; Riera-Palou, Xavier (2011): Modeling the Relative GHG Emissions of Conventional and Shale Gas Production. Environmental Science & Technology. 45, 10757-10764.

Stevens, Paul (2012): The 'Shale Gas Revolution': Developments and Changes. Briefing Paper. Chatham House EERG BP 2012/04. http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/bp0812_stevens.pdf; accessed 1 August 2013.

Tálos, Emmerich; Kittel, Bernhard (2001): Gesetzgebung in Österreich. Netzwerke, Akteure und Interaktionen in politischen Entscheidungsprozessen. Wien: WUV Universitätsverlag.

Tour, James M.; Kittrell, Carter; Colvin, Vicki L. (2010): Green carbon as a bridge to renewable energy. Nature Materials 9, 871-874.

Tyndall Centre (2011): Shale gas: a provisional assessment of climate change and environmental impacts.

Urbina, Ian (2011): Insiders Sound an Alarm Amid a Natural Gas Rush. The New York Times 26 June 2011. http://www.nytimes.com/2011/06/26/us/26gas.html?pagewanted=all&_r=1&; accessed 10 August 2013.

Vidic, R. D.; Brantley, S. L.; Vandenbossche, J. M.; Yoxtheimer, D.; Abad, J. D. (2013): Impact of Shale Gas Development on Regional Water Quality. Science 340, 1235009.

Wang, Zhongmin; Krupnick, Alan (2013): A Retrospective Review of Shale Gas Development in the United States. What Led to the Boom. Resources for the Future DP 13-12.

Weber, Andreas (2012): Die A-Moral der Wirtschaft und die Paradoxie ihrer Moralisierung. Die CSR-Strategie der österreichischen OMV AG und ihre strukturellen Grenzen. In: Bohmann, Gerda; Niedenzu, Heinz-Jürgen (Hrsg.): Markt – Inklusion - Gerechtigkeit. Zum Problem der sozialen Gerechtigkeit in der Marktgesellschaft. Österreichische Zeitschrift für Soziologie 37 (Sonderheft 11), 189-210.

Weber, Christopher L.; Clavin, Christopher (2012): Life Cycle Carbon Footprint of Shale Gas: Review of Evidence and Implications. Environmental Science & Technology 46, 5688-5695.

Material, Sources, Data

Agitano (2012): Umweltfreundliches Frackingverfahren für Schiefergas – Interview mit Prof. Dr. Hofstätter der Montanuniversität Leoben. http://www.agitano.com/umweltfreundliches-frackingverfahren-fuer-schiefergas-interview-mit-prof-dr-hofstaetter-der-montanuniversitaet-leoben/30329; accessed 21 September 2013.

Brunner, Christiane (2012): Entschließungsantrag der Abgeordneten Christiane Brunner, Freundinnen und Freunde betreffend Verbot von Schiefergas. 2129/A(E) XXIV. GP. http://www.parlament.gv.at/PAKT/VHG/XXIV/A/A_02129/fname_276228.pdf; accessed 20 August 2013.

Bundesministerium für Verkehr, Innovation und Technology; Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMVIT and BMLFUW 2012): Begleitschreiben - Ministerialentwurf betreffend ein Bundesgesetz, mit dem das Umweltverträglichkeitsprüfungsgesetz 2000 und das Luftfahrtgesetz geändert werden. http://www.parlament.gv.at/PAKT/VHG/XXIV/ME/ME_00388/imfname_254368.pdf; accessed 30 October 2013.

Bundesministerium für Wirtschaft, Familie und Jugend (BMWFJ 2013): Österreichisches Montan-Handbuch 2013. Bergbau – Rohstoffe – Grundstoffe – Energie. 87. Jahrgang. http://www.en.bmwfj.gv.at/Energy/WorldMiningData/Documents/MHB_2013.pdf; accessed 24 September 2013.

Bundesministerium für Wirtschaft, Familie und Jugend; Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMWFJ and BMLFUW 2010): Energie Strategie Österreich. http://www.bmwfj.gv.at/Ministerium/Staatspreise/Documents/energiestrategie_oesterreich.pdf; accessed 1 September.

Bürgerinitiative SCHIEFESgas (web): Weinviertel statt Gasviertel. http://www.weinviertelstattgasviertel.at/; accessed 24 November 2013.

Der Standard (2009): Keine Einigung im Gasstreit: Russland legt sich quer. 09.01.2009, 1.

Der Standard (2009a): Rückenwind für Projekt Nabucco. Alternative Pipeline-Route soll Europa unabhängiger von Gas aus Russland machen. 09.01.2009, 2.

Der Standard (2009b): Ukraine warnt Europa vor neuem Gasstreit mit Russland. 17.10.2009, 16.

Der Standard (2010): Russischer Gasprom schwimmen in Europa Felle davon. Zunehmende Konkurrenz durch Flüssiggas. 25.01.2010, 10.

Der Standard (2010a): Polnische Träume von einem Kuwait Europas. 20.07.2010, 8.

Der Standard (2010b): Der Schiefergas-Boom bringt Russland in Bedrängnis. "Energiewaffe" wird zunehmend stumpf – Pipelines und Flüssiggasterminals könnten unrentabel warden. 20.07.2010, 8.

Der Standard (2011): „Gas soll im Gestein bleiben". Umweltminister gegen Schiefergaspläne der OMV. 24.11.2011, 10.

Der Standard (2012): Grüne geben gegen das „Fracking" Gas. 03.02.2012.

Der Standard (2012a): Wissenschafter: Fracking würde UVP standhalten. 25.02.2012, 21.

Der Standard (2012b): OMV lenkt ein: Vorerst keine Schiefergasförderung im Weinviertel. 03.03.2012, 10.

Der Standard (2012c): „Teure Energie führt zu Verlagerungen in die USA". 27.07.2012, 17.

Der Standard (2012d): OMV gibt Schiefergas-Förderung auf. 18.09.2012, 16.

Der Standard (2013): Ein Rausch mit Gefahr von Kopfweh. 10.06.2013, 10.

Der Standard (2013a): Fracking belastet Trinkwasser in Brunnen. 27.06.2013, 8.

derStandard.at (2012): Kein Ende im Schiefergas-Krieg. http://derstandard.at/1332323983885/Weinviertel-Kein-Ende-im-Schiefergas-Krieg; accessed 20 November 2013.

derStandard.at (2012a): Montanuni: „Würden ohne Wirtschafts-Unterstützung nicht auskommen". 19.09.2012. http://derstandard.at/1347492845770/Hofstaetter-Ohne-Unterstuetzung-der-Wirtschaft-wuerden-wir-nicht-mehr-auskommen; accessed 1 August 2013.

derStandard.at (2013): Schiefergas im Weinviertel: "Die sind schon längst da". 21.02.2013. http://derstandard.at/1361240665507/Schiefergas-im-Weinviertel-Die-sind-schon-laengst-da; accessed 2 August 2013.

Die Grünen (2001): Grundsatzprogramm der Grünen. Beschlossen beim 20. Bundeskongress der Grünen am 7. und 8. Juli 2001 in Linz. http://www.gruene.at/partei/programm/parteiprogramm/gruenes-grundsatzprogramm.pdf; accessed 01 January 2014.

Die Grünen im NÖ Landtag (2011): Schiefergas: Grüne fordern Aufklärung über Bohrungen im Weinviertel. Angeblich haben Test-Bohrungen schon begonnen – ohne BürgerInnen zu informieren. Press release 24.11.2011.

http://www.ots.at/presseaussendung/OTS_20111124_OTS0298/; accessed 1 August 2013.

Die Grünen im NÖ Landtag (2011a): Landeskongress der NÖ Grünen: „Nein zu Bohrungen nach Schiefergas im Weinviertel". Petrovic/Enzinger: 136 Delegierte der Grüne verabschieden Resolution. Press release 27.11.2011. http://www.ots.at/presseaussendung/OTS_20111127_OTS0045/; accessed 1 August 2013.

Die Grünen im NÖ Landtag (2012): Schiefergas: Grüne Anfrage zum angeblichen "Fracking" im Weinviertel. Krismer: Missbraucht OMV Weinviertler Boden ohne Wissen der Bevölkerung? Und: Weiß die Landesregierung Bescheid? Press release 27.02.2012. http://www.ots.at/presseaussendung/OTS_20120227_OTS0051; accessed 1 August 2013.

Die Presse (2009): Das besondere Verhältnis der OMV zur Politik. 11.02.2009.

Die Presse (2010): Wenig Hoffnung auf die Gasrevolution aus den USA. 19.03.2010, 20.

Die Presse (2010a): Polens Traum von der Gas-Exportmacht. 27.07.2010, 18.

Die Presse (2011): Macht Schiefergas Polen zur Energiemacht? Innerhalb der EU gibt es Umweltbedenken. 22.08.2011, 14.

Die Presse (2011a): Brücke zur grünen Energiezukunft? 14.10.2011, F1.

Die Presse (2011b): Schiefergas für 30 Jahre in Österreich – OMV will aber nur „ökologisch" fördern. 03.12.2011, 18.

Die Presse (2012): OMV-Chef will EU-Strategie für Schiefergas. 19.04.2012, 18.

Die Presse (2012a): „In Österreich ist nicht einmal Nachdenken erlaubt". 22.12.2012, 15.

Die Presse (2013): Wie Bienen Berlakovich zum Verhängnis wurden. 05.05.2013.

Die Presse (2013a): „Die Sachlage wird uns zum Fracking zwingen". 18.05.2013, 15.

Die Presse (2013b): Die Energie- und Klimapolitik Europas steckt in der Sackgasse! 17.08.2013, 28-29.

European Commission (2013): Transparency Register - OMV Aktiengesellschaft. http://ec.europa.eu/transparencyregister/public/consultation/displaylobbyist.do?id=94274031992-65&locale=en#en; accessed 30 December 2013.

Format (2013): Fracking statt Easing. 21.06.2013, 66.

Gemeinderat Mistelbach (2011): 2010 – 2015 Gemeinderat Nr. 12. Gemeinderatsprotokoll 13.12.2011. http://www.mistelbach.at/gemeindeamt/html/222898166_1.pdf; accessed 1 August 2013.

Gemeinderat Mistelbach (2012): 2010 – 2015 Gemeinderat Nr. 13. Gemeinderatsprotokoll 27.03.2012. http://www.mistelbach.at/gemeindeamt/html/223005345_1.pdf; accessed 1 August 2013.

Global 2000 (2011): Förderung von Schiefergas ist nicht umweltfreundlich. Press release, 23.11.2011. http://www.ots.at/presseaussendung/OTS_20111123_OTS0052; accessed 1 August 2013.

Global 2000 (2013): GLOBAL 2000 zu Schiefergas: Europa bleibt skeptisch. Press release, 10.06.2013. http:///www.ots.at/presseaussendung/OTS_20130610_OTS0044; accessed 10 September 2013.

Global 2000 (web). http://www.global 2000.at; accessed 10 September 2013.

Global Compact Network Austria (web): www.unglobalcompact.at/; accessed 4 November 2013.

Greenpeace (2011): Greenpeace zu Schiefergas-Förderpläne: OMV versucht mit Öko-Märchen zu beschwichtigen. Press release, 02.12.2011. http://www.ots.at/presseaussendung/OTS_20111202_OTS0220; accessed 1 August 2013.

Greenpeace (2011a): Nein zu Schiefergas-Probebohrung im Weinviertel. Press relase, 22.12.2013. http://www.ots.at/presseaussendung/OTS_20111222_OTS0066; accessed 1 August 2013.

Kronen Zeitung (2011): Großer Umwelt-Widerstand gegen neue Gasbohrungen. 24.11.2011, 19.

Kronen Zeitung (2011a): Wirbel um Schiefergas-Bohrungen. Ortschefs fordern Sicherheit! 27.11.2011, 26.

Kurier (2009): Moskau dreht den Gashahn zu. 02.01.2009, 4.

Kurier (2009a): Russland und die Ukraine nähern sich im Gaskonflikt an. 21.11.2009, 17.

Kurier (2010): Die Revolution am Energiemarkt. 13.03.2010, 9.

Kurier (2011): Gas für mehr als 30 Jahre. 23.11.2011, 11.

Kurier (2011a): Saubere Förderung könnte 2013 anlaufen. 24.11.2011, 11.

Kurier (2011b): „Ganz Österreich mit Gas beliefern“. 24.11.2011, 18.

Kurier (2011c): Berlakovich spricht sich gegen Schiefergas Förderung aus. 25.11.2011, 10.

Kurier (2011d): Trinkwasser muss tabu bleiben. 25.11.2011, 18.

Kurier (2011e): Schiefergas: Grüne verlangen Novelle des Bergbaurechtes. 26.11.2011, 20.

Kurier (2011f): Schiefergas: NÖ Grüne lehnen Förderung strikt ab. 28.11.2011, 17.

Kurier (2011g): OMV will das Gas „sauber“ fördern. 30.11.2011, 17.

Kurier (2011h): Die OMV gibt Schiefer-Gas. 03.12.2011, 10.

Kurier (2011i): „Was passiert bei Erdbeben?“ 12.12.2011, 16.

Kurier (2012): Wird das Weinviertel zum Gasviertel? 19.01.2012, B4.

Kurier (2012a): OMV will besorgte Bürger von Schiefergas überzeugen. 24.01.2012, 12.

Kurier (2012b): Info-Abend lief aus dem Ruder. 25.01.2012, 16.

Kurier (2012c): Schiefergas: Keine Bohrung ohne Umwelt-Check. 18.02.2012.

Kurier (2012d): „Gaspreise machen mir Sorgen“. 29.03.2012, 9.

Kurier (2012e): EU muss Bedeutung von Gas kapieren. 31.03.2012, 9.

Kurier (2012f): Weniger Hürden für Ökostrom. 15.05.2012, 8.

Kurier (2013): Billige Energie lockt nach Texas. 14.03.2013, 11.

Kurier (2013a): „Thema Schiefergas wird überbewertet“. 27.04.2013, 11.

Kurier (2013b): „Teure Energie erdrückt Europa“. 08.05.2013, 11.

Kurier (2013c): Wie Schiefergas doch noch gewonnen werden kann. 08.05.2013, 11.

Kurier (2013d): „Dann wird nichts passieren“. 31.05.2013, 6.

Kurier (2013e): Voest findet Freunde in Texas. 22.07.2013, 14.

Lebensministerium (2012): Allgemeines zur Umweltverträglichkeitsprüfung. 08.07.2013. http://www.lebensministerium.at/umwelt/betriebl_umweltschutz_uvp/uvp/AllgemeineszurUVP.html; accessed 10 September 2013.

MinroG - Mineralrohstoffgesetz: Bundesgesetz über mineralische Rohstoffe. BGBL. I Nr. 184/1999, i.d.F.v. 02.09.2013.

Montanuniversität Leoben (2012): Jahresbericht 2012. Triple M 3/13. http://www.unileoben.ac.at/component/option,com_docman/task,doc_download/gid,230/Itemid,392/lang,de/; accessed 10 October 2013.

Montanuniversität Leoben (2012a): Entwicklungsplan der Montanuniversität Leoben. Wertschöpfung für die Zukunft. http://napps2.unileoben.ac.at/napps/public/mbl.nsf/13db8d6a0d8d1372c1256dac0053f561/33f0a8cf90def441c12579f30039b3b5/$FILE/MBL%20631112%20-%20Entwicklungsplan%20Montanuniversit%C3%A4t%20Leoben.pdf; accessed 11 November 2013.

Montanuniversität Leoben (2013): Curriculum für das Bachelorstudium Petroleum Engineering und die Masterstudien International Study Program in Petroleum Engineering sowie Industrial Management and Business Administration an der Montanuniversität Leoben. Mitteilungsblatt 89, ausgegeben am 28.6.2013. Studienjahr 2012/2013.

News (2012): »Österreich hatte überzeugende Politiker«. 27/2012 - 05.07.2012, 60-65.

Niederösterreichische Nachrichten (NÖN 2012): Schon gefrackt: Gegner entsetzt. 28.02.2012. http://www.noen.at/lokales/noe-uebersicht/mistelbach/aktuell/Schon-gefrackt-Gegner-entsetzt;art2689,375637; accessed 23 October 2013.

Niederösterreichischer Landtag (NÖ Ltg 2012): Sitzungsbericht. 47. Sitzung der Tagung 2011/12 der XVII. Gesetzgebungsperiode des Landtages von Niederösterreich. Donnerstag, den 23. Februar 2012. http://www.landtag-noe.at/service/politik/landtag/Sitzungen/17-gpw/2011-12/47-si.doc; accessed 1 August 2013.

Niederösterreichischer Landtag (NÖ Ltg 2012a): Dringlichkeitsantrag. Ltg.-1124/A-1/83-2012. http://www.landtag-noe.at/service/politik/landtag/LVXVII/11/1124/1124A2.pdf; accessed 1 August 2013.

Oberösterreichische Nachrichten (2011): 100 Euro mehr pro Jahr: Gaspreis zieht im Frühjahr kräftig an. 11.03.2011, 1.

OMV (2011): Code of Conduct – Unser Wertesystem. 5. Auflage. http://www.omv.at/SecurityServlet/secure?cid=1255740939475&lang=de&swa_id=154456496272.62607&swa_site=wps.vp.at; accessed 17 September 2013.

OMV (2011a): 2021 Strategy: Profitable Growth. http://www.omv.com/portal/01/com/omv/OMVgroup/About_OMV/OMV_Strategy_2021; accessed 20 November 2013.

OMV (2012): Sustainability Report 2012. http://www.omv.com/SecurityServlet/secure?cid=1255753870553&lang=en&swa_id=106548047425.35564&swa_site=wps.vp.com; accessed 01 September 2013.

OMV (2012a): The Code of Business Ethics. http://www.omv.at/SecurityServlet/secure?cid=1255739631558&lang=de&swa_id=154456496272.62607&swa_site=wps.vp.at; accessed 4 November 2013.

OMV (2012b): HSSE-Politik. http://www.omv.com/SecurityServlet/secure?cid=1255740160128&lang=de&swa_id=1201812299889.0852&swa_site=wps.vp.com; accessed 4 November 2013.

OMV (2013): Factsheet. Stand Juli 2013. http://www.omv.at/SecurityServlet/secure?cid=1245872639380&lang=de&swa_id=166055163818.07022&swa_site=wps.vp.at; accessed 17 September 2013.

OMV (2013a): Ad hoc announcement: Decision on Nabucco West. Press release 26 June 2013. http://www.omv.com/portal/generic-list/display?lang=en&contentId=125575369294621; accessed 21 October 2013.

OMV (2013b): Verhaltenskodex für OMV-Unternehmenslobbyisten. http://www.omv.com/SecurityServlet/secure?cid=1255751416787&lang=de&swa_id=1201812299889.0852&swa_site=wps.vp.com; accessed 4 November 2013.

Österreichische Bundesregierung (2011): Der Weg zum Innovation Leader. Strategie der Bundesregierung für Forschung, Technologie und Innovation. http://www.bka.gv.at/DocView.axd?CobId=42655; accessed 30 October 2013.

Österreichische Industrieholding AG (ÖIAG 2012): Geschäftsbericht 2012. http://www.oiag.at/files/annual_reports/oiag_gb2012.pdf; accessed 10 October 2013.

Österreichischer Arbeitskreis für Corporate Governance (2012): Österreichischer Corporate Governance Kodex. Fassung Juli 2012. http://www.omv.com/SecurityServlet/secure?cid=1171301804338&lang=de&swa_id=1201812299889.0852&swa_site=wps.vp.com; accessed 25 December 2013.

Österreichisches Parlament (2012): UVP-Novelle soll Umweltverträglichkeitsprüfungen beschleunigen. Parlamentskorrespondenz Nr. 563, 28.06.2012. http://www.parlament.gv.at/PAKT/PR/JAHR_2012/PK0563/; accessed 1 August 2013.

Österreichisches Parlament (2012a): Umweltverträglichkeitsprüfung: Novelle passiert den Nationalrat. Parlamentskorrespondenz Nr. 590, 05.07.2012. http://www.parlament.gv.at/PAKT/PR/JAHR_2012/PK0590/; accessed 1 August 2013.

profil (2011): Weinviertler Gasrausch. 50/11, 12.12.2011, 38-40.

profil (2012): „Krisen werden Europa formen“. 33/13.08.2012, 32-35.

Salzburger Nachrichten (2012): Schiefergasförderung: Gegner fordern Verbot. 29.02.2012, 21.

Salzburger Nachrichten (2013): Billiges Gas lockt die voest nach Texas. 14.03.2013, 17.

Salzburger Nachrichten (2013a): Polen landet Flop bei Fracking. 10.06.2013, 14.

Schibany, Andreas; Berger, Marting; Dachs, Bernhard; Ecker, Brigitte; Egeln, Jürgen; Gassler, Helmut; Gottschak, Sandra; Leitner, Karl-Heinz; Müller; Bettina; Rammer, Christian; Reiner, Christian; Streicher, Gerhard; Zahradnik, Georg (2013): Österreichischer Forschungs- und Technologiebericht 2013. Lagebericht gem. §8 (1) FOG über die aus Bundesmitteln geförderte Forschung, Technologie und Innovation in Österreich. Wien: Bundesministerium für Wissenschaft und Forschung/Bundesministerium für Verkehr, Innovation und Technologie/Bundesministerium für Wirtschaft, Familie und Jugend.

Schwarzer Veltliner (online): Das Schiefergas-Theater – Mai 2013 – Weinviertel. Ein Projekt des Viertelfestivals Niederösterreich 2013. https://www.facebook.com/schwarzer.veltliner; accessed 1 September.

Umweltausschuss (1993): Bericht des Umweltausschusses über die Regierungsvorlage. Bundesgesetz über die Prüfung der Umweltverträglichkeit (Umweltverträglichkeitsprüfungsgesetz – UVP-G). 1179 der Beilage zu den Stenographischen Protokollen des Nationalrates XVIII. GP. http://www.parlament.gv.at/PAKT/VHG/XVIII/I/I_01179/imfname_262425.pdf; accessed 1 August 2013.

Umweltbundesamt (web): Online-Abfrage UVP-Genehmigungsverfahren. http://www.umweltbundesamt.at/umweltsituation/uvpsup/uvpoesterreich1/uvpdatenbank/uvp_online/; accessed 13 October 2013.

UVP-G (1993): Bundesgesetz über die Prüfung der Umweltverträglichkeit und die Bürgerbeteiligung. BGBl Nr. 697/1993.

UVP-G (2000): Bundesgesetz über die Prüfung der Umweltverträglichkeit. BGBl. I Nr. 697/1993, i.d.F.v. 31.05.2013.

UVP-G (2000a): Begründung. Bundesgesetz, mit dem das Bundesgesetz über die Prüfung der Umweltverträglichkeit und die Bürgerbeteiligung geändert wird. http://www.parlament.gv.at/PAKT/VHG/XXI/A/A_00168/fnameorig_000003.html; accessed 1 August 2013.

UVP-G Novelle (2012): Änderung des Umweltverträglichkeitsprüfungsgesetzes 2000 und des Luftfahrtgesetzes. BGBl I Nr. 77/2012.

UVP-G Novelle (2012a): Bundesgesetz, mit dem das Umweltverträglichkeitsprüfungsgesetz 2000 und das Luftfahrtgesetz geändert werden. 1809 der Beilagen XXIV. GP – Regierungsvorlage - Vorblatt und Erläuterungen. http://www.parlament.gv.at/PAKT/VHG/XXIV/I/I_01809/fname_255421.pdf; accessed 1 August 2013.

Vorarlberger Nachrichten (2013): Studie: Trinkwasser wird durch Fracking belastet. 26.06.2013.

Weis, Laura (2012): „Foot on the gas“. Lobbyists push for unregulated shale gas in Europe. Corporate Europe Observatory. http://corporateeurope.org/sites/default/files/shale_gas_lobby_final.pdf; accessed 20 September 2013.

Wiener Zeitung (2010): Europa auf dem Weg zum Gas-Eldorado. 23.01.2010, 1.

Wiener Zeitung (2010a): Stille Energiereserven. 07.12.2010, 17.

Wiener Zeitung (2011): Gas folgt dem Öl und wird teurer. 11.03.2011, 25.

Wiener Zeitung (2011a): Erdgas wohl doch nicht ganz so sauber. 15.04.2011, 27.

Wiener Zeitung (2011b): Klagsdrohung und andere Ratlosigkeit. 31.05.2011, 7.

Wiener Zeitung (2011c): Experten erwarten „goldene Gas-Ära“. 07.06.2011, 25.

Wiener Zeitung (2011d): Tiefe Risse in die Erde bohren – aber nur für 80 Jahre. 17.12.2011, 4.

Wiener Zeitung (2011e): „Es heißt ja schließlich Weinviertel und nicht Gasviertel“. 17.12.2011, 5.

Wiener Zeitung (2012): OMV will zum Schiefergas – aber auf dem „österreichischen Weg“. 24.01.2012, 27.

Wiener Zeitung (2012a): Schiefergas – Chance oder Gefahr? 03.02.2012, 12.

Wiener Zeitung (2012b): Russland reduziert Gaslieferungen. 03.02.2012, 25.

Wiener Zeitung (2012c): Grüne schalten im Schiefergas-Streit den Nationalrat ein. 14.02.2012, 12.

Windbüchler-Souschill, Tanja; BI Risiko-Gas; BI SCHIEFESgas (2012): Kein Abbau von Schiefergas in Niederösterreich. Keine Probebohrungen Schiefergas im Weinviertel. 153/PET XXIV. GP – Petition. http://www.parlament.gv.at/PAKT/VHG/XXIV/PET/PET_00153/fname_243494.pdf; accessed 10 September 2013.

Wirtschaftsblatt (2010): Neuer „Blowout“ bringt auch US-Gasbranche in Verruf. 08.06.2010, 18.

Wirtschaftsblatt (2010a): Erdgas: Gazprom & Co wollen wieder auf großer Flamme kochen. Ausblick: Bis 2012 soll der Gaspreis um hundert Prozent und damit auf das Niveau von vor der Krise steigen. 26.08.2010, 15.

Wirtschaftsblatt (2010b): Schiefergas: ENI will polnischen Schatz heben. 01.12.2010, 9.

Wirtschaftsblatt (2010c): Verbund-Tochter sucht in Polen nach Schiefergas. 16.12.2010, 10.

Wirtschaftsblatt (2011): Verbund-Tochter Sorgenia investiert kräftig. 02.03.2011, 8.

Wirtschaftsblatt (2011a): Ölfelddienstleister als größte Profiteure der Preishausse. 11.03.2011, 19.

Wirtschaftsblatt (2011b): Polen will Gas – und US-Hilfe. 27.05.2011, 9

Wirtschaftsblatt (2011c): Deutschland steigt aus – ein goldenes Gas-Zeitalter folgt. 31.05.2011, 11.

Wirtschaftsblatt (2011d): Gas steht vor dem Eintritt in „Goldenes Zeitalter“. 07.06.2011, 10.

Wirtschaftsblatt (2011e): Umweltbelastung bei Förderung ein Streitpunkt. 20.06.2011, 20.

Wirtschaftsblatt (2012): „Schiefergas ist kein Weinviertler Thema“. 09.05.2012, 2.

Observations

OBS 2013*: Infoveranstaltung Schiefergas*[36]. BI Risiko-Gas. 3 July 2013, 19:30-21:30. Weingut Willi, Brünnerstraße 16, 2120 Wolkersdorf.

OBS 2013a: *„Schwarzer Veltliner" – Das Schiefergas-Theater – Ein Schwank in zwei Akten*[37]*.* Screenplay and direction: Jürgen Marschal, Elisabeth Semrad. 07 October 2013, 20:00-22:00. Palais Kabelwerk, 1120 Wien.

[36] Information event „shalegas" conducted by the citizens' initiative *Risiko-Gas*.

[37] Theater play „black veltliner – the shalegas theater – a farce in two acts".

Abbrevations

AES	Austrian Energy Strategy (Österreichische Energiestrategie)
BMLFUW	Bundesministerium für Land und Forstwirtschaft, Umwelt und Wasserwirtschaft – „Lebensministerium“ (Federal Ministry of Agriculture, Forestry, Environment and Water Management – *Ministry of Life*)
BMWFJ	Bundesministerium für Wirtschaft, Familie und Jugend (Federal Ministry of Economy, Family and Youth)
DOE	Department of Energy (United States)
EC	European Commission
EPA	United States Environmental Protection Agency
FPÖ	Freiheitliche Partei Österreichs (Freedom Party of Austria)
GHG	Greenhouse Gas
HSSE	Health, safety, security, environment
IEA	International Energy Agency
MinroG	Mineralrohstoffgesetz (Mineral Raw Material Act)
MUL	Montanuniversität Leoben (Mining University of Leoben)
ÖIAG	Österreichische Industrieholding Aktiengesellschaft
OMV	former Österreichische Mineralölverwaltung (Austrian Mineral Oil Administration)
ÖVP	Österreichische Volkspartei (Austrian People’s Party)
RAG	Rohöl-Aufsuchungs Aktiengesellschaft (Crude Oil exploration corporation
SPÖ	Sozialdemokratische Partei Österreichs (Social Democratic Party of Austria)
UVP	Umweltverträglichkeitsprüfung – Environmental Impact Assessment

Towards Anticipatory Governance of Responsible Research and Innovation

The objective of the Res-AGorA project is to develop a comprehensive governance framework for responsible research and innovation (RRI). This will be a contribution to the EU ambition of becoming a genuine Innovation Union by 2020 striving for excellent science, a competitive industry and a better society without compromising on sustainability goals as well as ethically acceptable and socially desirable conditions.

The goal of the Rea-AGorA project will be achieved through extensive case study research about existing RRI governance across different scientific technological areas, continuous monitoring of RRI trends in 16 European countries, and constructive negotiations and deliberation between key stakeholders. This comprehensive empirical work will be the building blocks of the creation of a governance framework for RRI.

The case study summarised in this document is output of Res-AGorA's extensive empirical programme (Work Package 3).

More information at www.res-agora.eu

Contact for Res-AGorA's case study programme (WP3)
Dr. Sally Randles
Manchester Institute of Innovation Research MIoIR
Sally.Randles@mbs.ac.uk

Prof. Dr. Jakob Edler
Manchester Institute of Innovation Research MIoIR
Jakob.Edler@mbs.ac.uk

Res-AGorA Co-ordinator
Prof. Dr. Ralf Lindner
Fraunhofer Institute for Systems and Innovation Research ISI
Ralf.Lindner@isi.fraunhofer.de

Acknowledgement

Co-funded by the European Union

This project is receiving funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 321427.