A Comparative Analysis of Shale Gas Extraction Policy: Potential Lessons for South Africa

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Thesis presented in fulfilment of the requirements for the degree of Master of Arts (Political Science) in the Faculty of Arts and Social Sciences at Stellenbosch University

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December 2013

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The financial assistance of the National Research Foundation (DAAD-NRF) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the DAAD-NRF.

Abstract

Since its arrival onto the U.S. energy scene in the early 2000s, shale gas has had a significant impact on the global energy market. The fact that the shale gas supply of a single country has had such a widespread influence on the global energy market hints at the power that this energy resource holds as a 'game changer'. With the fifth largest estimated shale gas reserves in the world, South Africa now faces the challenge of developing its own shale gas resources in the Karoo Basin.

Having lifted the moratorium on hydraulic fracturing in September 2012, the South African government has indicated its interest in pursuing the commercial extraction of the country's estimated shale gas reserves. This comes in light of the country's potential energy crisis, as well as an increased role for natural gas in the country's energy mix. South Africa has no history of shale gas extraction and currently has no legislation or regulatory practices in place to deal specifically with shale gas and hydraulic fracturing. The South African government thus faces the challenge of drawing policy lessons from other experienced shale gas-producing nations, such as the U.S., to close these regulatory gaps and exploit its national shale gas resources in an environmentally and economically responsible way.

Consequently, this thesis focuses on the regulation of the American shale gas industry by asking what policy lessons the South African government can draw from the United States of America on its regulation of shale gas extraction. Richard Rose's lesson-drawing approach to policy learning was adopted as the theoretical framework for this study and can also be applied as an analytical tool to aid in data collection and data analysis. Furthermore, the framework was operationalised through the research methods used for this case study, which consisted of a review of literature on the U.S. regulation of shale gas extraction.

This research produced a number of key findings in the form of policy lessons for South Africa. Four main policy lessons were drawn on the regulation of shale gas extraction: regulation of shale gas extraction must occur at all levels of government—national, provincial and local; policy research must be used to inform policymaking for the development of *new* legislation specific to shale gas and hydraulic fracturing, so as to avoid regulatory exemptions often linked to ad hoc policymaking on shale gas extraction; each level of government and their related regulatory agencies must have clearly defined regulatory roles relating to shale gas and hydraulic fracturing; and finally, there must be uniformity in terms of the regulatory focus of shale gas regulators at all levels of government.

Opsomming

Sedert skaliegas vroeg in die jare sedert 2000 op die Amerikaanse energietoneel verskyn het, het dit ‘n beduidende impak op die globale energiemark gehad. Die feit dat die voorraad skaliegas van een land so ‘n wydverspreide invloed gehad het op die globale energiemark is ‘n aanduiding van die mag van hierdie energiebron as ‘n spel-wisselaar.Suid-Afrika het die vyfde-grootste skaliegasreserwes ter wêreld, en staan nou voor die uitdaging om sy eie skaliegasreserwes in die Karookom te ontwikkel.

Nadat die moratorium op hidrobreking in September 2012 opgehef is, het die Suid-Afrikaanse regering aangedui dat hulle belangstel om die land se beraamde skaliegasreserwes kommersieel te ontgin. Dit het ontstaan in die lig van die potensiële energiekrisis wat Suid-Afrika in die gesig staar, asook die begeerte dat aardgas ‘n groter rol moet speel in die land se mengsel van energiebronne. Suid-Afrika het geen geskiedenis van skaliegasontginning nie en tans is daar geen wetgewing of regulerende praktyke in plek wat spesifiek te make het met skaliegas en hidrobreking nie. Die Suid-Afrikaanse regering staan dus voor die uitdaging om te leer uit die beleidsrigtings van ander ervare skaliegaslande soos die V.S.A. ten einde hierdie leemtes in regulering op te hef en sy nasionale skaliegasreserwes op ‘n omgewingsvriendelike en ekonomies-verantwoordelike manier te ontgin.

Gevolglik fokus hierdie tesis op die regulering van die Amerikaanse skaliegas-industrie deur te vra watter beleidslesse die Suid-Afrikaanse regering kan leer by die Amerikaanse regering oor die regulering van hulle skaliegasontginning. Richard Rose se 'lesson-drawing'-benadering tot die leer van beleid is aanvaar as die teoretiese raamwerk vir hierdie studie en kan ook aangewend word as 'n analitiese instrument om te help met dataversameling en -analise. Die raamwerk is verder geoperasionaliseer deur die navorsingsmetodes wat gebruik is vir hierdie gevallestudie, wat bestaan het uit 'n oorsig van die literatuur oor die V.S.A. se regulering van skaliegasontginning.

Hierdie navorsing het ‘n aantal sleutelbevindinge opgelewer in terme van beleidslesse vir Suid-Afrika. Die vier vernaamste beleidslesse oor die regulering van skaliegasontginning wat na vore gekom het, is die volgende: die regulering van skaliegas moet op alle vlakke van regering geskied – nasionaal, provinsiaal en op plaaslike vlak; navorsing oor beleid moet gebruik word om beleidsvorming in te lig sodat *nuwe* wetgewing ontwikkel kan word wat spesifiek gerig is op skaliegas en hidrobreking, ten einde uitsonderings op regulering te voorkom wat dikwels verbind word met ad hoc beleidsformulering; elke vlak van regering en

sy verwante reguleringsagentskappe moet duidelik gedefinieerde reguleringsrolle hê ten opsigte van skaliegas en hidrobreking; en, ten slotte, daar moet eenvormigheid wees in die reguleringsfokus van skaliegasreguleerders op alle vlakke van regering.

Acknowledgements

I wish to express my immense gratitude and appreciation to the following people:

To my supervisor, Dr. Ubanesia Adams-Jack, for her invaluable academic guidance and patience through a challenging academic experience, and for her encouragement and belief in my goal, from initial discussion to completion.

To my mother, Jenny, and my father, Brendon, for their unconditional support and encouragement throughout the two years taken to complete this thesis. I cannot find the words to thank you for standing by me, especially in tough times. Your support, in the end, is what made this thesis possible.

To my family and my friends, especially my grandmother Yvonne, and Riyaad and Nicola, for their words of encouragement and their belief in my ability to complete the task at hand.

Finally, I dedicate this thesis to my late aunt, Frances. Even in passing, you continue to inspire my growth and development, and continue to motivate me to live my life to the fullest and to always pursue my dreams.

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List of acronyms and abbreviations

AGAA	Astronomy Geographic Advantage Act (2007)
ANC	African National Congress
BLM	Bureau of Land Management
BOGM	Pennsylvania Bureau of Oil and Gas Management
CAA	Clean Air Act of 1970
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CWA	Clean Water Act of 1972
DCNR	Pennsylvania Department of Conservation and Natural Resources
DEP	Pennsylvania Department of Environmental Protection
DMR	Department of Mineral Resources
DOE	Department of Energy
DRBC	Delaware River Basin Commission
EGSP	Eastern Gas Shales Project
EIA	Environmental Information Administration
EMP	Environmental Management Programme
EPA	Environmental Protection Agency
EPCRA	Environmental Planning and Community Right-to-Know Act of 1986
FERC	Federal Energy Regulatory Commission
FRAC Act	Fracking Responsibility and Awareness of Chemicals Act
GECF	Gas Exporting Countries Forum
GSGI	Global Shale Gas Initiative
HAP	Hazardous air pollutants
IOGCC	Interstate Oil and Gas Compact Commission
IRP 2010	Integrated Resources Plan
LNG	Liquid natural gas
MERC	Morgantown Energy Research Center
MHSA	Mine Health and Safety Act (1996)
MPRDA	Mineral and Petroleum Resources Development Act (2002)
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act (1998)
NEMWA	National Environmental Management Waste Act (2008)
NEPA	National Environmental Policy Act of 1969
NERSA	National Energy Regulator of South Africa
NFS	National Forest System
NIMBY	Not-in-my-backyard
NORM	Naturally occurring radioactive materials
NWA	National Water Act (1998)
OSHAct	Occupational Safety and Health Act of 1970
PASA	Petroleum Agency of South Africa
PUC	Pennsylvania Public Utility Commission
RCC	Railroad Commission of Texas
RCRA	Resources Conservation and Recovery Act of 1976
SDWA	Safe Drinking Water Act of 1974
SRBC	Susquehanna River Basin Commission
STRONGER	State Review of Oil and Gas Environmental Regulation
TCEQ	Texas Commission on Environmental Quality
Tcf	Trillion cubic feet
TDS	Total dissolved solids
TKGA	Treasure the Karoo Action Group
TSCA	Toxic Substances Control Act of 1976
U.K.	United Kingdom
U.S.	United States of America
USFS	United States Forest Service
VOC	Volatile organic compounds

CHAPTER 1: Introduction

1.1 Introduction

"Energy policy affects everything we do, from issues of national concern such as national security, economic development, and sustainability, to more mundane aspects of our daily lives such as our access to power and fuels and the effect on our immediate environment" (WEC, 2011: 5). At present South Africa is facing a rather controversial energy policy issue, namely shale gas extraction as a potential and alternate energy source. In recent years, shale gas has become a popular and highly profitable energy resource in the United States of America.

"The dominant fuel in the world fuel mix has gradually shifted from wood to coal to oil over the past 150 years, with gas the latest fuel to grow rapidly. At this rate gas may overtake oil as the dominant fuel by 2020 or 2030" (Ridley, 2011: 31). Based on the example of the United States of America, such predictions may not be as far-fetched as one previously may have thought. Bearing this emerging and apparent energy shift in mind, it becomes of the utmost importance to investigate and discuss South Africa's situation, particularly in light of claims of significant gas finds beneath the greater Karoo regions of the country by major multinational corporations, such as Royal Dutch Shell, Bundu Oil & Gas and Falcon Oil & Gas.

1.1.1 What is shale gas?

According to the Department of Mineral Resources (2012 (a):17):

> "Shale gas is hydrocarbon gas extracted from shale [a sedimentary rock comprised of fine-grained particles, with characteristically low porosity and permeability], as opposed to conventional reservoir rocks such as sandstone or limestone, or from other unconventional reservoir rocks, such as coal or tight…sandstone."

Shale rock commonly contains minerals such as quartz and clay, among others. As with the above reference to 'conventional' and 'unconventional' rock, so too can different types of natural gas be divided into these categories.

Conventional forms of natural gas can generally be extracted by drilling into reservoirs of rock. In these types of reservoirs, the gas can migrate to the well and (through the well that has been drilled) up to the surface with relative ease and in a free-flowing manner. Unconventional gas, however, "refers to gas extracted from formations where the

permeability of the reservoir rock is so low that gas cannot easily flow…or where the gas is tightly absorbed and/or attached to the rocks" (Kuhn & Umbach, 2011: 11). "The low permeability means that the only way to produce gas is by fracturing the rock further" than the natural cracks and fractures that are already there (WEC, 2010:12). Shale gas and shale rock both fall within the 'unconventional' category. However, not all types of shale are suited for the purpose of shale gas extraction.

1.1.2 How is shale gas extracted?

Shale has traditionally been neglected by many oil and gas companies who have considered it to be sealing layers of rock that were just passed through by drillers in search of other conventional energy resources. As a consequence, the techniques that were required to exploit shale gas were also neglected and development of that technology lacked stimulation. Due to low productivity and small-scale rewards, drillers often sought out larger-producing formations requiring less-intensive exploration and drilling efforts (Kuhn & Umbach, 2011:13). Thus "new exploration and development technology changed the picture and made unconventional shale gas recoverable in areas previously thought to be infeasible and economically unrecoverable" (Kuhn & Umbach, 2011:13).

While now, through the development and application of technology, hydraulic fracturing has become an integral part of shale gas exploitation, it must be noted that the process itself is not unique or new to the shale gas field. According to the Department of Mineral Resources (2012 (a):19-20), hydraulic fracturing is often used for onshore production in the upstream petroleum industry for coal-bed methane or even groundwater exploitation, but can also be done offshore. In the USA, George and Johnny Mitchell, after many years of trying to find a solution to the problem of how to "liberate and extract plentiful supplies of 'locked away' impermeable shale gas", eventually achieved their goal by combining two previously known technologies (Kuhn & Umbach, 2011:14).

"[By] melting together two key technologies—horizontal drilling and 'slick water' hydraulic fracturing—they finally cracked the shale rock and thus cracked the code for opening up major North American shale gas resources" (Kuhn & Umbach, 2011:14). This discovery would ultimately act as a game changer for unconventional gas, not only for North America, but on a global level. In terms of drilling, the horizontal technique opens up a much larger area of the shale reservoir and brings more of the formation in contact with the wellbore which will take the gas to the surface. Equally, producing equivalent outputs while operating

at roughly a quarter of the costs, and with a far smaller footprint than that of vertical drilling operations, hydraulic fracturing appeared to be an ideal technical option to pair with horizontal drilling.

Hydraulic fracturing was first used in the 1940s, in the oil fields of Texas, as a means of artificially stimulating oil wells (Kuhn & Umbach, 2011:14). According to The Royal Society and The Royal Academy of Engineering (2012:9), "additional stimulation by hydraulic fracturing (often termed 'fracking') is required to increase permeability [of shale formations]." After identifying a suitable drill site, a well hole is drilled and cased. Explosive charges are fired down the well to perforate holes at various intervals within the shale rock, an area called the 'production zone'. A mixture of water, chemicals and sand (referred to as 'fracking fluid') is then injected into the well at high pressure. This pressure is greater than what the shale rock can withstand, and thus tiny fractures (cracks) are formed in the rock surrounding the well. These fractures are kept open by the sand particles, thereby allowing the shale gas trapped within the rock to flow into the well and back up to the surface once the well has been depressurised. Furthermore, the fracking fluid that was originally pumped into the well returns to the surface and is referred to as 'flowback water'. This flowback water "also contains saline water with dissolved minerals from the shale formation… Fracturing fluid and formation water returns to the surface over the lifetime of the well as it continues to produce shale gas" (The Royal Society and The Royal Academy of Engineering, 2012:9).

1.2 Preliminary study and rationale

1.2.1 Aim of the study

According to IPAA (2012):

> "Around the globe a shale gas revolution is occurring, creating jobs, boosting economies, and redefining the international energy scope. From the United States to China, governments of all geographies are reassessing their energy portfolios, businesses are reallocating investments, and consumers are taking a second look at their energy bills. The shale revolution has taken hold of the global energy stage and has spread beyond."

In a report released by the U.S. Energy Information Administration (EIA) in April 2011, for the purpose of an initial assessment of shale gas reserves in 14 regions around the world, findings suggested that South Africa as a country is potentially sitting atop of the fifth largest shale gas reserves in world. The EIA has estimated that South African shale gas reserves hover around approximately 485 Tcf (Trillion cubic feet) of technically recoverable shale gas

reserves (U.S. EIA, 2011 (a):4). Consequently, South Africa too has, over the last year or two, been faced with having to evaluate the possibilities that this potential energy resource could hold for the country, its economy and its energy policies. This contemporary issue continues to be a contentious one for South Africa.

This thesis aims to conduct a single-case research study on the shale gas industry in the United States of America, regarding the regulation of shale gas extraction for the purpose of drawing policy lessons for South Africa on possible shale gas extraction in the Karoo, by asking: "*What policy lessons can the South African government draw from the United States of America's regulation of shale gas extraction?".*

Boersma and Johnson (2012:570) find that:

> "The forced release of shale gas, once thought a pipe dream, has turned into a piped reality: an economic boon for producers, a research bonanza, a massive headache for regulators and a hotly debated political topic, which has pitted environmentalists against industry and those who see in shale the long-elusive goal of energy security for the United States [and other countries too]."

The reality that this 'research bonanza' presents is that it holds so much practical relevance for South Africa and stands to act as a policy challenge for policy makers in the country. Studies in this field have been conducted from economic and geological perspectives by South Africans in the past. However, to present knowledge, very few academic studies on shale gas from a policy perspective have been written by South Africans, especially from a lesson-drawing or policy learning stance (Twine, 2012; Van Tonder, 2012). The focus has instead been more environmental or geology oriented. Furthermore, existing comparative shale gas research has not been specifically conducted on or for the South African case. It is therefore critically necessary, in both academic and policy terms, that such research be conducted.

By drawing lessons from a country that has had to contend with shale gas extraction in a different setting, in particular the United States of America, its policy programmes may potentially serve to help the South African government with its own policy decisions on shale gas extraction. These policy lessons may help to inspire the development of new programmes, tailored and suited specifically to South Africa's case, which might not otherwise have been considered. By drawing on these, the South African government will be able to develop a plan of action which would allow it to reap as many benefits as possible from shale gas extraction, if so chosen, or otherwise protect the country's interests in the best

way possible. Furthermore, a set of policy recommendations centring on these lessons can be formulated, to serve as a guide for the South African government towards achieving the best possible outcomes for the extraction and exploitation of shale gas. This aspect serves to highlight the practical relevance of the study, particularly for South African policy makers.

Based upon the findings of this author, it would appear that the theoretical application of Richard Rose's approach to policy learning, in the form of lesson-drawing, has not been widely adopted for the purpose of policy research on shale gas in the South African context. In utilising said approach, this thesis will serve not only as an informative and new application of policy theory in South Africa, but possibly also to further shale gas policy research as an academic research theme. It must be noted that it is hoped that applicable shale gas policy lessons will serve primarily to lay the foundation for potentially useful contributions to academic literature and policy research in South Africa. By adding valuable policy-specific academic research to the general South African academe, through its availability, this will allow for policy makers in government to potentially draw upon sound academic research to draw policy lessons for shale gas extraction in the South African context in the numerous ways discussed above.

1.2.2 Rationale

In the words of Matt Ridley (2011: 5):

> "…the detection and exploitation of shale gas has been described as nothing less than a revolution in the world energy industry, promising to transform not only the prospects of the gas industry, but of world energy trade, geopolitics and climate policy."

The natural gas obsession that has taken over the United States in the last ten years has quickly flared into an international issue and trend, with numerous countries around the globe embarking on the process of establishing the whereabouts of natural gas reserves.

One among the largest of these shale gas reserves has been suggested to be located deep beneath the Karoo. In South Africa, Petroleum Agency SA has therefore granted permission to three foreign oil and gas companies—Royal Dutch Shell, Bundu, and Falcon Oil & Gas—which allow for the exploration of shale gas in the greater Karoo region of the country (Econometrix, 2012:17). "The first stage of such exploration takes place under an arrangement known as a Technical Cooperation Permit (TCP) with government and consists of nothing more than desktop research" (Econometrix, 2012:17). In an effort to press on with

its application for exploration rights submitted to the Petroleum Agency of South Africa (PASA) in December 2010, Royal Dutch Shell enlisted the assistance of Golder Associates to compile an Environmental Management Programme (EMP) and carry out a public consultation process with the interested and affected parties, in accordance with the stringent constraints laid down by the application process.

"In April last year [2011], Minister of Mineral Resources Susan Shabangu announced a general moratorium on hydraulic fracturing ("fracking") in South Africa" (Glazewski, 2012: 9). Albeit temporary, this would halt application processes for the investigation of potential shale gas reserves and their extraction in the Karoo Basin (Glazewski, 2012:9). In light of the abundance of negative press that has surfaced in response to extensive fracking for shale gas in the USA, and elsewhere in the world, Cabinet responded to pressure and concerns of various South African factions by means of the moratorium, at the same time promising to conduct a multi-disciplinary investigation on fracking to research fully all of its potentially related implications. A special task team was set up for this purpose. In August 2011, Minister Shabangu extended the moratorium for a further six-month period, yet by February of 2012 there were still no report-backs from the task team or any further discussion on extending the moratorium again.

In May of 2012, former Minister of Energy Dipuo Peters, expressed support for South Africa to engage in fracking for shale gas in the greater Karoo regions of the country. She has been quoted as saying that: "We cannot allow a blessing to lie fallow. If shale gas is one of the blessings, we are going to go for it" (Mail & Guardian, 2012). She went on to say that she hoped the pending Cabinet report would confirm estimated reserves and allow extraction thereof as this would benefit the people of South Africa (AllAfrica, 2012).

At the beginning of September 2012, Cabinet finally reported back on its decision regarding the future of shale gas extraction in South Africa. Upon review of the task team's report on fracking, Cabinet made the decision to lift the moratorium on shale gas extraction. Now, more than ever, as speculation turns to reality, it becomes clear that learning policy lessons from other countries about shale gas needs to be done in light of the green light being given to oil and gas companies interested in the Karoo. As much care has been taken to delay the process and decision for such a prolonged period, it would appear fitting that a great deal of care and effort should be put into learning how to develop shale gas extraction methods in South Africa in the best and most responsible manner.

Much of the research on shale gas in South Africa has focused on the negative environmental impacts that have been experienced elsewhere, most notably in the USA. The responses by the Treasure the Karoo Action Group (TKGA), for example, are a good case in point. Consequently, many NGOs and environmentalists alike have joined others on the 'not-in-my-backyard' (NIMBY) bandwagon and have unleashed a wave of discontent over the possibility of shale gas extraction and exploitation taking place in the Karoo (SABC, 2011). Only a handful of reputable reports have been written either by South Africans or about the South African case; in particular the Econometrix report, compiled by the late Tony Twine, which was released in early 2012 comes to mind. This 'special report', however, focuses mainly on the various economic considerations that come with the possible exploitation of shale gas reserves in the Karoo. While these considerations are of great importance to policy makers in the South African context, there are far more lessons that can be learned from other countries in similar shale situations than what these limited number of reports offer the policy makers and government of this country.

Impact of U.S. shale gas development across nations

Shale gas developments have had wide-reaching effects on global energy markets, as well as on the North American natural gas supply situation (James A. Baker III Institute for Public Policy, 2011:1). "It has had a ripple effect around the globe, not only through displacement of gas supplies in global trade but also by fostering a growing interest in shale resource potential in other parts of the world" (James A. Baker III Institute for Public Policy, 2011:1). This being said, the impact that shale gas is having on a global level cannot be ignored. The fact that one country's shale gas supply has had such a widespread influence on global energy markets, hints at the 'power' that this energy source yields. Having discovered potentially vast sources of shale gas in the Karoo, South Africa, and any other country finding itself in a similar position, cannot afford to ignore the opportunities that shale gas presents with its constant classification as a 'game changer'.

Other shale-rich countries such as China, Poland, Canada and Australia face a steep learning curve (Energy Source, 2012). Before development of their resources in a similar vein to the U.S. can become a reality, awareness of "long lead times, high capital and operational costs, necessary price environments to attract investment, and the importance of overcoming regulatory and environmental constraints" is necessary (Energy Source, 2012). As shown here, these and other countries have begun to realise that, in order to even consider shale gas

exploitation as a reality, there is both much to be done and much to be learned before this will become a true possibility. Countries like the United States of America can in this sense and context serve as case studies for shale gas policy lessons to be drawn from, providing lessons on regulatory frameworks, technology and best practices, to name but a few examples.

Importance of potential policy lessons for shale gas in South Africa

In spite of the rapid expansion of shale gas in the U.S., elsewhere in the world its development is still in the early stages. Much of the international research that has been conducted on shale gas discusses the implications for shale gas policy, mentioning such policy issues as environmental impacts, health and safety, water contamination, economic impacts, and others (Sakmar, 2011; An Unconventional Bonanza, 2012; Boersma & Johnson, 2012).

The kind of attention that has been given to shale gas opportunities in other countries and regions around the world should also be given to South Africa, because this kind of research and information is invaluable. The negative consequences that have been experienced abroad as a consequence of shale gas development and extraction could be avoided locally, to a certain degree, by reflecting on the kind of information that is presently available, for example, in the U.S. If policy lessons can be learned from other countries and which herein it is argued that they can, South Africa should by all means be investigating and interpreting these policy lessons considering the potential impact that they may hold for the potential development and extraction of shale gas in the country.

People across the world are still in the process of learning about shale gas extraction and exploitation, both in industry and policy contexts. There is still great uncertainty, on a global level, surrounding shale gas, with much deliberation on what should and should not be done and how shale gas opportunities should be dealt with. This research will be contributing to the on-going debate occurring on both national and international levels; a debate in which the contribution of South African research, both in terms of quantity and quality, appears to be severely lacking.

Conditions for easy replication of the U.S. shale gas industry might not exist in other countries yet, and may take approximately five to ten years to achieve. For this reason the USA is the primary case, on a global level, in terms of all things natural gas and shale gas-related, especially since the so-called shale gas revolution emerged out of that country.

"Developments in this unconventional gas sector in America are likely to set the tone [for] other countries… [and places] the U.S. is far ahead of the rest of the world in exploiting this energy source" (Energy Source, 2012).

South Africa at present does not have the kind of regulatory environment necessary for achieving the most benefits possible from shale gas. However, by drawing on clear lessons from foreign cases, and gaining new knowledge and perspectives that could be applied to and even inspire the development of unique programmes and policies, these shale gas benefits could be realised successfully.

1.2.3 Literature review

Policy learning and lesson-drawing

Authors such as Stone (1999) have highlighted the point that the concept of 'learning' in the field of public theory is often over-theorised, with no shortage of available concepts and definitions. 'Policy learning' is often used interchangeably with other concepts such as Richard Rose's 'lesson-drawing' or Dolowitz and Marsh's 'policy transfer' (Stone, 1999). This over-theorisation in many instances leads to difficulty in operationalisation. The significance of this 'definitional ambiguity' is that it highlights the fact that even though authors in the same field are utilizing the same terms to describe what they view as policy learning, they each have a different notion of what learning is. What one must do in order to determine which of these definitions and concepts of policy learning is most applicable to one's own research, is to break each concept down (Stone, 1999).

Based upon this analysis, the theoretical basis of this thesis will rest upon the work of Richard Rose and his concept of lesson-drawing as policy learning. "Rose [is] concerned with learning which affects instruments and program[me]s adopted by governments to implement policies… [and] focus[es] on the activities of members of domestic and transnational policy subsystems in this learning process" (Bennett & Howlett, 1992:285).

Rose (2005:42) also suggests that it is common and equally easy for countries to turn to their likeminded neighbours or friends to learn and borrow from, with the potential consequence of limited stimulus. However, rather than opting for the 'comfortable' and 'familiar' option, Rose suggests turning instead to places where you might find something 'useful', albeit under challenging or unfamiliar circumstances. Rose (2005:42) observes that:

> "The programmes of countries that are unfamiliar are more likely to offer fresh and challenging insights precisely because they are distant and different. …Given the plenitude of places to look for lessons there is no one best country as a source of ideas for programmes. Where you look should follow from what you want to learn."

This having been said, it becomes clear that an investigation is necessary to assess whether or not there are any valuable policy-related lessons to be learned from other countries with shale gas reserves, so as to determine what the best and worst practices and regulations concerning shale gas extraction by means of hydraulic fracturing are. Based upon the further evaluation of the regulation of shale gas extraction in the U.S., a set of policy lessons can be put together in the hope of leading South Africa on the optimal path towards achieving the best possible outcomes from embracing this shale gas venture.

The applicability of lesson-drawing to shale gas extraction policy

The tools and methods set out in the lesson-drawing approach to policy learning stand to lay the foundation for policy learning and lesson-drawing regarding the methodology of shale gas extraction in South Africa. Through their application, South Africa will have the means to begin its process of policy learning on shale gas extraction and development. Lesson-drawing, through identifying specific transferable lessons and by highlighting policy ideas and actions which were unsuccessful elsewhere, potentially stands to lay the foundation for providing at least some guidance on how to approach the regulation of the shale gas phenomenon. It will also potentially provide guidance on how to learn in a different, yet accepted, manner in the field of policy learning.

Rose (2005) advocates the use of models and policy programmes to draw policy lessons from foreign cases. Anecdotes from active policy programmes inform policy models from which policy lessons are ultimately drawn. Rose (2005:80) also advocates learning from the failures of other policy programmes to inform lesson-drawing as "they can be stated as maxims about what you should *not* do". However, this thesis applies Rose's lesson-drawing approach to policy learning in a novel way. It entails using it instead as a starting point for lesson-drawing, thereby choosing rather to learn from the regulation of shale gas extraction and development in the U.S. and the failures thereof, as opposed merely adhering to policy programmes and models. This will allow for lesson-drawing on regulation, which it is hoped will inform policy development on shale gas extraction and development in South Africa, which is presently sorely lacking.

Are lessons already being drawn?

At present, due to the differing nature and circumstances that exist in each of the different major shale gas formations across the USA, it appears that internal lessons are already being learned and drawn between both the shale gas formations themselves and between the different states in which they are located. Examples of this inter-state and inter-play learning can be seen between formations such as the Barnett Shale, Fayetteville Shale, Haynesville Shale and the Marcellus Shale. In particular, due to its long history of oil and gas production, the Barnett Shale has been a key source of regulatory and practical lessons for shale gas and hydraulic fracturing in other states and shales within the U.S.

Lesson-drawing on the regulation of shale gas and hydraulic fracturing is also happening on an international scale between the U.S. and other countries. For example, with its high shale gas prospects, a number of reports have been written on shale gas in the U.K. These reports cite concerns and lessons from countries such as the United States of America, together with other European countries, regarding what they could stand to learn about their shale gas development and ventures (Kuhn & Umbach, 2011; Moore & Less, 2012; The Royal Society and The Royal Academy of Engineering, 2012). For example, The Royal Society and The Royal Academy of Engineering (2012) have released a report which discusses what can be learned from environmental concerns and regulatory issues in both the USA and Europe.

Impacts on the global energy mix

Many predictions have been made in terms of energy security and the global energy mix regarding the projected increased role to be played by natural gas. The rise of shale gas has played a major role in this projected change in the future (and current) global energy mix. Projections of even further shifts in global consumption and energy prices than that experienced with surplus liquid natural gas (LNG) supplies are being expressed in relation to the future role of shale gas in the global energy arena. While both the benefits and the costs of shale gas production in the U.S. on global energy prices have already been witnessed, "the negative externalities of shale gas are still largely not understood" (Boersma & Johnson, 2012:374). Consequently, the big question is whether or not it is possible for shale gas to be developed in an environmentally responsible manner, leaving these costs to be "weighed against the current energy mix" (Boersma & Johnson, 2012:374).

1.3 Research design and methodology

This qualitative thesis will combine both descriptive and explanatory methods of policy learning through the use of a single-case, embedded case study. An embedded case study occurs within a single case when "attention is also given to a subunit or subunits… For instance, even though a case study might be about a single public program[me], the analysis might include outcomes from individual projects within the program[me]" (Yin, 1984:44). The subunits studied in this thesis are regulations on shale gas extraction in the U.S. at federal, state and local levels of government.

The United States of America is a unique case when it comes to shale gas policy and development, the most advanced case, globally speaking. "In cases where there are no other cases available for replication, the researcher can adopt a single case design. …The drawback of a single-case design is its inability to provide a generalising conclusion, in particular when the events are rare" (Zainal, 2007:2). To combat such drawbacks, the single-case design will be used in combination with Richard Rose's lesson-drawing approach, allowing for broad lessons to be drawn from context-specific cases and thus increase the range of applicability, in spite of its unique origins.

The focus of the case study is the shale gas policy programmes of the United States of America. As mentioned above, in particular, in spite of the single-case, due to the nature of and potential for evaluation of sub-units, an embedded case study design will be adopted. Again it must be emphasised that, "even though a case study might be about a single public program[me], the analysis might include outcomes from individual projects within the program[me]" (Yin, 1984:44). In the context of this thesis, this translates into analysis of the U.S. shale gas industry as a whole, with outcomes based upon the analysis of regulation of shale gas extraction at federal, state and local levels of government. This, in combination with Rose's lesson-drawing research design, allows one to conduct a thorough analysis of the broader case, while highlighting important issues and subunits of analysis which might otherwise have been overlooked when using other methods. These subunits, together with *specific* transferable policy lessons, allow for an exceptionally focused look at the problem at hand, which will ultimately be greatly beneficial in terms of policy learning for shale gas in South Africa.

This thesis will make use of qualitative research methods, allowing for greater flexibility in research and a more non-linear research path. This being said, a number of qualitative

research methods and data collection techniques were used. In terms of primary sources of research, various forms of documentation were used including: academic journals; reports of official proceedings such as U.S. government proceedings; U.S. policy programme documents; U.S. government statements, speeches and announcements, agendas, written reports of events and minutes of relevant meetings; other U.S. administrative documents, including proposals and progress reports; formal studies and published reports, masters theses, unpublished conference papers, and various media articles and news publications. Furthermore, geographical charts and maps of particular areas were also used for research purposes. Over and above these methods of data collection, the 'Shale Southern Africa Conference' was attended on 26-27 March, 2012, in Cape Town, in addition to a public meeting on the shale gas issue in South Africa hosted by Golder Associates and attended by Shell South Africa and other key stakeholders at Kelvin Grove in March, 2011, for the benefit of the author in terms of developing greater background knowledge on the issue.

The sources mentioned were accessed primarily through the internet. In particular, a large volume of government documentation and reports are in fact available for public access through U.S. government websites, both on the national and sub-national levels. Thus, U.S. government departments act as a good source of knowledge on the regulation of shale gas extraction and development at different levels of government in the U.S. Together with this, academic journals were accessed.

1.4 Limitations

With the various qualitative research methods that will be used, come a number of potential problems and limitations. Concerning the use of primary sources of data, such as documentation and archival studies, the issue of access to data comes to the fore. In acknowledging that due to the somewhat 'sensitive' nature of some of the proposed sources of documentation, such as U.S. (and in some instances South African) government documents, access to some of this documentation may be limited through controlled internet access. The same applies to some academic and published reports and studies that have been compiled and released on a restricted basis. To combat these limitations, authorisation available through the JS Gericke Library at Stellenbosch University was used, where possible, so as to gain access to electronic databases and journals for cases of restricted access to sources.

Furthermore, in light of the fact that certain data collection methods, such as interviews and travelling abroad to study the processes first hand, were not be used for the purpose of this thesis, it may be argued that this somehow limits the scope. However, while it is acknowledged that there might be some substance to this interpretation, due to the lack of necessary funding, time and the scope of the study, these kinds of data collection methods were unable to be conducted. However, these have not been disregarded, and have been considered for the purpose of further studies on the matter at hand, particularly for the purpose of a PhD study in shale gas policy.

1.5 Structure of the study

This chapter introduced the aim of the study, as well as the scope of research and theoretical framework. Chapter two unpacks the theoretical framework used for this study. The focus of this chapter is on the state of research on shale gas and potential developmental implications for the global energy mix, major debates in the literature on policy learning, and Richard Rose's lesson-drawing approach to policy learning. Chapter three presents an overview of the research design and methodology of this study, discussing case study design, documentation review and lesson-drawing as an analytical tool, as well as thematic analysis. Chapter four presents the case of regulation of shale gas and hydraulic fracturing in the U.S. This chapter focuses on regulations and regulatory agencies at federal, state and local levels of government, as well as implications of regulatory exemptions, and furthermore discusses the conflict of regulatory authority over shale gas extraction and development in the U.S. between various levels of government. Chapter five is divided into two sections; the first of which discusses the regulatory challenge of potential shale gas resources in South Africa. The second section presents and expands upon the relevance of the policy lessons on the regulation of shale gas and hydraulic fracturing extracted from the U.S. case that were highlighted in chapter four. Finally, chapter six is a conclusion and a general summary of findings.

CHAPTER 2: Literature Review

2.1 Introduction

This chapter introduces the discourse on policy learning and lesson-drawing. In so doing, this chapter defines and unpacks the theoretical frameworks and related concepts, as discussed in the literature on policy learning and lesson-drawing, that will be used to ascertain what policy lessons on the regulation of shale gas extraction the South African government can draw from the United States of America.

The chapter is organised into three main sections. Section one discusses the state of research on shale gas as well as some of the developmental implications that shale gas development holds for the global energy mix. Section two focuses on and unpacks the major debates within policy learning literature among theorists in the field. Finally, section three discusses Richard Rose's lesson-drawing approach to policy learning and the applicability of the approach to study the regulation of shale gas extraction.

2.2 The state of research on shale gas and developmental implications for the global energy mix

According to the World Energy Council (2010), there are over 688 recorded shales worldwide, located within 142 identified basins. It is said that "only a few dozen of these shales have known production potentials, most of those are in North America. This means that there are literally hundreds of shale formations worldwide that could produce natural gas" (WEC, 2010:3). In a world where good news about energy is often hard to come by, the dramatic rise in estimates of unconventional natural gas sources should not be ignored and rather taken as a possible sign of a shift towards a better global energy situation in the not so distant future. This is a consequence of the potential shifts arising out of an increased role to be played by natural gas, and more specifically shale gas, in the global energy mix, with even further implications for energy security and shifts in monopolies on an international scale.

2.2.1 Previous academic research on shale gas

Many studies on shale gas are in the process of being conducted across the United States of America and the world, both academic and state funded. Private and corporate-funded research is also being conducted. In the United States alone, shale gas research, from both policy and geological perspectives, is being researched at universities such as the University

of Maryland, Duke, University of Texas Energy Institute, Rice University Baker Institute and Cornell University, to name but a few. These research projects cover themes ranging from U.S. energy policy to green-house gases and the effects of hydraulic fracturing. However, not all of this is available as published research as yet, due to the fact that this research is still being conducted.

In the USA, state-funded research is also being conducted by the U.S. Environmental Protection Agency (EPA). Six months after the FRAC Act was presented in December 2009, "the U.S. House of Representatives Appropriation Conference Committee recommended that a focused study was needed [for] analysing the relationship between hydraulic fracturing and drinking water" (Sakmar, 2011:410). It was suggested that the study be conducted by the EPA, who agreed with the necessity, due to the environmental concerns and because the findings could be used to inform decision making (Sakmar, 2011:410-411). The preliminary outcomes of this study were expected to be released at some stage during 2012, while the final findings are only due to be released in 2014.

At the University of the Witwatersrand a PhD student in the School of Geosciences is currently completing her study on the geophysical, 3D-modelling of the Karoo Basin in an attempt to discover whether or not there are natural gas deposits (WITS University, 2012). Also, Professor Gerrit van Tonder, of the Institute for Groundwater Studies at the University of the Free State, is conducting research on potential groundwater contamination in the Karoo as a consequence of fracking for shale gas. In January of 2012, Econometrix released a report on "economic considerations surrounding potential shale gas resource in the southern Karoo of South Africa" (Twine, 2012:1). In particular, the report set out to discuss the potential economic opportunities that stand to arise if large shale gas resources are found in the Karoo.

Furthermore, the South African Water Research Commission, which "was established in terms of the Water Research Act (Act No 34 of 1971)…and aligns itself with national priorities" (South African Water Research Commission, 2013), is due to collaborate with the Cancer Association of South Africa (CANSA) in conducting research on water sources in the Karoo. The water analysis will be conducted at Stellenbosch University's Central Analytical Facilities, and testing was hoped to have begun in January 2013 for the purpose of studying the potential environmental impacts that fracking might have on the Karoo (van Schie, 2012).

Finally, the South African Department of Mineral Resources has released the full report on fracking to the public in September 2012. A Task Team on Shale Gas and Hydraulic Fracturing was formed to conduct a study for the South African government which aimed "to evaluate the potential environmental risks posed by the process of hydraulic fracturing as well as the negative and positive social and economic impacts of shale gas exploitation" (Department of Mineral Resources, 2012 (a):1). The primary findings of the report were to allow hydraulic fracturing for shale gas in South Africa and to create a monitoring committee, as well as to augment and amend current regulation, in order to develop a set of appropriate regulations for hydraulic fracturing and shale gas related tasks.

Some trends in research on shale gas have been highlighted here. As mentioned, the main perspectives from which this research has been conducted include geology, environmental studies, a specific focus on hydraulic fracturing techniques and processes, energy policy, and economics. With particular emphasis on South Africa, it must be noted that there have been no other significant policy reports relating specifically to South Africa, other than that released by the Department of Mineral Resources in 2012. One clear and important distinction between all of the abovementioned research and the research proposed in this study is the lack of concrete policy lessons being drawn from other countries for specific application and consideration by the South African government for the matter of shale gas extraction in the Karoo.

This study stands apart from other research on shale gas extraction because it applies to the work of Richard Rose on lesson-drawing to shale gas extraction as a policy issue in South Africa. Through its application in this study, it is suggested that the potential exists to obtain policy lessons and advice from the United States of America and its vast shale gas experience, which can then be applied specifically to South Africa. Particularly for a country that is new to shale gas extraction, this kind of valuable research appears to be somewhat absent in the field. As a consequence, this study stands to provide for a foundation for policy learning on shale gas extraction and development to ensue, which might one day contribute towards apposite policy development on the matter in South Africa.

2.2.2 Evidence of other cases of lesson-drawing on shale gas extraction

Lessons between states in the USA

There are different types of lessons that stand to be drawn from shale gas development and hydraulic fracturing. The first example is of lessons that are being drawn internally within the U.S. The Barnett Shale play in Texas was the first of the major plays to be exploited in the USA. "Because this shale play is starting to mature natural gas producers have been looking to extrapolate the lessons learned in the Barnett to the other shale gas formations present across the United States and Canada" (Sakmar, 2011:383). Also, due to the fact that the Barnett shale play is one of the original modern shale plays, it served as the 'testing grounds' for proving that new fracking techniques—combining horizontal drilling with hydraulic fracturing—could set in motion economical and successful shale gas development, which could potentially be replicated elsewhere.

In 2009, the U.S. Department of Energy Office of Fossil Energy National Energy Technology Laboratory released a primer on modern shale gas development in the U.S. The report, in discussing and describing the various shale gas plays that stretch across the USA, alludes to influence that the different plays have on one another (U.S. Department of Energy Office of Fossil Energy National Energy Technology Laboratory, 2009). Similarities do exist between the shale plays, as highlighted by the report, and not only is it suggested that great potential exists for lessons to be drawn between both states and plays, but interestingly the report does refer to cases where lessons have already been drawn (U.S. Department of Energy Office of Fossil Energy National Energy Technology Laboratory, 2009). Similar to Sakmar (2011), this report too refers to the Barnett Shale as having "been a showcase for modern tight-reservoir development typical of gas shales in the U.S" (U.S. Department of Energy, 2009:18).

In northern Arkansas and eastern Oklahoma, based upon the successful development of the Barnett Shale as well as age and geologic parallels drawn between them, development of the Fayetteville Shale commenced in the early 2000s (U.S. Department of Energy, 2009). Equally, drilling and development in the Marcellus Shale and the Woodford Shale have been adapted to follow the success of the Barnett Shale. Lessons still stood to be learned from the Albany Shale in Illinois, Indiana and Kentucky due to the thinner nature of these plays and different water usage, which has also been seen in the Antrim Shale in Michigan (U.S. Department of Energy, 2009).

A study done by the Nicholas Institute for Environmental Policy Solutions and Nicholas School of the Environment at Duke University was conducted in 2011 on shale gas extraction in the state of North Carolina, considering what shale lessons could potentially be drawn from other U.S. states in their decision of whether or not to engage in shale gas development in the state (Plikunas, Pearson, Monast, Vengosh & Jackson, 2011). No active sites for oil and gas production are located in North Carolina at present, and consequently there is no real comprehensive regulation or framework for the oil and gas industry. However, the laws that do exist create a *de facto* ban on fracking, because injections of waste products into the ground and horizontal drilling techniques have been banned for a many years. According to Plikunas *et al* (2011:3):

> "…if North Carolina lawmakers choose to create a regulatory structure for shale gas extraction, they have the opportunity to address potential environmental, health, and safety risks at the outset. The experiences of other states can provide valuable insight into the risks that accompany this activity, and the policy decisions that other states have made in an attempt to mitigate those risks can inform North Carolina lawmakers as they consider whether and under what conditions to allow shale gas extraction."

Lessons between countries

According to Rahm (2011:2974), "the U.S. may be a bellwether for other parts of the world". Countries such as Germany, Poland, Romania and Hungary are in discussions with major oil and gas companies over applying hydraulic fracturing to their own shale gas reserves (Rahm, 2011:2974). "The U.S. government is encouraging this effort by establishing partnerships with other countries. In November of 2010 the U.S. entered into an agreement with China called the U.S.–China Shale Gas Resource Initiative, and a similar partnership has been created with Poland" (Rahm, 2011:2974).

An Unconventional Bonanza (2012) reported that China is making some progress in its shale gas development project by making attempts to learn from the USA and major oil and gas companies that are either American or are in operation in the country. Furthermore, Butkiewicz (2012:1) discusses that other Asian countries such as Japan and South Korea are "looking toward North America to diversify their energy imports [through shale]", as they struggle to meet their own energy demands.

As mentioned above, Poland has also begun developing and fostering relationships with U.S. and Canadian companies to aid their shale development. According to Kluz (2012):

> "Strict EU [European Union] regulations regarding environmental issues and water do not support the growth and development of the shale gas industry. The EU Commission has shown no willingness to invest in R&D for shale gas, arguing that the market should develop shale gas."

Therefore, by building these partnerships with U.S. and Canadian companies, not only can shale lessons be drawn directly from each country, but bringing the necessary technology and infrastructure to the country will certainly aid in speeding up the development process in Poland. Furthermore, Kluz (2012) goes on to state that "Poland has the potential to become a global shale gas expert, transferring its knowledge to countries around the world," indicating the potential that this specific learning process and relationship could hold for the benefit of even more countries in the future.

In a study done on India's preparedness and capacity to embrace the shale gas revolution, Negi, Pahwa & Arora (2012:1) have attempted to draw shale lessons for India, based upon "the U.S. success story and the reservations expressed by [a] country like France…with a view to evolve the way forward for India." Mention is made of the attempts by private Indian businesses to acquire stakes in American operations companies involved in shale projects to "help the Indian companies in becoming acquainted with shale gas exploration and production technologies…[which] will help them to implement the same in India in the future" (Negi *et al*, 2012:7).

Very importantly, the report by Negi *et al* (2012) concludes that, based upon aspects such as technical and physical resources, land access and regulations, sub-surface understanding, maturity of the gas market and gas evacuation infrastructure, the example of the shale gas revolution in the U.S. cannot necessarily be replicated, but there are most definitely lessons to be learned which will serve to provide references for the Indian oil and gas industry and shale gas developers. Interestingly, the report finds that "there are valuable lesson[s] to be learn[ed] from European experience[s] as India is more align[ed] to Europe than [the] U.S." (Negi *et al*, 2012:8). This is due to similarities, including barriers to water access and intensive use, very little experience and short time frame, relatively small oil and gas industries, and exploration activity by foreign and global oil and gas companies being only in the beginning stages.

Newman and Radhakrishnan (2012) have found that there are lessons on electricity generation that South Africa should be drawing from the U.S. shale gas example. They further suggest that shale gas could serve to act as part of the solution to the problem of

reducing South Africa's carbon emissions. In order to achieve its ambitious emissions reduction goals, South Africa will have to consider and find lower-carbon energy technologies, and shale gas might be the answer to this, hence the increased interest in the exploitation of South Africa's estimated shale reserves (Newman & Radhakrishnan, 2012).

The Royal Society and The Royal Academy of Engineering (2012) released a report on hydraulic fracturing and shale gas extraction in the United Kingdom. The report puts out a set of recommendations for U.K. shale gas policies, doing so by drawing lessons from U.S. environmental concerns. In particular, examples of improper operational practices and exemption of oil and gas companies and their practices from regulation were learned from. This has led to the development of recommendations on what to avoid in the United Kingdom. Freeman (2011) states that "The UK government has made it clear it wants to benefit from the practical and regulatory lessons learnt in the U.S." This will be done through exchanges between the U.K. Environmental Agency and U.S. Environmental Protection Agency (EPA) on best practices (Freeman, 2011). Furthermore, while their approaches may differ, "expertise, and regulatory issues that will arise will be similar to those encountered in the U.S.," and should therefore be learned from (Freeman, 2011).

The United States government in 2010 initiated a programme, called the Global Shale Gas Initiative (GSGI), to help other countries to transfer expertise and teach them about the shale gas industry, thereby taking "the lead in helping other countries find the right balance between energy security and environmental concerns" (Sakmar, 2011:373). Furthermore, the GSGI also aims to "share information about the umbrella of laws and regulations that exist in the United States…to ensure shale gas development is done safely and efficiently" (Sakmar, 2011:373).

Not only is the U.S. seemingly providing a wealth of knowledge and shale gas lessons to other countries, but other countries are also offering their knowledge in return. Jefferies (2012) conducted a study on lessons that Canada's Alberta oil sands can offer to the development of the Marcellus shale play in the USA. Jeffries (2012:116) cites such lessons as assessing the potential impact of extraction of resources before commencement and also "the need for legally mandated transparency and separation between the regulator and operator within the monitoring process" (Jefferies, 2012:110).

Upon analysis of the examples presented here, it is evident that the potential does exist to learn from other countries regarding shale gas extraction, especially from the U.S. However,

this study's approach to drawing policy lessons on shale gas extraction uses the lesson-drawing approach to policy learning. In this way, the study aims to discover what policy lessons can be drawn for the South African government from the U.S. regarding its regulation of shale gas extraction. By doing so, this research stands not only to lay the foundation for contributions to the South African shale gas case, but also for contributions to the global field of academic literature on shale gas extraction and development from South African authors.

2.2.3 Impacts on the global energy mix

In terms of the global energy market and energy security, a projected increase in the natural gas component of the global energy mix has been predicted (An Unconventional Bonanza, 2012). A surplus supply of LNG (liquid natural gas) has already seen shifts in consumption and prices on a global scale. "Shale, along with new finds of conventional gas, will allow many more countries to produce their own gas and make available gas for export from a lot more places, many of which are less difficult to deal with than some oil-producing countries" (An Unconventional Bonanza, 2012:15). So much stands to be gained from this natural gas revolution, but, at the same time, much remains to be learned.

"As pointed out, the U.S. unconventional gas success story has been a paradigm shift that has turned expectations upside-down. In essence, it has been a game changer for the emerging world gas market" (Umbach & Kuhn, 2011:42). According to Sakmar (2011:389), the transformation that has taken place within the U.S. gas market can be referred to as a shale gas 'revolution', which has had effects not just domestically, but in various regions around the world where unconventional gas potential has also been discovered. Deutch (2011:83) is of the opinion that it is an exaggeration to refer to a shale gas 'revolution', but be that as it may, the realisation of the revolutionary benefits depends upon how quickly political and economic systems can adapt to this change within the global energy mix and global energy market.

The realisation of the commercial potential of shale gas has brought focus back to the natural gas world. Discussions regarding the export possibilities of LNG *from* North America to other parts of the world and new markets that have opened up, have changed perceptions of North America from being a growing "sink for global natural gas supplies to becoming a [viable and potentially lucrative] source" (Medlock III, 2011:22). As natural gas becomes more widely available, the potential exists that as "more of it is traded, the regional gas markets that exist today may well merge into a more integrated and open international gas

market with a single price" (Deutch, 2011:82-83). Effects will be felt in both the global energy market and in the energy policy responses of different countries, however these changes will not be uniform (Deutch, 2011:82-82; 89).

In terms of implications of the natural gas boom on global natural gas trade, the effects will hardly go by unnoticed. In today's natural gas market, three main divisions exist—North America, Europe, and Asia. Unlike the region-related oil prices of the past, "natural gas is unlike oil, which is traded at the same price everywhere" (Deutch, 2011:86-87). If natural gas does exist in a technically recoverable state in the estimated quantities that the U.S. EIA and other organisations have predicted, then the impacts will not just be felt in these regional divides. Effects will be felt in individual countries too, the advantage of which is a domestic fuel supply in the form of natural gas, which enhances the energy security of individual nations (Kuhn & Umbach, 2011:42). "Development of unconventional gas reserves brings foreign direct investment (FDI), creates new jobs, and helps to diversify away from other imported fuels, or, as is in the case in the U.S., help the nation gain energy independence" (Umbach & Kuhn, 2011:42).

Regarding concerns over monopolies in energy markets, while there have been some fears and suggestions that the potential exists for the development of a natural gas cartel, some authors suggest that this is unlikely (Medlock III, 2011; DiPeso, 2011). According to Medlock III (2011:26), "increasing the elasticity of supply of natural gas in countries outside the GECF [Gas Exporting Countries Forum]…[reduces] the monopoly power that could be exerted by a cartel on the market." DiPeso (2011:102) suggests that "gas doesn't lend itself to cartel behaviour as easily as oil." The reasoning behind this is that with oil there is an almost monopoly in the transportation-energy market, thus providers are able to manipulate consumers who have no alternative but to buy fuel. However, gas is used largely for heating and power generation, which are markets in which other substitutes and alternatives are available. This, together with the fact that natural gas supplies are widely distributed across the globe, means that dependence on conventional and historical market leaders will decline.

While some have referred to shale gas as the new transition fuel, renewable energy and a game changer that brought about a natural gas revolution and a so-called potential age of natural gas, one would be remiss to ignore the factors that could prevent its ultimate realisation. In the end, however, one must remember that "the implications of shale gas

developments are substantial. In fact, it is likely that we are only beginning to fully understand what the innovations of the last decade have wrought" (Medlock III, 2011:28).

2.3 Major debates in policy learning literature

This section focuses on policy learning and unpacking the major debates within policy learning literature among theorists in the field. Within the field of policy learning, the concept of 'learning' has been interpreted in many different ways. Distinctions between 'policy transfer' and 'lesson-drawing' have, for example, been established within public policy vocabulary (Stone, 1999). These terms are nevertheless still used interchangeably, and sometimes inappropriately, by those writing about them. There are three major debates within policy learning literature that this author has highlighted. The first debate centres on the existence of subtypes of policy learning, the second debate focuses on disagreement over motivations for policy learning, while the third debate revolves around whether or not different approaches to policy learning can be grouped together or not.

2.3.1 Do subtypes of policy learning exist?

The first major debate in policy learning literature concerns the existence of subtypes of policy learning. This debate is multidimensional, with some sub-debates. The wider debate on subtypes of policy learning emerged out of a lack of definitional consensus surrounding the concept. According to Stone (1999:52):

> "'Policy learning' is yet another label connected with policy transfer, but this concept is analytically distinct. Here, the emphasis is on cognition and redefinition of interests on the basis of new knowledge which affects the fundamental beliefs and ideas behind policy approaches. …The objects of transfer can include (i) policies, (ii) institutions, (iii) ideologies or justifications, (iv) attitudes and ideas, and (v) negative lessons."

The concepts of 'policy transfer' and 'lesson-drawing' are often the two most prominent concepts being discussed in policy learning literature. In actual fact, both Stone (1999:52) and Bennett and Howlett (1992:288) suggest that the literature on policy learning, transfer and lesson-drawing is over-theorised. "There is, however, some danger in the casual interchangeability of 'lesson-drawing' and 'policy transfer'. Policy transfer is the broader concept encompassing ideas of diffusion and coercion as well as the voluntaristic activity of lesson-drawing" (Stone, 1999:52).

According to Page (2000:3), with 'policy transfer', the focus is "on the study of how policies in exporter jurisdictions are identified as worthy of emulation and how they are applied in

importer jurisdictions." However, lesson-drawing is concerned with the 'fungibility' of policy programmes and possibility of transferring them between jurisdictions (Page, 2000; Rose, 2005; Wolman, 2009). Based upon these definitions, it is fitting and in line with the aims of this thesis that its theoretical basis will rest upon the work of Richard Rose and his concept of lesson-drawing as policy learning. "Rose [is] concerned with learning which affects instruments and program[me]s adopted by governments to implement policies… [and] focus[es] on the activities of members of domestic and transnational policy subsystems in this learning process" (Bennett & Howlett, 1992:285).

Returning now to the broader and encompassing debate on whether or not subtypes exist within policy learning, as alluded to by Stone (1999), some authors warn against the dangers of equating these different methods of policy learning. This is said in light of the concern regarding over-theorisation in the field. Different authors may be discussing the same concepts but referring to them differently. This generates unnecessary excess and repetition in the theory. It could confuse those studying policy learning, as well as stunt further accurate development of the concept and field. While other subtypes such as 'policy band wagoning', 'systematic pinching of ideas' and 'emulation and harmonisation' have been named in the policy learning literature, policy transfer and lesson-drawing remain the most popular subtypes of policy learning, where subtypes are outlined (Stone, 1999:51-52).

2.3.2 Disagreement over the motivations for policy learning

Another debate, which is also linked to existence of different concepts of policy learning, concerns the motivation for policy learning itself. This includes disagreement over whether to use policy transfer or lesson-drawing. Proponents of both policy transfer and lesson-drawing highlight different aspects of each policy learning subtype to state their case. To begin with, proponents of policy transfer maintain that a key aspect of their research agenda is the act of finding reasons for the transfer of policy (James & Lodge, 2003:183). However, "the question of explanation appears less central to the concerns of Rose…who suggests 'lesson-drawing' as a guide for policymakers rather than entailing an explanation why it occurs" (James & Lodge, 2003:183).

Policy transfer proponents make one of these points in their case by highlighting the objects and actors involved in transfer. "Dolowitz & Marsh identify seven possible objects of transfer: policy goals, structure and content; policy instruments or administrative techniques; institutions; ideology; ideas, attitudes and concepts; and negative lessons" (Baumann &

White, 2010:3). In lesson-drawing, however, the objectives of policy learning are considered to be what Rose refers to as 'policy programmes', which are studied by policy-makers and analysts alike. "Every programme is a mixture of resources, and the mix varies from programme to programme…Programmes combine the 'hardware' and the 'software' needed to advance towards a policy goal" (Rose, 2005:17). Furthermore, according to Wolman (2009:17):

> "lesson-drawing is concerned with whether programs are fungible, that is, capable of being put into effect in more than one place… In the policy process a lesson can be defined as a program for action based on a program or programs undertaken in another city, state, or nation."

Based upon these different actors and objects of policy learning, as mentioned above, proponents of both methods argue that theirs is the 'better' and more effective learning tool of the two. Wolman (2009) argues and suggests that lesson-drawing is the best way to engage in the process of policy learning and policy transfer together. Newmark (2002), for example, highlights the differences between the two methods to make his case. In discussing lesson-drawing, Newmark makes the point that, compared to policy transfer, both positive and negative lessons can be and are to be learned from. Furthermore, he says that policy adoption and change are not absolutes when it comes to lesson-drawing, rather, there is a possibility that these things might occur, and if not, this does not imply that policy learning has not or could not have taken place. Instead, "negative lessons are drawn when an entity decides neither to adopt a particular policy or program[me] after reviewing what has been done elsewhere" (Newmark, 2002:155).

On the other hand, while an inherent motivation to learn exists among those using lesson-drawing methods, some have highlighted that policy transfer requires numerous factors to help facilitate policy learning through this method. "A number of factors further facilitate policy transfer including a common language, similar ideologies, relationships among personnel, and the existence of think-tanks and policy entrepreneurs" (Newmark, 2002:156). Based upon this, proponents of lesson-drawing will suggest that lesson-drawing offers a greater opportunity to learn—with fewer obstacles. While context and differences are taken into account when studying policy programmes, they are not viewed as hindrances, and learning from those different and 'unusual' from oneself is encouraged.

There is much further debate about which of the policy learning methods is equally more useful and more appropriate to use in the current globalised context in which we live.

According to Stone (1999:53), not only do lesson-drawing and policy transfer contribute to comparative public policy at a scholarly level, but they also complement "a broader concern with 'global policy studies' and the need for public policy to directly address globalisation" (Stone, 1999:53). In making the argument for lesson-drawing, Stone (1999:54) states that "one response to globalisation may be that an enhanced capability for lesson-drawing allows decision-makers to counter-act the decay of sovereignty and control over domestic policy brought by globalisation." Furthermore, she states that it is likely that policy failure and implementation problems will arise as a consequence of policy transfer. Rather, "comparative analysis [lesson-drawing] has a role to play identifying domestic circumstances or structures that aid effective policy transfer [and policy learning]" (Stone, 1999:54).

2.3.3 Can different subtypes be grouped together?

Numerous policy learning authors and theorists have emphasised the tendency of Dolowitz and Marsh in their work to not quite distinguish between different subtypes of policy learning, but rather to group them together. Dolowitz (2003) goes so far as to casually and repeatedly equate policy transfer and lesson-drawing, using the terms interchangeably on a continual basis. Evans & Davies (1999: 363-364) suggest that policy transfer, rather than being a subtype of policy learning, is in fact a generic concept or framework under which all other subtypes can be organised as 'dimensions of policy transfer'. Furthermore, Evans & Davies (1999:363-364) observe that:

> "In essence, [Dolowitz and Marsh (1996)] have drawn together a general framework of heterogeneous concepts including policy diffusion, policy convergence, policy learning and lesson-drawing under the umbrella heading of policy transfer which mainly draws on the work of Rose (1991, 1993), Bennett (1991), Robertson (1991) and Wolman (1992)."

Furthermore, in so doing, Dolowitz and Marsh view lesson-drawing, among other methods, to be a subtype of policy transfer, ultimately subsuming them under one broader label (Hamber, 2003; James & Lodge, 2003; Stone, 1999). Evans and Davies (1999) follow in the footsteps of Dolowitz and Marsh by also suggesting that policy diffusion, policy convergence and lesson-drawing all refer to 'different types' of policy transfer. Wolman (2009:11), too, is of the opinion that "policy transfer is…a subset of policy learning where learning occurs as a result of information about policies in place elsewhere."

Some authors argue that policy learning and policy transfer are two entirely distinct concepts. "'Social learning' or 'policy learning' is yet another label connected with policy transfer, but

this concept is analytically distinct" (Stone, 1999:52). In her work, Stone (1999) appears to distinguish between policy transfer and policy learning for herself, suggesting in fact that policy learning leads to policy transfer. Newmark (2002:154) also suggests a distinction; however this distinction refers to policy transfer and lesson-drawing being viewed on two different levels. In his opinion, "distinction should be made among these terms as policy transfer and policy convergence are general terms, while lesson-drawing and emulation are more specific" (Newmark, 2002:154).

In a somewhat opposite approach to that of the likes of Dolowitz and Marsh, who suggest that lesson-drawing is a subtype of policy transfer, in keeping with the 'general' and 'specific' labels concept, Baumann and White (2010:2) argue that instead of policy transfer, lesson-drawing is associated with 'generalisability'. In essence, lesson-drawing aims to take cases of specific policy successes, then extracts general models, ultimately to draw general policy lessons. In effect, Baumann and White (2010:2) suggest that policy learning and policy transfer are both based upon lesson-drawing.

2.4 Lesson-drawing: Richard Rose's approach to policy learning

"Every country has problems, and each thinks that its problems are unique to its place and time… However, problems that are unique to one country…are abnormal" (Rose, 1991:3-4). Rather that potentially blindly transferring policy from elsewhere that may not work in a different setting, Richard Rose presents lesson-drawing as an analytical tool for helping policymakers with finding solutions to their policy problems; solutions which are more properly suited to their own local context. "Confronted with a common problem, policymakers in cities, regional governments and nations can learn from how their counterparts elsewhere respond. More than that, it raises the possibility that policymakers can draw lessons that will help them deal better with their own problems" (Rose, 1991:4). For these reasons and others discussed further on in this section, lesson-drawing has been chosen as an analytical tool and approach to policy learning to aid in the drawing of policy lessons for South Africa on the regulation of shale gas extraction in the U.S.

2.4.1 Lesson-drawing theory

According to Rose (2005:23):

> "…lesson-drawing expands the scope for…choice in the national political agenda, for it adds to proposals generated by domestic experience the stimulus of examples drawn

> from foreign experience. It does so without commitment to a particular set of partisan values. The only condition for its use is that exponents of a value can locate an example of a programme already in effect elsewhere."

Furthermore, he states that "when a social problem arises, policymakers with different ideological outlooks can turn to different countries in search of lessons" (Rose, 2005:23). A so-called 'one-size-fits-all' blanket prescription can be avoided by adopting lesson-drawing as a learning tactic. "Lesson-drawing accepts the contingency of public policy. Because it specifies the condition that must be met for a programme to be effective, it can also identify under which circumstances a programme that works in one country will *not* work in another" (Rose, 2005:23).

With the intention of fully understanding and grasping the concept of lesson-drawing, one must first come to terms with the basic principles and definitions that come with it. To be clear, "lesson-drawing is about whether programmes can transfer from one place to another; it is not about what politicians think ought to be done" (Rose, 1991:5). Two of the primary elements of lesson-drawing are 'programmes' and 'lessons', and one must have a clear understanding of what they are, and equally what they are not. Foreign programmes influence policymaking through their analysis in light of one's domestic context. "A lesson uses knowledge of foreign measures to create a programme that can be applied at home or, in the case of learning from failure, a lesson shows how to avoid repeating foreign mistakes" (Rose, 2005:8-9).

Rose (2005:41) argues that existence of a common problem is the only limiting factor when it comes to where one may search for lessons to be learned. When policymakers face new problems, these problems are not necessarily novel, they might just be 'new' to the country at hand, while well-established elsewhere (Rose, 2005:41). Equally dissatisfaction is also a common starting point in searching for a solution from another policy context, experiencing the same problem (Rose, 2005:41). "When you are dissatisfied with a programme, a solution can be sought by canvassing for ideas within the national policy network. This can be followed by the construction of a novel programme based on assumptions about how it could work" (Rose, 2005:41). Policy makers might suggest that things are proceeding satisfactorily since that was their opinion the last time that they assessed a given situation, typical of the "if it ain't broke, don't fix it" mentality (Rose, 1991:10). However, dissatisfaction is the primary factor which will offset the satisfactory state.

As defined by Rose (2002:3), "a programme specifies the particular means that government adopts to address policy intentions." Programmes can thus be considered to be the hardware and the software of lesson-drawing which are required to advance a policy goal. "Every programme is a mixture of resources and the mix varies from programme to programme" (Rose, 2005:17). In his 1991 article, Rose (1991:7) states that:

> "…because policymakers are action-oriented, a lesson focuses upon specific programmes that governments have or may adopt. A lesson is more than an evaluation of a programme in its own context; it also implies a judgement about doing the same elsewhere. A lesson is thus a political moral drawn from analysing the actions of other governments."

What is important to recognise and remember about lessons, is that they do not necessarily need to be transferred. As discussed above, lessons can be both positive and negative by nature. Lessons may be drawn; so too may negative lessons, in so much as they tell policy makers what to avoid repeating in their own setting.

Here the key point is that, in engaging in research, instead of searching for new knowledge, policy makers for assurance turn to what has worked and been successful elsewhere. Policy makers are 'satisficers' (Rose, 1991:10) in that satisfaction can be both the beginning or the end point when searching for new programmes that will close the gap between aspirations and achievements. Critically, one of the key creators of dissatisfaction is uncertainty in government and within the minds of policymakers. Equally, if changes in political values occur, this too can create dissatisfaction with programmes that were already in operation and considered to be satisfactory. Ultimately, "as policymakers' awareness of dissatisfaction increases, the cost of inaction rises. Dissatisfaction stimulates search with the argument: 'You can't afford not to'" (Rose, 1991:12-13).

In terms of where to look for these lessons, Rose (2005:42) suggests that it is common and equally easy for countries to turn to their likeminded neighbours or friends to learn and borrow from, with the potential consequence of limited stimulus. However, rather than opting for the 'comfortable' and 'familiar' option, Rose suggests turning instead to places where you might source something 'useful', albeit under challenging or unfamiliar circumstances. "The programmes of countries that are unfamiliar are more likely to offer fresh and challenging insights precisely because they are distant and different." (Rose, 2005:42). Furthermore, Rose (2005:42) says that you should choose places to learn from based upon what you want to learn.

While on the one hand political values can be a very influential factor in terms of which direction a search takes, there is also a push/pull factor that exists. "A small number of countries pull as exemplars, attracting a stream of visitors to examine their programmes. The United States, by virtue of novelty and scale, has long been exemplar" (Rose, 1991:14). It would appear appropriate then to draw lessons on the regulation of shale gas extraction in the U.S. for South Africa. Even though the systems of government may differ, the U.S. is still the primary example of shale gas extraction and development of a related industry on an international level.

According to Rose (1991:21):

> "…lesson-drawing draws upon empirical evidence of programmes in effect elsewhere to create a new programme for adoption at home. The formulation of a programme is best considered as a creative act, rather than as a process of copying. Especially in cross-national lesson-drawing, some adaptation to take account of local circumstances will be necessary."

Rose has identified five different primary types of lessons—which can also be translated into different ways of drawing a lesson—with a few new additions to the list made in his later works. The list includes the following types of lessons: photocopying and copying; adaptation and emulation; hybridization; synthesis; and inspiration. The key difference among the five is whether or not "the design of a programme draws on a single foreign example or a combination of foreign examples" (Rose, 2005:81).

Falling within the list of lessons drawn from single examples, are photocopying and copying. *Photocopying* is "producing an exact photocopy with a minimum of change in the names of institutions and places and dates" (Rose, 2005:81). However, just as a poem translated from one language to another can never truly be identical, so too can a programme from country not be precisely the same as another. Next, *copying* is considered to be the simplest form of lesson-drawing. Ultimately one is duplicating almost all the features of a programme that is presently in operation somewhere else , "while [still] allowing for variation in minor details in order to allow for differences in context and in preferences of those doing copying" (Rose, 2005:82).

The next three types of lessons are those which draw on multiples sources and foreign examples. The first of these is *hybridization*. "If two or more foreign programmes are observed, then a lesson can be drawn that is a hybrid, combining compatible elements of several programmes" (Rose, 2005:83). For example, when borrowing elements of political

systems, Rose (2002:13) importantly notes that "all elements in a hybrid programme can…be observed in action, albeit in different places." Secondly, *synthesis* "combines elements from similar programmes in different countries in a distinctive [or novel] way or…combines foreign examples with elements of its existing domestic programmes" (Rose, 2005:83). However, problems may present themselves with this form of lesson-drawing because due to the synthetic nature of the lesson with "no counterpart elsewhere, its potential effectiveness is more difficult to evaluate" (Rose, 1991:22).

Thirdly, yet another type of lesson is *inspiration*. "Programmes elsewhere can be used for inspiration instead of analysis. This is particularly likely to happen when a policy maker unfamiliar with foreign countries travels abroad" (Sinha, 2003:11). Rose (1991) warns that a similar problem to that of synthesis can emerge with inspiration due to potential difficulty with having no 'guide' to compare with and to. "Viewing a familiar problem in an unfamiliar setting expands ideas of what is possible, and can inspire fresh thinking about what to do at home. But it does not demonstrate how and particular programme actually works" (Rose, 1991:22). For this reason Rose also suggests that inspiration could be considered as a form of speculation.

This research study uses two subtypes of lessons from Rose's list: adaptation and emulation. "*Adaptation* involves two governments in the one-to-one relationship of a leader and a follower," in which the details of the design of a programme that is in effect in another place are altered without removing significant or major elements (Rose, 2005:83). Furthermore, Rose (2005:13) observes that:

> Adaptation "does not require that they be identical, nor is it realistic to assume that any programme can be copied without adaptation. The closer the correspondence to the experience of the exporting country, the greater the extent to which the lesson is evidence based."

Also referred to as *emulation*, which rejects direct copying, this type of lesson-drawing "accepts that a particular programme elsewhere provides the best standard for designing legislation at home, albeit requiring adaptation to take different national circumstances into account" (Rose, 1991:21). This author recognises the U.S. shale gas industry as being the 'best standard' from which to learn, with the aim of designing shale gas extraction legislation in South Africa. While the aim is not to copy directly from U.S. legislation, these 'lessons' have been adapted to suit the South African political context, with the aim of laying the

foundation for the development of a better regulated shale gas industry in South Africa than might otherwise be achieved.

2.4.2 Lesson-drawing's relevance for policy learning on regulation

Implemented in terms of Richard Rose's (2002:4) ideal:

> Lesson-drawing applies "knowledge about a programme in one country to the design of a programme in another. The starting point is that another country has already paid the cost of being first in the field. [Thus,] lesson-drawing tries to avoid the costs of being first and re-inventing the wheel by learning from the trials and errors of a programme already in operation."

The first step in the process is to begin scanning for programmes elsewhere and thus to seek information about programmes that address problems that resemble or are similar to one's own. The second major step is to then construct a conceptual model of the programme that one has sourced and selected on the basis that it is or has been in operation in another country. Thirdly, the next step is to "compare models of foreign practice with a model of the programme causing dissatisfaction at home" (Rose, 1991:20).

However, this research, in light of its aim to learn from the U.S. regulation of shale gas extraction, applies the lesson-drawing approach differently to what was originally intended for it. Instead of focusing on a policy programme and constructing a related conceptual model, this research focused specifically on the regulation of shale gas extraction in the U.S. by its government. It is from these legislations and regulations by various agencies at federal, state and local levels of government in the U.S., that lessons were drawn on shale gas extraction in the U.S., which is considered to be the prime case on shale gas extraction and development on the international level. Consequently, as South Africa currently does not have any regulatory framework in place to deal specifically with shale gas extraction, drawing policy lessons on these matters from the prime international example could greatly benefit South Africa in its future shale gas development.

In light of the fact that this thesis aims to learn with the end goal of using this policy research to lay the foundation for contributions to policy development on shale gas extraction by the South African government, it makes sense to draw lessons from one government to another. Specifically, it makes sense to draw lessons on how the U.S. government regulates shale gas extraction and development within its own national context, so as to lay the foundation to inform how the South African government could regulate the extraction and development of

the country's own estimated shale gas reserves. Therefore, studying the broad regulation of shale gas is more relevant to the aim of this research than studying a specific policy programme.

While this might differ from the original lesson-drawing approach, lesson-drawing is still being applied, and is nonetheless very relevant to policy learning on regulation. Lesson-drawing is not only an approach to policy learning, but it is also an analytical tool that can be adjusted slightly in its application to still produce valuable policy lessons on regulation. Rose (1991) talks about using lesson-drawing to help deal with one's own problems by learning from how others have applied solutions to the same problems elsewhere.

South Africa does not yet have a policy programme on shale gas extraction to speak of, as its shale gas reserves have not yet been confirmed, nor is there any legislation specific to shale gas or hydraulic fracturing. Rose (1991) also speaks of dissatisfaction being a key reason for policymakers to embark upon a lesson-drawing quest; however, in South Africa, as indicated, there is no policy programme on shale gas to be dissatisfied with. Instead, this thesis adopted lesson-drawing an as analytical tool with the intention for the lessons drawn to make a policy research contribution that is preventative in nature.

By learning what to avoid from the U.S. regulation of shale gas extraction, if and when shale gas extraction, exploitation and development happen in South Africa, policy lessons may be drawn in order to avoid less than ideal outcomes that occurred in the U.S. Due to the fact that South Africa is in need of specific legislation for and regulation of shale gas extraction and development in the likelihood that it will occur in the Karoo, the focus should thus be on drawing lessons from regulation of the same issue within the context of a prime example similar to ours.

2.5 Conclusion

In light of the fact that lessons are already being drawn on different levels, both within the U.S. and between other shale-rich countries, this thesis uses policy learning and lesson-drawing as its theoretical framework.

Many debates within policy learning literature can be highlighted; three of which encompass the major issues at hand. Firstly, the debate on whether or not subtypes of policy learning exist helps to unpack the many definitional and conceptual issues between theorists in the field; with lesson-drawing and policy transfer emerging as the two most prominent subtypes

of policy learning. Furthermore, the second debate surrounding the motivations for policy learning also serves to highlight why lesson-drawing is better suited to use in the globalised context in which we presently exist. The third major debate on policy learning illustrates the disagreement upon the grouping of subtypes of policy learning and whether or not policy transfer or lesson-drawing is the primary subtype.

Additionally, in discussing Richard Rose's lesson-drawing approach to policy learning, this thesis applies lesson-drawing as an analytical tool somewhat differently. In spite of being advocated by Richard Rose, policy lessons will not be drawn from specifically from policy programmes elsewhere, nor will this be followed by the construction of a model. Rather, this thesis, in meeting its aim of learning to inform the South African government on the exploitation of its own estimated shale gas reserves, draws lessons from the legislation and regulation of shale gas extraction and development in the U.S.

CHAPTER 3: Research Design and Methodology

3.1 Introduction

The aim of this research project is to investigate shale gas extraction policies in the USA to discover what policy lessons the South African government can draw from this case. This chapter describes the research design and methodology of the study. It includes discussions on the rationale behind the chosen research approach, a description of the research case chosen for the study and an overview of the types of information needed. Furthermore it discusses the chosen research design, data collection methods, and data analysis.

3.2 Rationale for qualitative research design approach

Designing any study begins with selecting a topic and choosing a research method. There are two general research methods approaches commonly recognised: qualitative and quantitative.

> "Quantitative research is inquiry into an identified problem, based on testing a theory, measured with numbers, and analyzed using statistical techniques. The goal of quantitative methods is to determine whether the predictive generalizations of a theory hold true. By contrast, a study based upon [a] qualitative process of inquiry has the goal of understanding a social or human problem from multiple perspectives. Qualitative research is conducted in a natural setting and involves a process of building a complex and holistic picture of the phenomenon of interest" (CHNRI, 2013:41-42).

Qualitative research is less linear than its quantitative counterpart, and thus allows for more flexibility. Qualitative methods are context-bound and are "based on inductive forms of logic… [with a key goal] to uncover and discover patterns or theories that help explain a phenomenon of interest" (CHNRI, 2013:43).

The nature and key distinguishing features of qualitative research methods would be much better suited to this research, and would yield more desirable, insightful findings and results than qualitative research. Documentation review, applied in combination with a case study, lends itself far more to aiding in lesson-drawing on shale gas extraction policies. Shale gas extraction is a contemporary issue and area of study in which new findings are released on a constant basis. These findings may well influence the direction of the lessons drawn, requiring flexibility and room for inductive reasoning.

Johnson and Onwuegbuzie (2004:20) discuss the advantages and limitations of qualitative research. Among the advantages listed are: its usefulness regarding the in-depth study of a

limited number of cases, with an emphasis on providing individual case information; the ability to "describe, in rich detail, phenomena as they are situated and embedded in local contexts"; the opportunity for researchers to respond to changes during fieldwork that may alter the focus of the study; and the fact that "one can use an important case to demonstrate vividly [phenomena] to the readers of a report" (Johnson & Onwuegbuzie, 2004:20). Conversely, their discussion surrounding the weaknesses of qualitative research includes the potential for findings to lack generalisability to other settings or people; the potential for difficulty related to testing hypotheses and theories and, finally, that there is a possibility that the results could be "more easily influenced by the researcher's personal biases and idiosyncrasies" (Johnson & Onwuegbuzie, 2004:20).

This particular research study possesses and is suited to the advantages described above. In line with the aim of this research, which is to find out what lessons can be drawn from the U.S. shale gas industry on shale gas extraction for the South African government, the research focus is on the regulation of the U.S. shale gas industry. The U.S. is an important case in the global energy sphere, especially where teaching and sharing knowledge on shale gas and hydraulic fracturing lessons with other countries such as South Africa is concerned.

While weaknesses do exist and can equally be attributed to any approach to research or set of research methods, the weaknesses often associated with qualitative research mentioned above are acknowledged, but do not apply to this particular research study. Generalisability, and the lack thereof, is an issue for qualitative research, but it is not the aim of this study to generalise. Rather, the aim of the study is to draw lessons from the U.S. shale gas industry that are general to shale gas extraction and hydraulic fracturing, but which may then be transferred to other countries, such as South Africa. These general lessons can then be adapted to be context-specific for the South African case, so that the negative lessons from the U.S. shale gas industry are not repeated in the new setting. This is in line with the aims of Rose's approach to policy learning, which is distinct from generalising and presents lesson-drawing as an analytical tool.

Richard Rose's lesson-drawing approach to policy learning, which will be used for the purpose of this research, is itself quite well suited to qualitative research. Lesson-drawing aims to help "deal with problems of public policy by drawing lessons from the experience of other governments...to learn under what circumstances and to what extent programmes effective elsewhere may also work here" (Rose, 2005:1).

Drawing policy lessons requires a level of retrospective generalisation, which is necessary when it comes to the time for lessons to be drawn. This type of research requires detailed descriptions of policy programmes in effect elsewhere, policy learning and a thorough interpretation of one's findings to take place in order to *learn* what may help and improve the policy situation in one's own country. Murphy, Meijer and Visscher (2009) and Stevenson and Clement (2010) both use Richard Rose's lesson-drawing method for qualitative research aimed at developing policy recommendations for the improvement of public policy in specific countries, based upon lessons learned from other countries. These examples once again highlight the appropriate use of a qualitative research design for this research, in light of its aim to draw lessons from the U.S. for South Africa on the regulation of shale gas extraction.

3.3 Case study as research design

According to Creswell (1998) there are a number of different types of qualitative research designs. These include phenomenological studies, grounded-theory research, ethnographic studies and case studies. This research project uses the case study design. The case study research design is considered to be a strategy for conducting an empirical investigation specific to the real-life context of a contemporary phenomenon, drawing on multiple sources of evidence, thus focusing on key situations, players and incidents (Hsieh, 2004:90).

According to Zainal (2007:1-2):

> "Case study [design] enables a researcher to closely examine the data within a specific context…[and] explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions."

Yin (1984:23) defines the case study method "as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources, of evidence are used." However, Yin (1984:22-23) himself cites Schramm's 1971 definition of case studies:

> "the essence of the case study, the central tendency among all types of case study, is that it tries to illuminate a *decision* or set of decisions: why they were taken, how they were implemented, and with what result."

In discussing the use of case studies in research, Rowley (2002:16) suggests "that case studies are particularly well suited to new research areas or research areas for which existing theory seems inadequate." This characteristic of case studies relates especially to policy research on shale gas, which is still a new field of study. "It is the research question's nature which leads the researcher to choose a qualitative method…such as a case study approach." (*Chapter 3: Research Design*, Date unknown) Yin (1989:19) prefers the use of the case study when examining contemporary events, in the event that, for cases of scientific research, the relevant behaviours cannot be reasonably manipulated. Singleton, Straits, & Straits (1993:317) also recommend that when the item under study is a single unit of analysis, or a single social phenomenon, that case studies be used. In addition, Singleton, Straits, & Straits (1993:319) recognise that sometimes the case study is simply the best research strategy in terms of field research, because other methods preclude the problem under study.

Shale gas extraction presents a very complex phenomenon. Particularly in the U.S. with practices and regulation varying on local, state and federal levels, shale gas development and extraction occurs in a very complex context, one from which this study aims to learn. Although the shale gas industry in the U.S. is not altogether a new one, it can still very much be considered to be a contemporary issue, event and industry. On a global level, the development of shale gas is still brand new and there is still so much left to learn. Furthermore, in light of the fact that the case study design allows for close examination of an issue within a specific context, it is well-suited to studying of a complex regulatory issue such as shale gas extraction in the U.S., which is considered to be a prime international example in case.

3.3.1 Defining the case study

This thesis combines both descriptive and explanatory methods of policy learning through the use of a single-case, embedded case study which forms part of the research design. Yin (1984) explains that an embedded case study occurs within a single case when "attention is also given to a subunit or subunits… For instance, even though a case study might be about a single public program[me], the analysis might include outcomes from individual projects within programmes" (Yin, 1984:44). The case for this research is the United States of America, due to its level of experience and its highly-developed shale gas industry compared to all other shale-rich countries. Furthermore, the subunits of this embedded case study are

the different levels of government at which regulation of shale gas occurs. These include federal, state, and local levels of government and their related agencies.

3.3.2 Rationale for using case study research design for this study

The case study research design is proposed as the best-fit research design for this research project and contemporary phenomena in question. The case study research design is suitably appropriate regarding the nature of lesson-drawing method as an analytical tool. Lesson-drawing requires an in-depth study of the policy programmes of a chosen country, at either a national or local level, depending on the specific research study. The use of multiple sources of evidence and the flexible nature of case study research allow for the addition of new findings, which may well alter the outcome of the study in a positive manner. This is due to the possibility of the discovery and inclusion of new focal points during data collection and analysis. If one determines through data analysis that the focus or direction of the research is wrong, or that it could yield more accurate and relevant findings if it were adapted, case study research's flexibility allows for this. These new findings may be critical and change the nature of research in the field for good.

In a similar light, a rich and in-depth study, that is characteristic of a case study research design, allows for better understanding and richer descriptions of the chosen case, especially regarding single-case studies. In this particular study, the case refers to the established shale gas industry in the United States of America. Furthermore, case study research design lends itself to the study of contemporary phenomena. The issues of shale gas extraction and shale gas itself can be classified as contemporary phenomena, especially in the context of the global energy market.

Finally, the combination of case study research design and the use of Richard Rose's lesson-drawing as an analytical tool allows one to take in-depth findings and lessons from one place or country to another, such as from the U.S. to South Africa. This is done by focusing on the case of the U.S. and using lesson-drawing as an analytical tool to find general policy lessons on shale gas extraction regulation, which is later contextualised for the South African setting. This is the aim of this research study, and thus reiterates the appropriateness of the choice of case study research design for this research study in terms of trying to find what lessons on shale gas extraction can be drawn from the U.S. shale gas industry for use by the South African government.

3.3.3 Advantages of case study research

Probably the most commonly referred to advantage of the case study research design is its flexibility and its non-linear nature concerning research design, data collection and data analysis. Case studies make use of natural controls, as opposed to statistical or laboratory controls, which allow for a given phenomenon to be selected while the case study is being designed (Meredith, 1998:448). Important to note here is the fact that "case studies usually investigate contemporary phenomena in human society… Instead of creating a controlled environment as experimental research does, a case probes into events that happen in natural settings" (Hsieh, 2004:95-96). For this research, the natural settings relate to the regulation of shale gas extraction at federal, state and local levels of government.

Another key advantage of the case study design that is very unique, is that case study research allows for the use of various data collection methods to be used simultaneously. "This is to capture the complex reality under scrutiny. Most qualitative cases attempt to discover and portray the multiple aspects of the subjects in detail", with the subjects once again referring to the regulation of shale gas extraction at each individual level of government in the U.S. (Hsieh, 2004:99). Ultimately this allows for richer descriptions and portrayals of real-life contemporary phenomena, in natural settings. Case study research collects and analyses its data simultaneously for longer periods than experimental research, thus creating the opportunity for unexpected variables to occur and be taken cognisance of; such as amendments or promulgation of legislation on shale gas and hydraulic fracturing at various levels of government. Hsieh (2004:102) explains: "one consequence of this is that the data are interwoven with influential but natural factors generated from the real learning context. Analytical statements which consider naturally existing factors are strongly believed to have a more significant impact on learning."

Especially in the case of contemporary phenomena which have not yet been exhaustively researched, case studies open up these phenomena to new fields of study. Case studies provide guidance and direction to researchers studying new areas and phenomena. This allows for duplication and ultimately for the reputability of the findings of completed studies to be confirmed. This transfers to ability to replicate research (Meredith, 1998). This is particularly advantageous for this study, in light of its underlying aim of providing policy research which will act as a foundation for contributions toward policy knowledge on the

regulation of shale gas extraction in South Africa. This is due to a need for an increase in academic research on the issue for South Africa, by South African scholars.

3.3.4 Disadvantages of case study research

Schell's (1992:6) assessment of this type of research is somewhat critical: "One of the key criticisms of [case study] research… [is] the lack of a well defined, formalized methodology". Hsieh (2004:101) also makes the point that: "Very often, data analysis takes place at the same time as data collection… Since the procedure can be repeated and modified, it may seem as if there is no plan for the research." Similarly, it has been suggested that, due to this lack of experimental rigour and existence of a solid and structured research plan, there is little that researchers can rely upon to validate their findings, especially with single cases. However, these disadvantages are embraced in this research study.

The fact that the direction of the research study may change during data analysis is viewed positively, as it allows for a more dynamic study and more relevant findings, especially for a contemporary phenomenon that is still developing, such as shale gas extraction and development. "Yin (1981) agrees to some extent that there are shortcomings in the methodology of case study research, but contends that these shortcomings are not innate, and represent opportunities for development within the research strategy" (Schell, 1992:9).

Meredith (1998:444) highlights four key disadvantages of case study research: "the requirements of direct observation in the actual contemporary situation (cost, time, access hurdles); the need for multiple methods, tools, and entities for triangulation; the lack of controls; and the complications of context and temporal dynamics." These disadvantages are not applicable to this research. This study uses document review which eliminates the requirement of direct observation, which Richard Rose also does not always require when using lesson-drawing as an analytical tool, thus eliminating the requirements. Similarly, document review and lesson-drawing (as an analytical tool) provide sufficient tools to better understand complicated contexts, as well as solve temporal issues by removing time restrictions and allowing for data analysis over long periods.

3.4 Rationale for choosing the United States of America as a case

The chosen case for this research study is the shale gas industry of the United States of America. Three motivating factors should be mentioned regarding the choice of the United

States of America as a case in this study. Firstly, the U.S. has an established shale gas industry on a global level. Secondly, due to the history and development of extraction techniques coming out of the U.S., it has vast knowledge of shale gas development and extraction. Other countries can learn from its experiences, as well as from its management and regulation of the shale gas industry. Thirdly, and on a similar note to the second point, with its wealth of regulatory understanding and know-how, U.S. government agencies and industry regulators have extensive regulatory knowledge and lessons to share and teach to other shale-rich countries.

Over the last decade or so, the shale gas industry in the U.S. has really grown and established itself. In comparison with other regions and countries across the world, the United States is presently considered to be the biggest producer of shale gas and currently also, as a whole, boasts the most developed and technologically advanced shale gas industry. "In the early 2000s U.S. gas production was in slow but steady decline despite increasing drilling activity… The U.S. shale gas phenomenon gathered momentum from 2004 onwards through the combination and application of two proven technologies, namely horizontal drilling and pressure-induced hydraulic fracturing or 'fracking'" (Rogers, 2011:117). It ultimately set in motion a 'shale gas boom', which turned the industry in the United States into a case to top all cases concerning shale gas. From this achievement, other countries stand to learn a great deal.

Based upon this classification as a prime example of shale gas development, the U.S. case has much to offer in terms of policy lessons, regardless of a lack of ease when it comes to replication of the case (Energy Source, 2012). South Africa at present does not have the kind of stable regulatory environment that is necessary to achieve the most benefits possible from shale. However, by drawing lessons from foreign cases, namely the U.S., and gaining new knowledge and perspectives that could be applied to and even inspire the development of unique programmes and policies, these shale benefits could be realised.

In terms of technological developments regarding extraction techniques in the field of shale gas extraction, the USA stands to teach other countries a great deal. This is in line with the second motivating factor for choosing the U.S. as a case. With these types of technological developments and knowledge on hydraulic fracturing and horizontal drilling in the U.S. shale gas industry, there are many possible lessons that may be drawn from the U.S. example. The types of lessons included here would relate to operations management and practices for shale

gas extraction (Kohlhaas, 2011). By gaining this type of knowledge about shale related expertise, other countries, such as South Africa, stand to learn from the U.S. and avoid some of the operational mistakes that were, for example, made in the industry.

In a 2012 report by Accenture (Stark, Allingham, Calder, Lennartz-Walker, Wai, Thompson & Zhao, 2012), an analysis was conducted with specific focus on water regulation and management to assess what and how other countries would be able to learn from the experiences of the United States. Dittrick (2013) observes that:

> "Accenture analyzed how countries with prove[n] shale gas reserves, specifically Argentina, China, Poland, and South Africa, can look toward experience gained in U.S. water regulation and management to develop shale gas economically and sustainably… Although regulators in emerging locations might not align with U.S. regulations, policy-makers worldwide contemplating hydraulic fracturing rules and water use-disposal rules could draw upon a large volume of U.S. operating and environmental data."

This represents an example of suggested lesson-drawing from U.S. regulation of shale gas, as with the third motivating factor for choosing the U.S. as a case.

In spite of having a federal system of government, which may differ from countries hoping to learn from the U.S., this does not mean that there are fewer lessons to be drawn. The U.S., with shale gas regulation on federal, state, and local levels of government, presents a wealth of regulatory knowledge and is thus a prime case to examine for the purpose of drawing policy lessons. These regulations at various levels form a framework from which to draw lessons on both successful regulation of shale gas, as well as regulatory gaps and mistakes to avoid—very important lessons in themselves.

Furthermore, when it began in the U.S., the shale gas industry received a lot of interest from many different sectors. Years of research, trials and funding generated a wealth of knowledge within the American shale gas industry. Chazan (2012) observes that:

> "Shale gas boomed in the U.S. thanks to the hundreds of entrepreneurial independent explorers, the huge network of oil service companies offering drilling rigs and other vital equipment, and the sophisticated financial markets that channelled capital to [these] new ventures."

Taking the example of corporate and private investment and involvement in the U.S. shale gas industry, other countries considering shale gas development within their borders stand to

learn a great deal from the U.S. example about managing foreign and private investment into a state-controlled industry—as could be the potential case in South Africa (Chazan, 2012).

According to Chazan (2012), of "the only countries with the right combination of factors – such as the right geology, government support, robust gas prices, plenty of service companies and interest from the big exploration companies", South Africa is currently not included. Taking the aforementioned into consideration, it would appear that the U.S. is a prime example of a shale gas producing nation. In order to build up to having all of the right factors to successfully develop and exploit its estimated shale gas reserves, the U.S. is the best global case to examine for the purpose of drawing policy lessons on shale gas.

Very importantly, in recognising the increasing global surge in the development of unconventional gas resources, "in April 2010, the U.S. Department of State launched the GSGI [Global Shale Gas Initiative] in order to help countries seeking to utilize their unconventional natural gas resources to identify and develop them safely and economically and in an environmentally sensitive manner", as well as to balance energy security concerns (Sakmar, 2011:396). As a consequence, the U.S has already begun teaching other countries regulatory and management lessons on shale gas, even further entrenching its status as the prime case from which to draw policy lessons on shale gas extraction and development.

3.5 Data collection

While social scientific methods such as participant observation, interviews and social surveys have been widely used for the purpose of gathering data in qualitative studies, there is another method that is often marginalised. This is the *documentation review method*, or the use of documentary sources in social research. In its simplest form, a document can be defined as a written text. Documents are recorded text and images that have been compiled without the input or intervention of the researcher using them. Documents that are evaluated and analysed for studies come in many different forms. According to Bowen (2009:27-28):

> "They include advertisements; agendas, attendance registers and minutes of meetings; manuals; background papers; books and brochures; diaries and journals; event programs (i.e. printed outlines); letters and memoranda; maps and charts; newspapers (clippings/articles); press releases; program proposals, application forms, and summaries; radio and television program transcripts; organizational and institutional reports; survey data; and various public records."

Documents can also fall into the primary or secondary category, depending on whether they were eyewitness accounts or written by people who received those accounts from elsewhere, and also into the public, personal or private categories.

By definition, "the use of documentary methods refers to the analysis of documents that contain information about the phenomenon we wish to study" (Mogalakwe, 2006:221). While most literature surrounding documentation review methods discuss and emphasise the use of documentation review in combination with other methods as a component of triangulation, it has been known to be used independently as a method for qualitative research (Bowen, 2009). "Understandably, documents may be the only necessary data source for studies designed within the interpretive paradigm…or it may be the only viable source… In other types of research, the investigator should guard against over-reliance on documents" (Bowen, 2009:29). In this study, documentation review is used as a data collection technique to serve as substitute for the option of travelling abroad, which due to temporal and financial constraints, could not realistically be considered.

This method is on a par with social surveys, participant observation and in-depth interviews, and is sometimes even more cost effective (Mogalakwe, 2006:221). According to Bowen (2009:29), "as a research method, document analysis is particularly applicable to qualitative case studies… Documents of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem." This is relevant to this research, due to its aim. This study aims to draw policy lessons in a case study for South Africa, in an attempt to discover regulatory insights from U.S. regulation of its shale gas industry.

For this research project, the dominant sources of information about the U.S. shale gas industry will be gathered from U.S. government documentation on local, state and federal levels. This requires looking at federal acts and various other state and local level regulations on shale gas and shale gas extraction, in order to find out how the U.S. government has responded to shale gas development. Secondly, information will be gathered from academic journal articles and other published research. The use of other published research on shale gas will help to focus this researcher's own research findings. By studying the findings and concerns that have emerged through other published research on shale gas, important issues and trends for consideration and potential incorporation into this research study's conclusions will be highlighted and gained.

The above mentioned documents and sources were accessed primarily through the internet, with much information available from U.S. government websites. Academic and professional journals were accessed in conjunction with this. In spite of the potential for data collection from the internet to be questionable on levels of authenticity, quality, credibility, and meaning, the researcher has heeded this risk and, as displayed above, has taken precaution to access data through reputable internet sources, such as government websites and through academic institutions rather than unreliable and non-academic articles that are so widely available on the internet.

3.5.1 Advantages of documentation review methods

Bowen (2009:31) sets out a number of advantages of documentation review methods. In some aspects, documentation review can be considered to be more efficient than other research methods when it comes to qualitative research. It can be less time consuming than other methods, such as interviews and direct observation, due to the fact that data can be *selected* over and above being *collected*. This means that relevant sources can be identified as deemed applicable to the research project rather than having to conduct lengthy fieldwork, only to discover that one does not have the information one requires. Two further advantages that are linked are availability of documents and the cost-effectiveness of the method. Particularly now, due to the widespread availability of documentation on the internet, many documents are easily obtainable and freely available in the public domain. As is the case with this study, many U.S. government documents on shale gas are available on government websites. This is also true in respect of many published reports by international organisations and companies.

Tied to availability, is of course cost-effectiveness. Documentation review will often prove to be more cost-effective than other qualitative data collection methods; in some cases due to the fact that with some documentation and literature, the research and data in the documents have already been collected and gathered by other researchers, thus, what is left to do is to analyse and evaluate their appropriateness, relevance and usefulness for your studies. This is particularly advantageous considering the immense costs required for research in new fields of study, such as shale gas.

Another advantage highlighted by Bowen (2009:31) is a lack of obtrusiveness and reactivity. “Documents are ‘unobtrusive’ and ‘non-reactive’—that is, they are unaffected by the research

process" (Bowen, 2009:31). The content of the documentation will not change due to the presence of the researcher, nor will they have any impact upon what is written in the document in terms of being able to alter its contents. This ties in with another advantage; stability of documentation. According to Yin (1994) in Bowen (2009:31), "the inclusion of exact names, references, and details of events makes documents advantageous in the research process… [and] documents [also] provide broad coverage; they cover a long span of time, many events and many settings".

3.5.2 Disadvantages of documentation review methods

One of the main disadvantages of documentation review is the insufficient detail and sometimes lack of applicability of documentation to a research study. Most of the time documentation used in documentation reviews has been compiled with a different research agenda to one's own, and thus makes it difficult to find documentation that provides sufficient detailed information to fully answer a different research question. A second disadvantage, according to Bowen (2009:32), is low retrievability. Sometimes documentation is simply difficult to access, and other times it is deliberately blocked from public access. A third and final disadvantage of the documentation review method is biased selectivity. This refers to availability of an incomplete collection of documentation, with the available documents potentially being aligned to particular policies or views of a given organisation, which could ultimately lead to bias.

Despite the existence of the abovementioned disadvantages to using documentation review, not all of these are applicable to this study. Even though most documentation in compiled according to a research agenda different to a researcher's own, in many cases documents still serve to highlight important points and issues which help to focus the work and findings of researchers that use and review them, as is the case with this study. Documentation review used in conjunction with lesson-drawing, allows for the analysis of valuable research in spite of differently oriented research agendas, with the end result of a set of important policy lessons. Along the lines of the second disadvantage discussed above, while this point is valid, the researcher has tried to use the channels made available through Stellenbosch University to gain free access to various academic journals and publications not usually feely available to the general public without subscription or at a fee. This also extends to access to U.S. government websites and databases providing free and open access to government documents.

Finally, while it is true that some documentation is compiled under the influence of certain policies or views, for this study this characteristic of documentation review will actually be used and embraced. U.S. government regulatory approaches to shale gas are a focus of this study, and therefore especially useful when comparing local, state and federal responses to shale gas, which will ultimately be studied and assessed for the potential applicability and adaptability of these general policy lessons to the South African context.

3.5.3 Data collection methods for this study

For the purpose of this study, lesson-drawing as an analytical tool will be applied in conjunction with documentation review. This allows one to conduct a thorough analysis of the broader case, while at the same time highlighting important issues and subunits of analysis which might otherwise have been overlooked. In particular, while used as a starting point for policy learning on shale gas and hydraulic fracturing regulation in the U.S., the application of Rose's lesson-drawing tool in this study is unique. Rather than travelling abroad to immerse oneself in policy programmes to be able to draw policy lessons, lesson-drawing for this study will be done through documentation review of literature on the regulation of shale gas and hydraulic fracturing in the U.S.

Having studied the literature, rather than create a model to draw lessons, as advocated by Rose, this study will extract general lessons from the regulation of the U.S. shale gas industry. Thereafter, once those general policy lessons that have been de-contextualised are in a form which may make them transferable to other policy contexts or countries, such as South Africa, for re-contextualisation and application, they will be instituted in a new policy context. Lesson-drawing tools, in combination with documentation review of a single-case embedded case study, allow for more accurate and relevant results (specific to the aim of this study) to be drawn from the U.S. for shale gas extraction in South Africa. Ultimately, Rose's method for extracting policy lessons from policy programmes is enhanced by using documentation review as a method, creating the possibility to draw general policy lessons on shale gas extraction.

As discussed previously, this thesis will make use of qualitative research methods, allowing for greater flexibility in research and a more non-linear research path. In terms of sources of research, various forms of documentation were used, including: academic and professional journals; reports of official U.S. government proceedings; U.S. government statements,

speeches and announcements; agendas, written reports of events and minutes of relevant meetings; other U.S. administrative documents, including proposals and progress reports; formal studies or evaluations, as well as various media articles. Furthermore, maps of particular shale gas formations were also used for research purposes.

3.6 Data analysis

For the purpose of a data analysis, this research study makes use of thematic analysis to analyse the collected data on the regulation of shale gas in the U.S. This was done to assess what policy lessons the South African government can learn about shale gas extraction. According to Bowen (2009:32):

> "Document analysis invokes skimming (superficial examination), reading (thorough examination), and interpretation. This iterative process combines elements of content analysis and thematic analysis… [Specifically,] thematic analysis is a form of pattern recognition within the data, with emerging themes becoming the categories for analysis… The process requires a careful, more focused re-reading and review of the data."

Thematic analysis is not purely about processing the data which has been gathered previously through the literature study, it also incorporates documentation review methods and lesson-drawing as an analytical tool. Thematic analysis is also about being able to get to grips with the data at a higher level of understanding; at which patterns and themes may begin to be recognised within the data, and thus analysis of those themes can occur. "Thematic analyses move beyond counting explicit words or phrases and focus [on] identifying and describing both implicit and explicit ideas within the data, that is, themes" (Guest, Mac Queen & Namey, 2012:10).

Having now highlighted the fact that with thematic analysis comes pattern-finding and the highlighting of recurring themes, this type of analysis not only complements document review methods of data collection, but also that of Richard Rose's lesson-drawing as an analytical tool used for data collection purposes. Throughout the process of documentation review, lesson-drawing as an analytical tool helps with the identification of themes and patterns in the form of policy lessons on the regulation of shale gas extraction in the U.S. These lessons, highlighted through the use of lesson-drawing, help to identify themes and lessons that are both positive and negative in instruction. Once identified, these general lessons and themes are altered and contextualised for their application within a new policy context, in this case from the U.S. to South Africa.

Once again, it is important to highlight that fact that, while in line with Rose's originally intended application of lesson-drawing to draw policy lessons, in this research, conceptual models are not constructed out of general lessons from policy programmes. Instead, general policy lessons and policy themes are drawn from the regulation of the U.S. shale gas industry by federal, state and local levels of government and their related agencies. These general lessons on regulation in the U.S. context are then analysed and contextualised for potential application and contribution towards a foundation for the development of a South African shale gas industry and the promulgation of necessarily related legislation.

3.7 Conclusion

In conclusion, this study used the U.S. shale gas industry as its case. The U.S. shale gas industry presents a highly-developed industry on a global level, with a longer history of development and technological advancements, which in turn can be treated as a case from which other countries hoping to develop their own shale gas industries may draw lessons. Data will be collected and analysed using documentation review and thematic analysis. Richard Rose's lesson-drawing was also used for the purpose of fulfilling the aim of discovering what policy lessons the South African government can learn from the shale gas industry of the United States, regarding shale gas extraction and industry development.

CHAPTER 4: The regulation of shale gas extraction in the U.S.

4.1 Introduction

This chapter discusses the U.S. shale gas industry, and the regulation thereof. Firstly, a brief history of shale gas development in the U.S. is discussed, followed by a discussion on how shale gas advanced onto the U.S. policy agenda. This is followed by a description of four major shale gas formations in the United States, presenting examples of domestic lesson-drawing on the regulation of shale gas extraction. Thereafter, the chapter focuses on the regulation of shale gas development and extraction at federal, state, and local levels of government, followed by a discussion on the emerging concerns surrounding shale gas development and hydraulic fracturing as a consequence of gaps in shale gas and fracking-specific regulation at all levels.

This chapter applies Richard Rose's lesson-drawing approach for the purpose of drawing lessons from one country to another. However, this will be done in a manner slightly different to the conventional approach. While Rose recommends the immersion of oneself into the political workings of a given country, he also suggests a thorough study of the policies of said countries surrounding the chosen issue. The regulation of shale gas development and extraction in the U.S. is studied by using document review. Instead of designing a complete model from which to draw lessons, in accordance with Rose, lessons are drawn through the selection of important points that emerge from the analysis of documents on shale gas development in the U.S. This highlights re-emerging policy issues, and therefore 'lessons', which can then be analysed and considered for application in a new policy context such as South Africa.

4.2 Background

In order to understand the regulation of shale gas extraction and development as policy issues in the U.S., it is first necessary to understand the lines along which shale gas development in the U.S. came about. Secondly, it is also important to have an understanding of how shale gas extraction and development became issues on the policy agenda of the U.S. government.

4.2.1 Brief history of shale gas development in the U.S.

Wang and Krupnick (2013:1) observe that:

> "Naturally, scholars, policymakers, and many other stakeholders who are interested in the development of shale gas outside of the United States are asking about the important factors for successfully developing shale gas resources. One way to shed light on this issue is to learn from the U.S. experience. While it is difficult to know definitively the necessary or sufficient conditions for stoking a shale gas boom, a historical review of the U.S. experience can at least inform the conditions that helped."

Natural gas production has been continuous—for a long time in small quantities—since the earliest years of gas developments in the U.S. (Roberson, 2012). "The first well drilled specifically to produce natural gas in North America was completed in Devonian shales" (Harper, 2008:2). William A. Hart completed the first producing well in 1821 in a town called Fredonia in New York State. For 35 years the well produced a few thousand cubic feet of natural gas per day, and was used by the people of Fredonia primarily for street lighting (Considine, Watson, Entler & Sparks, 2009; Roberson, 2012).

According to Roberson (2012:71-72):

> "Although hydraulic fracturing was first used in 1903, the first commercial stimulation was not performed until 1949… The technological advances of horizontal drilling and hydraulic fracturing allowed the Barnett Shale around Fort Worth, Texas, to begin its trek to becoming one of the most active natural gas plays… [and] in 1981, George Mitchell of Mitchell Energy began an 18 year-long experiment to extract commercial amounts of natural gas from the Barnett Shale."

Within roughly the last decade, the United States of America has experienced an extraordinary shale gas boom. Between 2000 and the present, figures show the growing contribution of shale gas to total U.S. natural gas production levels. This has consequently resulted in other countries developing a keen interest in developing their own shale gas resources.

4.2.2 How shale gas got onto the policy agenda in the U.S.

There are two primary reasons which explain how shale gas got onto the policy agenda in the U.S. The first reason has its roots in the energy crisis of the 1970s. The second reason, on the other hand, relates to the realisation of the market potential of shale gas, particularly through its commercial development.

Following the energy crisis of 1973, energy shortages and consequent rises in natural gas prices, the U.S. Department of Energy was prompted to fund a multistage research and development programme of the Morgantown Energy Research Center (MERC) in 1976, called the Eastern Gas Shales Project (EGSP), that spanned across three different shale

basins. MERC engineers patented a directional shale gas drilling technique which would ultimately lead to the horizontal drilling techniques applied today (Trembath, Jenkins, Nordhaus & Shellenberger, 2012; Wang & Krupnick, 2013). "In October 1977, DOE [Department of Energy] was created to consolidate in one agency the responsibilities for energy policy and R&D program[me]s" (Wang & Krupnick, 2013:8).

"In the 1980s, producers began looking beyond traditional sources of natural gas production to keep up with the growing market and to compensate for depleting reservoirs" (Kuhn & Umbach, 2011:10). In 1986, with the help of the Department of Energy, the first multi-stage horizontal fracture was demonstrated—a step on the path to achieving commercial-scale fracking (Trembath, *et al*, 2012). The 1990s saw an industry evaluation of coal-bed methane, followed by a shift to shale gas. However, even at that stage, shale gas was not yet fully embraced as an alternative.

From the early 2000s, concern was raised by the U.S. oil and gas industry over the potential depletion of U.S. conventional natural gas reserves. "Most experts believed that North America would soon have to become a net importer of natural gas, in the form of LNG [liquid natural gas] … Believing that natural gas prices would rise, U.S. gas producers also began exploiting unconventional sources" (Deutch, 2011:83-84). However, only in 2005 did the potential of unconventional natural gas, such as shale gas become apparent.

At this point, relatively high natural gas prices prompted the realisation that there was possibly money to be made by applying, on a large scale, the fracking technologies discovered by Mitchell, at a cost of "around one-half to one-third the production cost associated with new conventional gas wells in North America" (Deutch, 2011:84). Much to the surprise of both the oil and gas industry and the U.S. government, unconventional gas resources, particularly shale gas, were turning out to be more promising and lucrative than ever previously expected. From this point onward, shale gas shifted onto the policy agendas of all levels of government, federal, state and local, and so began what is now referred to as the 'shale gas revolution'.

4.3 Significant shale formations in the United States of America

There are a number of major producing shale formations—or 'plays', to use the industry vernacular. Shale gas is present in most of the lower 48 states of the U.S. (Figure 1). The most active of all of these formations include the Barnett Shale, Fayetteville Shale,

Haynesville Shale and the Marcellus Shale. There are important policy lessons that can be drawn from the regulation of shale gas resources and hydraulic fracturing from each of these plays; each concerning different aspects of policy and regulation thereof.

The Haynesville Shale provides lessons on regulation of a shale formation over a large area with varying geological characteristics. The Fayetteville Shale is an example from which lessons can be drawn on how to develop a shale formation quickly, in an efficient way, through the application of existing regulation in place elsewhere. This in other words, is an example of a transfer of regulation. The Barnett Shale in Texas was one of the first modern shale plays to be commercially drilled and provides lessons on the development of regulation from scratch for a new shale play. This lesson is also applicable to the development of regulation for any new energy source in the energy sector. These lessons specific to the Barnett Shale can be transferred, not only between states and plays within the U.S., but also to other countries.

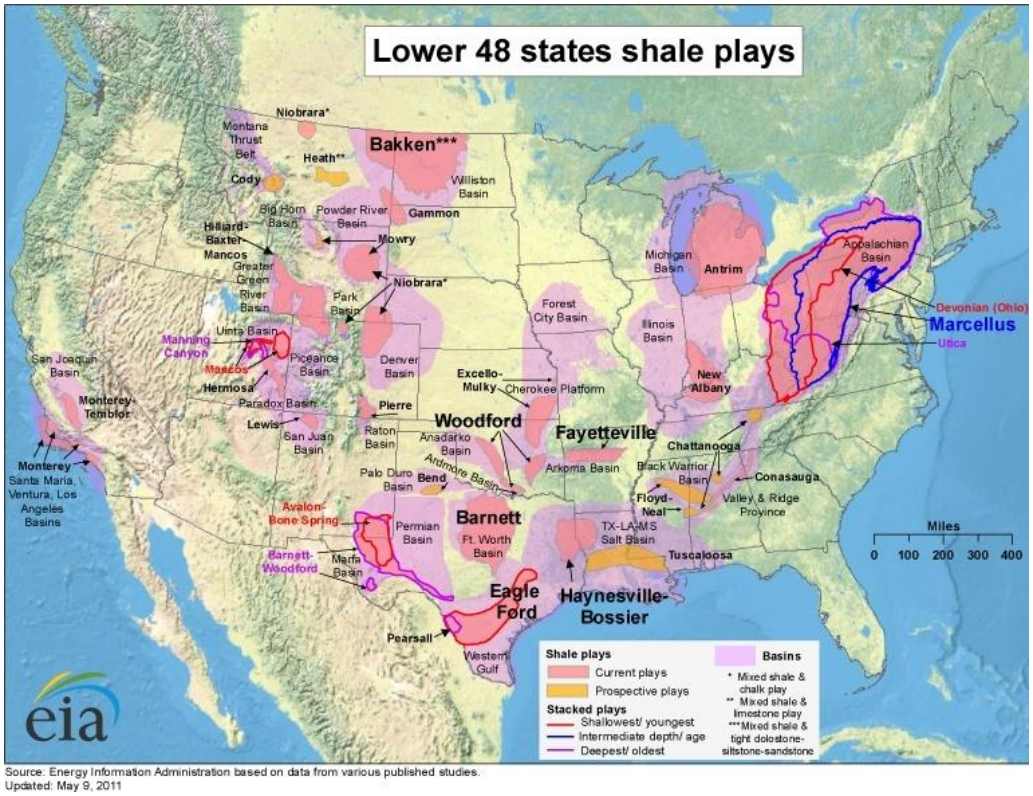

Figure 1. Lower 48 states shale plays (U.S. EIA, 2011 (b)).

Of particular importance, concerning opportunities for lessons to be drawn, is the Marcellus Shale in the north-eastern region of the U.S. The Marcellus Shale is the most expansive shale play in terms of size in the U.S. and crosses the state boundaries of such states as Pennsylvania, New York, West Virginia, Maryland and Ohio. The Marcellus Shale is a prime

example of a large shale formation that crosses many different internal jurisdictional boundaries within a country. For this reason, the Marcellus shale provides important lessons on how this has been managed and regulated in the U.S., since independent regulations for shale gas and hydraulic fracturing exist on state and local levels of government within each individual state within the boundary of the Marcellus Shale. These lessons on sub-national and multi-agency regulation of shale gas and hydraulic fracturing could potentially be imported to other shale-rich countries such as South Africa with its similarly expansive Karoo Basin, which also crosses over various provincial boundaries. These lessons could also potentially be imported to other shale-rich countries, again like South Africa, in the hope of developing a regulatory framework for their own shale gas resources under similar geological and geographical conditions.

4.4 How shale gas extraction is regulated in the U.S.

This sub-section will focus on the multi-level regulation of shale gas and hydraulic fracturing in the U.S. Regulation of shale gas and hydraulic fracturing occurs at all levels of government, namely federal, state, and local levels. In order to draw policy lessons on how shale gas and hydraulic fracturing are regulated by the U.S. government, one must understand the roles played by both the regulations and the regulatory agencies at each level of government.

4.4.1 Federal regulation

There is a series of environmentally-oriented federal laws that govern most of the aspects relating to shale gas development. Certain other federal laws contain exemptions specifically relating to hydraulic fracturing and shale gas development. “Many of the federal laws are implemented by the states under agreements and plans approved by the appropriate federal agencies” (Arthur, Langhus & Alleman, 2008:11). There are a number of federal agencies responsible for administering most of the federal laws relating to oil and gas development and production in the U.S., most prominent of which is the Environmental Protection Agency.

Federal agencies

The most prominent regulatory agency for shale gas and hydraulic fracturing is the Environmental Protection Agency (EPA). “The Agency’s focus and obligations under the [federal] law are to provide oversight, guidance and, where appropriate, rulemaking that achieve the best possible protections for the air, water and land where Americans live, work

and play" (EPA, 2013 (a)). By applying these roles, the EPA also gives special emphasis and focus to shale gas development and hydraulic fracturing in the U.S., ultimately to ensure the environmental protection of the American people (EPA, 2013 (b)). Currently, the EPA is investigating, as directed by Congress, the impact and risks of fracking on drinking water with initial results available in late 2012 and the final report in 2014 (Negro, 2012; Thorn, 2012). "The [EPA] has continued to develop new federal policy around unconventional oil and gas production, including new air rules for the industry" under the authority of the Clean Air Act in 2012 (Baker & McKenzie, 2012:2). These are the first federal air standards for wells using hydraulic fracturing and are intended to reduce emissions from these wells (Clark, Burnham, Hart & Homer, 2012).

Secondly, two other federal agencies, the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) also play a role in regulating shale gas and hydraulic fracturing. These agencies are linked to the Department of Interior and the Department of Agriculture respectively (U.S. Geological Survey National Assessment of Oil and Gas Resources Team & Biewick, 2013; USDA, 2013). The BLM and USFS have standards to which all operations that have been authorised under a federal oil and gas lease must conform (DOI & USDA, 2007). "Federal oil and gas lease[d] surface operations are managed by the BLM…[and] on National Forest System (NFS) lands, the FS has approval authority for the surface…portion [use] of Federal oil and gas operations" (DOI & USDA, 2007:1).

In May 2012, the BLM proposed a draft rule for oil and gas production on federal (public) land. The purpose of this was to modernise its management of well-stimulation activities, including hydraulic fracturing used for shale gas extraction (Clark *et al*, 2012; Infante, Hopkins, Obershain & Fisher, 2012). It is important to keep in mind that not only do these federal agencies implement federal legislation and regulations related to shale gas and hydraulic fracturing, but they are also able to develop and propose new regulations to these ends. This is indicative of the active role of federal agencies in regulating shale gas and hydraulic fracturing.

Federal regulation applicable to shale gas development

A number of federal laws for oil and gas are applicable to and cover different phases in the shale gas development process. As indicated above, the EPA is the primary federal agency involved where shale gas and general oil and gas regulation is concerned. The EPA enforces

an environmentally-strong focus and presence in the federal regulation process and is a constant feature in shale gas and hydraulic fracturing regulation on the federal level.

The first federal act applicable to some of the major aspects of shale gas development (and oil and gas development, more generally speaking), is the *Clean Water Act of 1972(CWA)*. The CWA regulates and issues quality standards for the discharge of pollutants into U.S. surface waters and also covers minimisation of erosion and sedimentation from oil and gas sites. Under the authority of the CWA, the EPA sets wastewater and water quality standards for all surface water to guard against pollutants. No dumping of any pollutants into U.S. waters is allowed without a permit under the CWA. Finally, in 2014, the EPA is planning to propose CWA standards for treating wastewater that comes specifically from shale gas wells (Groat & Grimshaw, 2012; Wiseman & Gradijan, 2012).

The *Clean Air Act of 1970 (CAA)* serves to limit air emissions that are discharged by equipment used in natural gas operation, thereby also covering shale gas extraction. "The act authorizes the EPA to regulate hazardous air pollutant emissions and to protect public health and welfare by establishing National Ambient Air Quality Standards (NAAQS)" which states are then required to implement (Brady, 2012:8-9). The EPA, in accordance with its new federal policy, has also started to include oil and gas sites under CAA protections. This, controls emissions of volatile organic compounds (VOCs) through a technique called 'green completion' (Wiseman & Gradijan, 2012).

Congress enacted the *Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)* in 1980, under which oil and gas operators must report the releases or spills of hazardous chemicals, in threshold quantities, other than oil and gas. Operators may also be held liable for the cleanup thereof (Groat & Grimshaw, 2012; Wiseman & Gradijan, 2012). A 1986 amendment created "a federal 'Superfund'", which pays for cleanups of abandoned wells, waste sites, spills and emergency hazardous releases. However, under CERCLA, the power of enforcement lies with the EPA, which is able to hold parties financially liable for cleanups if it so decides (Brady, 2012:9).

Under the *Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA)* and the *Occupational Safety and Health Act of 1970 (OSHAct)*, when certain hazardous chemicals are stored at threshold levels on drilling sites, operators are required to maintain material safety data sheets (Groat & Grimshaw, 2012; Wiseman & Gradijan, 2012). Under these acts, the EPA collects data on toxic chemicals and releases, which it then makes available to the public

via its own Toxic Releases Inventory (Brady, 2012). Furthermore, "the *Toxic Substances Control Act of 1976 (TSCA)* grants the EPA authority to create regulations to collect chemical data in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing and use" (Roberson, 2012:88).

Exemptions for shale gas development under federal regulation

"[The] federal regulatory 'superstructure' does not always regulate environmental, health, and safety risks associated with fracking in the same way it regulates other industries" (Spence, 2013:449). Shale gas and hydraulic fracturing operations are often exempt from federal regulations that apply to the general oil and gas industry. These exemptions are frequently linked to mitigating factors such as concerns over pollution of and irreversible harm to the environment, as well as public health and safety. This hampers environmental protection, due to the lack of regulation for certain aspects of the shale gas extraction process and hydraulic fracturing.

The most noteworthy exemption for shale gas and hydraulic fracturing is under the *Safe Drinking Water Act of 1974 (SDWA)*. The SDWA was enacted to protect U.S. public drinking water quality and its sources, including rivers, reservoirs, lakes, springs and ground water wells (Brady, 2012; Roberson, 2012; Sakmar, 2011). The EPA is the primary federal agency responsible for administering the minimum drinking water quality standards of the SDWA, and it also regulates the underground injection of fluids, in order to protect underground drinking water sources. Historically, however, the EPA had not regulated gas producing wells, due to the fact that it did not consider fracking to be covered by the regulatory definition given to underground injection of fluids (Sakmar, 2011). In 1997, the case of the *Legal Environmental Assistance Foundation (LEAF) versus the EPA* resulted in the U.S. Court of Appeals for the 11th Circuit ruling that hydraulic fracturing does constitute underground injection under the SDWA, therefore requiring regulation by the EPA (Brady, 2012; Willie, 2011). In 2004 the EPA conducted a study and claimed "that hydraulic fracturing poses little or no threat to underground sources of drinking water" (Brady, 2012:4).

In spite of criticism received on the findings of the report, Congress enacted a statutory exemption (Spence, 2013). Sakmar (2011:409) observes that:

> "Ultimately, in the Energy Policy Act of 2005, Congress amended SDWA Section 1421 to specify that the definition of 'underground injection' excludes the injection of fluids or propping agents (other than diesel fuels) used in hydraulic fracturing

> operations related to oil, gas, or geothermal production activities. This exclusionary language effectively removed the EPA's (unexercised) authority under SDWA to regulate the underground injection of fluids for hydraulic fracturing purposes."

This is more commonly referred to as the 'Halliburton Loophole'. In this particular case, through the 'loophole', the interests are served of oil and gas companies that stand to benefit from lax regulations and restrictions on shale gas development and hydraulic fracturing for production are served.

Following on from this, and the growing concerns over shale gas development and fracking, two bills have been introduced to Congress to amend the exemption in the SDWA, but neither was passed by Congress. According to Brady (2012:5):

> "The first was in the House of Representatives in 2008, where Representatives DeGette, Salazar, and Hinchey introduced a bill aimed at protecting drinking water from oil and gas development. The second came in 2009 when members of both houses of Congress introduced the Fracking Responsibility and Awareness of Chemicals Act (aptly named the 'FRAC Act')."

Ultimately this means that exemptions for shale gas and hydraulic fracturing under the SDWA are still largely in play.

Usually under the *Clean Water Act (CWA)*, industrial facilities that produce 'stormwater runoff' are required to obtain a stormwater permit. Stormwater runoff is considered to be a pollutant under the CWA. Furthermore, these permits are required for both construction and operation points (Groat & Grimshaw, 2012). Very importantly, however, the CWA does not require stormwater permits for what it considers to be 'uncontaminated' "discharges of stormwater runoff from oil and gas exploration, production, processing, or treatment operations" (Wiseman & Gradijan, 2012:22). In spite of this, the EPA still required permits for discharges coming from oil and gas facilities because sediment from stormwater was still considered to be a pollutant. Brady (2012:7-8), however, observes that:

> "In 2005…Congress amended the CWA through the Energy Policy Act, by defining the term 'oil and gas exploration, production process, or treatment operations and transmission facilities' to include construction activities. Thus, this amendment extended the stormwater permit exemption to all oil and gas field operation activities which includes those activities associated with hydraulic fracturing."

Following this, the EPA issued a final rule which exempts discharges of stormwater with sediment from oil and gas facilities. However, after a challenge from the National Resources Defense Council, the Ninth Circuit Court of Appeals vacated the EPA's rule and thus the EPA reinstated its previous stormwater permit requirements.

Under the *Resources Conservation and Recovery Act of 1976 (RCRA)*, the EPA has the authority to control and regulate hazardous waste, and thus also the management and disposal thereof. Two subtitles of the act, Subtitle C and Subtitle D respectively, in particular are applicable to hazardous and non-hazardous waste. Under these RCRA subtitles, wastewater produced from fracking is subject to the same exemptions as all other oil and gas wastes (Spence, 2013). The RCRA delegates the task of developing definitions of hazardous waste products to the EPA (Spence, 2013). In 1978, the EPA released definitions and reduced management requirements for oil and gas industries. Congress exempted oil and gas wastes from Subtitle C regulations for hazardous wastes, which the EPA seconded (Roberson, 2012). Ultimately, this leaves fracking wastes only regulated according to non-hazardous waste requirements which are far less stringent.

Yet another federal exemption occurs under the *Emergency Planning and Community Right-to-Know Act (EPCRA)*. There is no federal law that requires the composition of fracking fluid to be disclosed to environmental regulators. The EPCRA only requires the annual submission of a Toxic Chemical Release Form to the EPA for its inventory (Spence, 2013). However, the oil and gas industry is exempt from being required to complete and submit the form due to industry classification. Consequently, there have been concerns from citizens who are unable to test their wells for contamination by comparing results with the Toxic Chemical Release Inventory. Fortunately, however, it is still a federal regulatory requirement that fracturing operators complete and file a material safety data sheet for each hazardous substance used in their operation (Spence, 2013).

Under Section 112 of the CAA, the EPA is required to establish a set of standards for the emission of hazardous air pollutants (HAPs) from what are referred to as ‘major source’ and ‘area source’ category operations. Area sources are more stringently regulated under the CAA regulations applicable to the oil and gas industry, as opposed to major sources, when concerning HAPs. Furthermore, while area sources are not required under the CAA to obtain a Title V Permit, major sources are (Brady, 2012). According to Brady (2012:9):

> “Under EPA regulations, however, HAP emission from oil and gas exploration or production wells are exempt from the aggregation rule within the statutory definition of ‘major source’. Since most oil and gas wells, on their own, do not emit the threshold limit of HAPs under the statutory definition, they are not required to obtain a Title V Permit. This leaves HAP emissions from oil and gas wells essentially unregulated under the CAA.”

The *Comprehensive Environmental Responsibility, Compensation, and Liability Act (CERCLA)* holds three groups responsible for the costs related to clean up of hazardous chemicals, as well as the reporting of such spills: operators and owners of facilities using these hazardous chemicals, those arranging disposal of the hazardous substances, and those who accept the hazardous substances (Groat & Grimshaw, 2012). Brady (2012:10) observes that:

> "CERCLA defines a hazardous substance as those substances designated or listed under various statutes, including hazardous wastes listed pursuant to RCRA, as amended by the SDWA, but excludes petroleum, including…natural gas… This exclusion means that spills and releases of…natural gas, which contain chemicals otherwise covered under the definition of hazardous substances, are immune to federal regulation under CERCLA."

Concerns have been raised that these exemptions give oil and gas companies little incentive to follow through with preventing and cleaning up spills of hazardous substances.

In 1969, the *National Environmental Policy Act (NEPA)* established a framework with the intention of creating a means to protect the environment (Brady, 2012:10). NEPA requires that federal agencies conduct a proper assessment of the environmental impacts that may accompany any proposed action, as well as the alternative to this, if any are available. This is done by completing an Environmental Assessment to determine the extent of environmental impact of a given, and a separate and subsequent Environmental Impact Statement if significant environmental impacts are predicted (Brady, 2012; Roberson, 2012).

However, the Energy Policy Act of 2005 created an exemption, which extends to cover natural gas and thus shale gas development. According to Brady (2012:10):

> "The Energy Policy Act of 2005 created a rebuttable presumption that certain oil and gas related activities authorized…are subject to a 'categorical exclusion' under NEPA. The activities presumed to qualify for a categorical exclusion include activities…for the purpose of exploration or development of natural gas if the activity falls under one of the five categories. The excluded activities are presumed to have no significant environmental impact."

Ultimately, what this has resulted in is the fact that oil and gas activities are essentially no longer subject to the procedural requirements of NEPA, as described above.

4.4.2 State regulation

Hydraulic fracturing has always been primarily under state control, with the exception of cases on federal and Indian Reserve lands. In general, states that have a long history of oil

and gas development and production have their own state-level agencies which have the authority to regulate and control both exploration and production rules (Kulander, 2013). State agencies and regimes are often also tasked with trying to protect the environmental integrity of their states. Even though most environmental regulations that can be applied to the oil and gas industry are federal regulations under the control of the EPA, hydraulic fracturing is in many cases left to be managed exclusively under state authority.

Federal regulation and agencies are not always able to control and protect the environment effectively, and thus many federal regulations contain provisions that allow for states to implement their own programmes with federal approval (Arthur, Langhus & Alleman, 2008; Roberson, 2012). "By statute, states may adopt their own [sets of regulations], but they must be at least as protective as the federal principles they replace—they may actually be more protective in order to address local conditions" (Arthur, Langhus & Alleman, 2008:11). Once the EPA, or another relevant federal agency, approves the programmes, primary jurisdiction lies with the state (Arthur, Langhus & Alleman, 2008:11). States also determine the degree of local regulation by municipalities and the like, but that will be discussed further in the next section.

"Currently, states lead the day-to-day oversight of natural gas development because they have the on-the-ground personnel and expertise to safeguard local air, land and water" (America's Natural Gas Alliance, 2013). Due to unique geological features in different states, state-level enforcement of shale gas extraction regulation becomes vital (America's Natural Gas Alliance, 2013). Shale gas formations can vary greatly between different regions of a country in terms of geology. This is true for the United States of America where, in the state of Texas, for example, two separate shale formations fall within state boundaries, but both have completely different environmental surroundings and geological characteristics. Moreover, the shale plays in Texas are once again different to the Marcellus Shale in Pennsylvania.

Specific state-level regulations for shale gas and hydraulic fracturing account for such considerations as well design, well-casing depths, location and spacing, degrees of disclosure of drilling and fracking fluids, requirements for water storage, management and disposal, surface and wildlife impacts, and waste management and disposal (America's Natural Gas Alliance, 2013; Stark *et al*, 2012). According to Kulander (2013), new fracking rules on the state-level that have emerged over the last three years in the U.S. focus primarily on disclosure of additives in fracking fluids, as well as new requirements for fracking permits.

Furthermore, due to the fact that hydraulic fracturing is not explicitly mentioned in existing oil and gas regulation, most new state regulation is simply an extension of the existing regulations that also cover secondary and tertiary oil and gas development processes.

Aside from state regulations, there are a number of state-level agencies with the authority to control shale gas development in gas producing states. Arthur, Langhus and Alleman (2008:11) observe that:

> "The state agencies that regulate environmental practices and monitor and enforce their laws and regulations may be located in…the Department of Environmental Protection (such as in Pennsylvania) [or] the Texas Railroad Commission [that] regulates oil and gas activity in the nation's largest oil and gas producing state, home to the Barnett Shale."

While the structures and names of these state-level agencies differ, they do, however, have very similar regulatory functions related to shale gas and hydraulic fracturing (Arthur, Langhus & Alleman, 2008).

A number of independent review programmes and agencies are also in place for the oil and gas industry. "State oil and gas environmental programs are also periodically reviewed against a set of guidelines developed by an independent body of state, industry, and environmental stakeholders", called the State Review of Oil and Gas Environmental Regulation (STRONGER) (Arthur, Langhus & Alleman, 2008:12-13). Prior to this, the Interstate Oil and Gas Compact Commission (IOGCC) was responsible for state reviews. The IOGCC is a multi-state governmental agency that acts as an authority on shale gas extraction and "advocates for environmentally-sound ways to increase the supply of American energy…by providing governors of member states with a clear and unified voice to Congress" (IOGCC, 2013). Together with the Groundwater Protection Council, the IOGCC also helps to manage the FracFocus disclosure website, which was created to report to the public chemicals usage for fracking. In many cases, FracFocus is used by oil and gas producing states as an official forum for chemical disclosure (FracFocus, 2013; Williams, 2012).

To gain a slightly more in-depth understanding of state regulation of shale gas, two gas-producing states and shale formations will be discussed in more detail. First, the discussion will cover Pennsylvania, with an emphasis on the Marcellus Shale. This will be followed up by a discussion on shale gas development in Texas, with an emphasis on the Barnett Shale. These two examples have been selected owing to the abundance of policy lessons which they

offer, regarding the broader themes of who is regulating shale gas and hydraulic fracturing and furthermore, what is the underlying regulatory influence of the regulator in each state.

Pennsylvania

"Pennsylvania is one of the original natural gas producing states [in the U.S.]" (Roberson, 2012:94). Pennsylvania's state regulatory and statutory history is not as extensive as its drilling and production history. While there have been many statutes and regulations enacted throughout the drilling and production history of the state, only very few of these have directly covered the exploration and development of different petroleum resources (Carter, Harper, Schmid & Kostelnik, 2011). Kulander (2013:1125) states that "so much of Pennsylvania's oil and gas case law is over a century old and, until recently, practically no regulations affected hydraulic fracturing."

Some distinction and clarification is necessary when trying to understand the regulation of fracking and shale gas development in the state of Pennsylvania. Carter *et al* (2011:224) observe that:

> "The body of documentation used to regulate the oil and gas industry in Pennsylvania is composed of both statutes and regulations. 'Statutes' are laws enacted by Pennsylvania legislature. In contrast, 'regulations' are certain rules written by those working with the state executive branch… Ultimately, all statutes and regulations are consistent with the Pennsylvania State Constitution."

In Pennsylvania, as part of the state Department of Environmental Protection (DEP), the Pennsylvania Bureau of Oil and Gas Management (BOGM) oversees oil and gas development in the state in accordance with state statutes. Ultimately, as a part of its oversight duties, the BOGM regulates safe exploration, development and production of natural gas reserves extracted from the Marcellus Shale, with the aim of protecting the natural resources and environment of the Commonwealth of Pennsylvania (DEP, 2013). The DEP has the responsibility of issuing drilling permits, operations inspections and the management of water quality issues. This is done to "advise well drillers and operators on best management practices and procedures for environmental control and waste management" (DEP, 2013).

There are a number of other state agencies and commissions that are actively involved in the regulation of the development and production of shale gas in Pennsylvania. Firstly, the Pennsylvania Department of Conservation & Natural Resources (DCNR) is the state agency

acting as the leasing agent for natural gas extraction activities conducted on state land that it manages. It has also developed extensive guidelines to ensure minimal impacts on the environment and human safety from natural gas extraction (Marcellus Shale Advisory Commission, 2011). The Public Utility Commission (PUC) is Pennsylvania's regulatory agency responsible for overseeing every public utility that operates in the Commonwealth (Marcellus Shale Advisory Commission, 2011). The Federal Energy Regulatory Commission (FERC) holds exclusive jurisdiction over the interstate transportation of natural gas (Marcellus Shale Advisory Commission, 2011).

River basin commissions such as the Susquehanna River Basin Commission (SRBC) and the Delaware River Basin Commission (DRBC) are also important regulatory agencies for shale gas development in Pennsylvania. "Because of the water consumption requirements, gas companies may not begin gas well construction, drilling, or fracking without commission approval", thus allowing for regulation of the use of water resources (Pennsylvania State University, 2011:4).

Shifting focus more toward state regulations and statutes on shale gas and hydraulic fracturing, "one might speculate that the differences between…state regulatory regimes correlate with the variant natures of the missions of the agencies given primary jurisdiction over natural gas production operations in each state" (Spence, 2013:457). This is an important regulatory lesson. In Pennsylvania, the primary state regulator is the Department of Environmental Protection and it appears that shale gas and fracking rules are general in nature, but, for example, rules for waste disposal are particularly strong and detailed (Spence, 2013). "On the other hand, though Pennsylvania's environmental rules are more specific than Texas', it does not appear that Pennsylvania's regulation of natural gas production (and of fracking in particular) is generally more environmentally stringent than regulation is in Texas" (Spence, 2013:458). While this may be true in relation to certain aspects of regulation of shale gas, on the whole there is still a far greater environmental focus surrounding shale gas regulation in Pennsylvania than in Texas.

In 2012, for the first time since 1984, there was a comprehensive rewrite of Pennsylvania's Oil and Gas Act. "Pennsylvania's legislature recently passed House Bill 1950, which was signed by Governor Tom Corbett on February 14, 2012, and designated Act No. 13 of 2012 ("Act 13")" (McQuaid, Hulbert & Gaetani, 2012:1). Amendments made to the previous Oil and Gas Act under the new 'Act 13' can be divided into different categories (McQuaid,

Hulbert & Gaetani, 2012). Firstly, amendments have been made to bonding and regulatory requirements, particularly for well application permits which are now required to be submitted to adjacent municipalities.

Secondly, setback distances and location requirements have been amended. These amendments provide increased protection for surface waters and underground sources of drinking water against pollution from shale gas and hydraulic fracturing activities, as well as protection against diminution of state water supplies from these same activities. Thirdly, Act 13 amendments have been made for the prevention of land disturbance and protection of groundwater. Regulatory precautions have been taken to prevent spills and pollution from wastewater fluids. Further amendments have also been made to chemical disclosure obligations, however Act 13 still provides a degree of "trade secret and proprietary information protections to…vendor[s], service provider[s], [and] operator[s]" (McQuaid, Hulbert & Gaetani, 2012:3).

Regarding the disposal of drilling fluids, Pennsylvania has made strides towards extensive recycling of wastewater from hydraulic fracturing. This has been accomplished through new standards for the amount of total dissolved solids (TDS) for drinking water. "[In Pennsylvania] the industry is moving aggressively toward 100% recycling of the water used in its operations because underground disposal options are limited in these areas" (America's Natural Gas Alliance, 2013). Furthermore, in 2011, the state Governor, Tim Corbett, "requested that drillers stop sending fracking wastewater to treatment plants, which could only partially treat the water before releasing it into rivers" (Negro, 2012:6). Finally, one of the biggest changes that has emerged with the new Act 13, which directly covers hydraulic fracturing, was the introduction of impact taxes—commonly referred to as 'fees'. "Among the key provisions of Act 13 is the establishment of a drilling impact fee, which utilizes operators' fee payments" which are then collected and "deposited into the newly established 'Unconventional Gas Well Fund'" for the benefit of the Commonwealth (McQuaid, Hulbert & Gaetani, 2012:1; Kulander, 2013:1127).

Ultimately, in the state of Pennsylvania, amendments developed for direct application to shale gas and hydraulic fracturing activities—seen with Act 13—have been made with an underlying environmental influence. This influence can be seen through the focus of new regulation on environmental protection and waste management for example. This suggests that the impact of an environmentally-oriented regulator of shale gas and hydraulic

fracturing, such as the DEP and BOGM, can be quite significant in determining the nature of regulations for natural resources such as shale gas and its associated hydraulic fracturing activities. This presents an important policy lesson under the broader theme of the role of the underlying emphasis of regulatory agencies for shale gas and hydraulic fracturing, which may be transferred to other countries and policy contexts.

Furthermore, another lesson exists with regard to the development of new regulation directly applicable to shale gas and hydraulic fracturing in the form of Act 13. The lesson here is that, even in a state like Pennsylvania with an established history in natural gas production, it was still deemed necessary to develop and promulgate an entirely new set of regulations to specifically regulate shale gas and hydraulic fracturing. Finally, this is also a lesson on the use of interactive federalism, which allows sub-federal levels of government to experiment and innovate with their own regulations for shale gas and hydraulic fracturing, while still maintaining and respecting previously-determined roles in relation with other levels of government.

Texas

As the second largest state in the U.S., both in terms of population and land area, Texas has a very long history of oil and gas production (Rahm, 2011). Even though successful drilling of oil in Texas has occurred since the 1860s, "Texas did not enter into the true boom of oil and gas production until 1901 when the Spindletop gusher came in. Since that discovery, Texas has maintained its position as one of the world's largest producers of oil and gas" (Rahm, 2011:2978). According to 2011 figures in Rahm (2011:2978), the state of Texas produced approximately 30% of the total U.S. natural gas, thus emphasizing its role and classification as a key player in natural gas production in the U.S. "Perhaps more than any other state, Texas has been criticized for its fracking regulations, primarily because until recently no rule addressed the practice specifically" (Willie, 2011:1765).

Texas has no formal regulation of hydraulic fracturing. "The Railroad Commission of Texas (RRC) regulates natural gas exploration and production and has jurisdiction over all natural gas wells. The Texas Commission on Environmental Quality (TCEQ) protects the state's natural resources and strives for clean air, clean water, and the safe management of waste" (Roberson, 2012:90). Together, these two agencies have created a memorandum of understanding which covers the division in jurisdiction between them. From this agreement, the RRC has the authority to regulate practically all other environmental facets of oil and gas

development and production in Texas. “However, the RRC must submit groundwater contamination notices to the TCEQ. The TCEQ provides recommendations concerning groundwater protection such as identifying fresh water zones and drilling protection depths from geological data” (Roberson, 2012:90). The TCEQ also has limited regulatory power over air quality in the state (Kulander, 2013).

The organisation of regulatory agencies for hydraulic fracturing is quite different from that of other U.S. states. As mentioned above, the RRC is the main regulatory agency in Texas that controls and administers regulations for oil and gas development and drilling (Brady, 2012). However, unlike in other states where the main environmental agency is in charge of oil and gas development and production, in Texas, the TCEQ is “not the primary state regulatory agency with jurisdiction over oil and gas operations or the wastes produced from those operations” (Kulander, 2013:1129). The TCEQ is more involved with regulating the quality and the use of surface waters in the state.

Texas has chosen to apply most of their existing regulatory regimes relevant to natural gas production to hydraulic fracturing operations. However, in early 2012 revisions were made for hydraulic fracturing (Spence, 2013). In comparison with other oil and gas producing states such as Pennsylvania, Texas has far more prescriptive and specific rules for the operational requirements of hydraulic fracturing in contrast with environmental protection. This difference in orientation and focus of regulations might be attributed to the differences in the underlying goals of the various state regulatory regimes with primary natural gas jurisdiction (Spence, 2013). In line with this concept of mission-oriented regulation, it follows that in Texas it can be said that the state legislature sought to advance natural gas development without placing emphasis upon environmental values. This was done by delegating the regulatory authority for oil and gas development to the RRC, an oil and gas commission. However, this is somewhat counterbalanced by sharing some authority with the TCEQ. Once again, this highlights an important policy lesson under the theme of underlying influences of regulators of shale gas and hydraulic fracturing on regulation thereof.

The most important fracking-related regulation in the state of Texas is certainly the disclosure law of 2011. “On March 11, 2011, the Chairman of the Texas House of Representatives Committee on Energy Resources filed a bill entitled “Disclosure of Composition of Hydraulic Fracturing Fluids” (Roberson, 2012:90). The purpose of this bill was to require oil and gas operators to disclose to the RRC the chemical composition of fracking fluids used in fracking

operations, and thereafter make this information available to the public via the a chemical disclosure website. On 17 June, 2011, Texas Governor Rick Perry passed law HB 3328, making Texas the first state in the U.S. to mandate public disclosure of fracking chemicals—except for proprietary information, together with required water volumes, to the public disclose registry website, called FracFocus (Bipartisan Policy Centre, 2012; Negro, 2012; Thorn, 2012). "To address competitiveness concerns, the Texas rule also includes processes to protect trade secrets that might otherwise be exposed by disclosure operations" (Bipartisan Policy Center, 2012:17).

"One element of disclosure laws that has attracted criticism by environmentalists in Texas, and other states with similar loopholes, is the part that allows an operator to withhold certain information from disclosure that it claims to be a trade secret" (Kulander, 2013:1130). Particularly, if under the disclosure law the chemical components of fracking fluids are covered as a trade secret, according to the Texas Government Code, immediate public disclosure is not required. Importantly, however, it must be noted that there is an exemption to the trade secret clause. "The operator must still provide a way to supply the withheld information to 'health professionals' and 'emergency responders' in case of an injury, release, or other accident caused by or attributable to the fracking operation" (Kulander, 2013:1131). This presents an interesting policy lesson regarding who benefits from particular regulatory exemptions and loopholes. With the above in mind, it would appear that in Texas, regulatory exemptions tend toward serving the benefit of oil and gas companies, investors and operators, as opposed to environmental protection and public health and safety.

Water and air quality regulations fall under the authority of the TCEQ. In light of terrible droughts experienced in Texas in 2011 and 2012, the TCEQ relies upon a seniority water rights programme to control the volume withdrawn for natural gas production, which works on a seniority priority basis (Kulander, 2013). Air quality, specifically the effect had by oil and gas operations, is another major focus of the TCEQ. "After extensive study, the executive director of the TCEQ determined that the air permitting rules for oil and gas production and treatment sites, particularly in high population areas, had to be significantly revised" (Kulander, 2013:1135). Thus, "in January of 2011, the TCEQ promulgated rules covering twenty-three counties in and around the Barnett Shale… [making] air quality standard permits necessary for the operation of new stationary facilities or groups of facilities, at a site where natural gas" is processed (Kulander, 2013:1135).

While many states have made regulatory provisions regarding well casings, so as to prevent any pollution of water and land from natural gas and fracking operations, Texas has very specific regulations: "Texas rules specify exactly where the well casing must be constructed within the well, the materials to be used, and how the casing is to be cemented and pressure tested" (Spence, 2013:455-456). As it stands, "the RRC is confident that the casing, cementing, drilling, and completion requirements adequately protect Texas' groundwater from hydraulic fracturing fluids" (Roberson, 2012:90). However, it is important to realize that this kind of statement refers to existing oil and gas regulation, which is not necessarily specific in nature only to hydraulic fracturing. Furthermore, "in reality, the RRC does not require a special fluid injection permit for hydraulic fracturing" (Roberson, 2012:90).

While it is apparent that in Texas, regulatory agencies for shale gas and hydraulic fracturing do play an active role in regulation, the fragmented nature of regulation on one hand and the failure to develop a set of new shale gas and hydraulic fracturing-specific regulation, have left Texas with a patchwork regulation. This is made up of a hodgepodge of regulatory action of varying degrees and many exemptions which serve oil and gas company benefits, but hinder full environmental protection and public health and safety.

Rahm (2011:2978) observes that:

> "While other states have moved legislatively or administratively to control shale gas drilling within their jurisdictions, the regulatory climate of Texas has thus far prevented any further action in the Lone Star State… The reasons are interrelated and primarily due to the fragmentation of the regulatory bureaucracy, a fundamental anti-regulatory disposition, and a well entrenched legal and administrative structure that promotes oil and gas extraction above other concerns."

Oversight of some important aspects of industry, such as the exemption of limited use of groundwater sources for shale gas and superseding of mineral rights over land rights, has left major holes in state regulation as a consequence of these exemptions. It is also indicative of the results from when a sub-national regulatory agency adopted a different regulatory path than federal government, which is an important policy lesson.

Furthermore, while already lacking a strong environmental protectionism ethos, "under the leadership of Governor Rick Perry, Texas has taken a decidedly anti-EPA and anti-federal regulation position" (Rahm, 2011:2978). The TCEQ has been given primacy to implement environmental laws relating to air and water. However, in 2010, the TCEQ found itself in a position of conflict with the EPA over what the EPA considered to be a lax enforcement of

the Clean Air Act, which is a federal regulation. In 2010, Texas was the only state to refuse the implementation of the EPA's greenhouse gas regulations. This led to the EPA seizing authority over the issuing of greenhouse gas permits under the CAA in the state. This was appealed by the state, which claimed that the EPA was overreaching its authority. The TCEQ, however, did investigate toxic air emissions in Texas after complaints from citizens in Dish County. Findings revealed elevated levels of toxic air pollutants, such as benzene. This led to the subsequent implementation of an air emissions monitoring programme in the Barnett Shale (Rahm, 2011).

There has also been conflict between the RRC and the EPA. Rahm (2011:2978) observes that:

> "[The RRC] is responsible for community safety and stewardship of natural resources, while at the same time one of its missions is to promote enhanced development and economic vitality… [However, given] its dual purposes, some would suggest that the missions of community safety and of stewardship of natural resources fall victim to that of promoting the oil and gas industry."

The EPA has accused the RRC of lax enforcement of the Safe Drinking Water Act in Texas. In 2010, the EPA issued an Imminent and Substantial Endangerment Order, in order to protect the drinking water in the Southern Parker Country in the Fort Worth region of the Barnett Shale, which the RRC had not addressed. In responding to findings of flammable substances in the drinking water wells in the area, the EPA trumped the authority of the RRC (Rahm, 2011). These examples are indicative of the importance of developing an interactive federalism between regulatory agencies at all levels of government, which will help with clearly defining the role of each agency. The pursuit of a common goal is important in developing regulation that is not filled with holes caused by exemptions, leading to a clear shift away from federal-level aims. This is a key policy lesson for the regulation of shale gas and hydraulic fracturing.

4.4.3 Local regulation

In addition to federal and state level regulation of oil and natural gas production, regulation at the local level is also of importance in the U.S. In addition to regulatory requirements at federal and state levels, "entities such as cities, counties, tribes, and regional water authorities may each set operational requirements that affect the location and operation of wells or require permits and approvals" (Arthur, Langhus & Alleman, 2008:13). Local governments,

in order to protect both the environment and welfare of the citizens in the areas that they govern, may establish ordinances.

"State law determines the extent of authority that municipalities may exercise, including the extent to which they may enact ordinances or regulations regarding gas drilling" (Negro, 2012:4). These permits may be for the control of such things as well placements, noise levels, drilling-related traffic, as well as set back distances from residences, schools and urban areas (Arthur, Langhus & Alleman, 2008). "In Texas, a municipality may determine, for example, through zoning laws and permitting, whether and where drilling occurs" (Negro, 2012:4). States have in some cases also integrated certain municipal concerns over oil and gas production into state decision-making processes, and in other cases, some states have taken steps to reverse the authority given to local governments (Negro, 2012).

Wiseman & Gradijan (2012:16) observe that:

> "Several states have begun examining—and in some cases changing—the balance of local and state jurisdiction. Pennsylvania, for example, now allows counties to impose unconventional gas well fees on shale gas development and municipalities to impose the fee if counties fail to do so."

However, Pennsylvania state law still prohibits municipalities from controlling most aspects of oil and gas development. (Wiseman & Gradijan, 2012)

Like with the city of Pittsburgh, Pennsylvania as an example, there have been increased levels of activity on the part of cities in a move towards the banning of fracking within their relevant jurisdictions (Infante *et al*, 2012). Within Pennsylvania, two counties located in the South Newark Basin have placed a moratorium on fracking taking place on state forest land. This moratorium is valid until 2018 (Infante *et al*, 2012). Zoning laws have caused issues, as was the case in South Fayette, Pennsylvania, between the local government and Range Resources. Ultimately, due to the fact that the zoning ordinances created buffer zones around commercial areas, hospitals and schools, Range Resources argued that "these zoning ordinances violate state planning codes and amount to a *de facto* drilling moratorium" (Infante *et al*, 2012:8).

In a slightly different light, "some cities do not attempt to limit shale gas development, but require it to have less impact on human health and the environment. For example, Fort Worth and Southlake, Texas, require green completions on all natural gas wells" (Clark *et al*, 2012:11). In Texas, the use and appropriation of groundwater is controlled by municipalities

and in many areas by Groundwater Conservation Districts, which have the authority to develop and enact rules for the use and protection of groundwater (Kulander, 2013). Some municipalities in the state are also becoming involved in the use of city water for fracking purposes. The City of Grand Prairie was the first municipality in Texas in August 2011 to ban the use of city water supplies for fracking purposes, while some cities do not allow their water supplies to be used for fracking beyond the city limits.

4.5 Implications of regulatory exemptions for shale gas

The exemptions for shale gas and hydraulic fracturing in related regulations on federal, state and local levels of government in the U.S. have created negative implications regarding environmental protection and public health and safety. These implications have in turn led to the emergence of related concerns, which have been highlighted in the literature on the regulation of shale gas and hydraulic fracturing as such. Based upon these implications or concerns from exemptions for shale gas and hydraulic fracturing, there are a number of central themes around which policy lessons on these mitigating factors can be drawn.

Very important lessons can be learned from these regulatory exemptions by other countries looking to develop their own shale gas resources and shale gas industries. These regulatory exemptions in the U.S. have played a significant role in shaping the development of the shale gas sector of the U.S. oil and gas industry. Depending on what onlookers from other countries are aiming to achieve by learning from the U.S. case, by studying and analysing the regulatory exemptions, they may choose to adopt certain exemptions to achieve within their own borders an environmentally-safe and cost-effective means to develop their own shale gas reserves, or equally, choose to take lessons on what to avoid duplicating in their own setting. Importantly, Richard Rose does not dismiss so-called ‘negative’ lessons, but rather advocates learning from what one might term the ‘errors’ of others (Rose, 2005).

The development of the shale gas industry in the U.S. has brought with it a great deal of scrutiny from the American general public, and has generated a significant debate over the potential health, safety and environmental risks associated with shale gas development. The social and economic benefits that come with fracking stand to be offset largely by potential environmental impacts. These environmental risks, if left unresolved and unregulated, could well stand to hamper the strides made in terms of both the cost-effectiveness and the development of shale gas as a resource (Infante, *et al*, 2012; Roberson, 2012).

The uncertainty of the health and safety effects of fracking has encouraged some states in the U.S. to impose moratoria on hydraulic fracturing or consider stricter regulations for its processes until more could be understood. "President Obama and other members of his Administration also called for increased scrutiny of fracking practices, and [for] Congress conducted hearings and investigations" (Infante *et al*, 2012:1). Most notably, on 3 March, 2010, the U.S. Environmental Protection Agency (EPA) announced that it would be conducting a comprehensive investigation into the "potential adverse impact that hydraulic fracturing may have on water quality and public health" (Broderick *et al*, 2011:75). The results and final report are expected to be released in 2014.

Major concerns that are recurring in the literature on shale gas include such issues as "groundwater (aquifer) contamination by fracking chemicals, accidental chemical spills, waste disposal, air quality, the land footprint of drilling activities…and the amount of water used" (Rahm, 2011:2975), as well as seismic activity. These concerns are some of the most important themes or focal points upon which U.S. regulation on shale gas and fracking have been made, amended, or challenged. Again, it is important to remember that these 'concerns' have emerged as implications of regulatory exemptions. While all of these concerns may be categorised with the help of thematic analysis, they are, however, ultimately all related and inextricably interlinked and, in many cases, overlap under the broader theme of concerns resulting from shale gas extraction activities.

The first of these concerns relates to groundwater contamination. Normally groundwater is water of a high quality that collects in underground aquifers. The concern usually lies with the potential contamination of aquifers and drinking water sources by methane, fracking fluids and other naturally occurring radioactive materials (NORMs) (Zoback, Kitasei & Capithorne, 2010). This may happen through failure of well integrity or contaminants travelling through unintended subsurface fractures created by fracking. In this case, concerns have emerged due to exemptions for shale gas development and hydraulic fracturing in such legislation as the SDWA and CWA. Also, there are no uniform regulations between states at state level for drilling and well construction and integrity, creating the opportunity for potential contamination to occur. Without direct consequences from regulators, there is a very good possibility that this could cause drastic environmental and health impacts (Broderick, Anderson, Wood, Gilbert & Sharmina, 2011; Thorn, 2012; Groat & Grimshaw, 2012).

Also linked to the contamination of ground and surface water are concerns about fracking fluids and flowback fluids. Fracturing fluid is made up of a mixture of 99% water and sand which acts as a proppant, and roughly 1% of a mixture of different chemicals which are used to give the fracturing fluids different qualities for fracking, based upon the characteristics of the target shale formation (Broderick *et al*, 2011; International Energy Agency, 2012). Typically a mixture of between 3 to 12 chemicals is added to the fracturing fluid, depending on the given characteristics. Rahm (2011:2976) observes that:

> "Critics allege that some of the substances used are hazardous materials and carcinogens, toxic enough to contaminate groundwater resources and create toxic air emissions. These include diesel fuel, kerosene, benzene, toluene, xylene, and formaldehyde."

A number of communities have claimed that hydraulic fracturing activities and waste products have polluted their air and drinking water (Rahm, 2011).

Flowback fluid contains the abovementioned chemicals, as well as naturally-occurring matter such as naturally occurring radioactive materials (NORMs). Cases of contaminated drinking water have been seen in Wyoming, while the EPA also investigated a case of NORM contamination of groundwater in Dimock, Pennsylvania (Vann, Murrill & Tiemann, 2013:14). Further concerns have been raised due to refusal by oil and gas companies to disclose the chemical composition of their fracking fluids, claiming that it is a trade secret. While contamination could occur due to exemptions under the SDWA, CWA and RCRA, the issue of trade secrets falls under the EPCRA exemption. Operators are not required to submit to the EPA Toxic Chemical Release Forms stating which chemicals they are using. They are only required, in the case of emergency spills, to make the chemical composition available to emergency medical practitioners who are then also required to uphold confidentiality.

Surface water and land contamination is another major concern. The term surface water refers to water that has been collected above ground in rivers, lakes, streams and ponds. Concerns of contamination of surface waters and land during the transport, storage and disposal of chemicals for fracking have emerged (Zoback, Kitasei & Capithorne, 2010). Contamination can occur through spillage, overflow, runoff, flowback chemicals, or transport of fluids and chemicals (Broderick *et al*, 2011). In some states, evaporation pits, used for flowback fluid, do not even require a protective lining, and if they do, standards vary and so, in some cases, improper requirements lead to leaks and spills (Groat & Grimshaw, 2012). The fact that there are no uniform federal regulations or best-practices approach to regulate the storage, transport

or disposal of fracking fluids and chemicals, has proven problematic. States and local governments regulate these issues independently of one another, creating opportunities for accidents and/or contamination if correct practices are not followed. Exemptions here fall under the RCRA, CERCLA and EPCRA, particularly for the management, disposal, cleanup and disclosure of fracking fluids and chemicals.

As discussed earlier, exemptions for the treatment and management of wastewater from fracking fall under the RCRA classification of fracking wastes as being non-hazardous (Williams, 2012). This poses a significant environmental threat not only to vegetation, surface water sources and animals, but also to humans through air emissions from evaporation. Due to improper storage and management of fracking fluids, Tropical Storm Lee in 2011 caused wastewater ponds to overflow in Pennsylvania (Williams, 2012:26). "Wastewater may change riparian vegetation which affects roosting spots, shade and woody debris that are relied upon by trout, eagles, herons, and other species" (Roberson, 2012:127). There have also been cases of entire herds of cattle being found dead after drinking contaminated surface water in Louisiana (Roberson, 2012).

Differing geologic conditions across the U.S. mean that disposal techniques that work for one area may not work for another. In the Marcellus Shale, attempts have been made to recycle wastewater from fracking, but transporting water to treatment facilities creates the opportunity for contamination of surface water and land, as well as the deterioration of land and road conditions. In many cases hundreds of truckloads of water need to be transported to and from the well site. This places an intense burden on local roads which cannot carry the strain of the heavy traffic. It also causes intense traffic congestion which can be frustrate local citizens in areas where drilling is occurring. To remedy this, the "West Virginia Department of Transportation has increased the bonds that industrial gas drillers must pay from $6,000 to $100,000/mile" (Broderick *et al*, 2011:92-93).

Treatment facilities are also often unable to treat wastewater due to high levels of NORMs and chemicals. In spite of the intention of treating, cleaning and recycling this flowback fluid, Roberson (2012:123) observes that:

> "…because there is no comprehensive federal standard to determine a safe level of radioactivity in drilling wastewater, drilling wastewater is unrealistically compared to federal drinking water standards... Most treatment facilities are unable to remove enough NORMs to meet the federal drinking water standards before releasing wastewater into rivers."

There have also been cases in Montana and Wyoming where wastewater was discarded and disposed of on the surface of well sites without being tested for radioactivity (Roberson, 2012). Concerns have been raised due over environmental impacts such as the alteration of ecological structure, erosion, damage to vegetation, and, most importantly, extreme damage to croplands (Roberson, 2012). Due to disparities in the way in which state and local governments handle wastewater treatment and management, these types of issues might arise through unclear authority between these levels of government, as well as varying federal regulatory exemptions under the RCRA, NEPA, EPCRA and CERCLA.

For hydraulic fracturing, water consumption is one of the most contentious issues when it comes to the development of shale gas wells. Significant amounts of water are required throughout the drilling and production phases of operation of a shale gas well. Water may be obtained from surface water sources such as rivers, lakes, ponds and in some instances the sea. It may also be sourced from local boreholes (which means drawing water from either shallow or even deep aquifers), municipal supplies, or reused and recycled waste water from treatment plants, industry or previous fracking operations (Groat & Grimshaw, 2012; International Energy Agency, 2012). "In the U.S., each stage in a multi-stage hydraulic fracturing operation requires around 1,100-2,200m^3 of water so that the entire multi-stage fracturing operation for a single well requires around 9,000-29,000m^3 (9-29 megalitres)" (Broderick *et al*, 2011:90).

Depletion of water sources is a major concern, which could "lower the water table, affect biodiversity, and harm the local ecosystem. It can also reduce the availability of water for use by local communities and in other productive activities, such as agriculture" (International Energy Agency, 2012: 31-32). In some states, such as Texas, operators are allowed to withdraw as much groundwater for fracking as they deem necessary, due to specific exemption of groundwater use under the state water code.

Hydraulic fracturing has in recent years become associated with seismic activity in the form of low magnitude earthquakes. This has been cause for concern, for citizens regard safety issues relating to fracking with trepidation, particularly in light of drilling sites being in such close proximity to populated and residential areas and schools. While studies have indicated that there is no conclusive link between fracking and earthquakes, they do agree that the related underground injection of wastewater from shale gas operations could be the cause (Zoback, Kitasei & Capithorne, 2010). Similar occurrences of increased seismic activity near

to wastewater injection sites have been experienced in a number of different states, including Oklahoma, Colorado, Arkansas and Ohio (Thorn, 2012; Clark *et al*, 2012). Due to the lack of regulation on wastewater disposal in the form of exemptions under the RCRA, this has become a major concern due to seismic activity caused by its underground injection.

By emitting high levels of pollutants, such as carbon dioxide and others into the air, natural gas extraction has contributed significantly to air pollution. Gas-powered compressors, used at well sites, emit carbon dioxide and vehicles used for transportation in the hydraulic fracturing processes also release carbon dioxide into the air (Roberson, 2012). In particular, large quantities of methane are released during production and storage processes. Even rural areas of Wyoming have lately failed to meet federal air quality standards due to high levels of volatile organic compounds (VOCs) (Roberson, 2012). "VOC reacts with sunlight and creates smog that is hazardous to human health and causes chest pain, coughing, throat irritation, bronchitis, emphysema, and asthma" (Roberson, 2012:129).

Some of the fracking-related environmental concerns are also directly affecting human and animal health and quality of life. "Shale gas caught the public's attention when drilling rigs were no longer silhouetted by a prairie, but instead pierced the urban skyline interlaced with homes, businesses, schools, and churches" (Robertson, 2012:115). The proximity of shale gas drill sites to homes and residential areas has been a cause for great concern amongst affected parties. "Erection of new pipelines to accommodate the newly-produced natural gas from shale gas plays can be an issue, especially in heavily-populated areas," with reported incidents of explosions in some cases (Rahm, 2011:2976). Policy makers and regulators are now facing "the task of ensuring that shale gas development does not interfere with existing land uses, such as residential uses with natural resources" (Plikunas *et al*, 2011:10).

Environmental groups are claiming that the 2004 EPA study's results were botched and that more research on the impact of hydraulic fracturing is necessary. Not only are they suggesting inherent high risks to human health, but that the same risks also impact upon wildlife through, for example, wastewater discharge into rivers (Roberson, 2012:126-127).

The industry also used to use diesel fuel which contains benzene—a known carcinogen—which people claimed was causing cancer in communities close to fracking activities. This was also suggested regarding the effect of crystalline silica dust, another known carcinogen in the sand used as a proppant. Subsequently, the decision was made to discontinue diesel use (Roberson, 2012; Clark *et al*, 2012). Public concerns over global climate change and

greenhouse gas emissions have arisen due to methane emissions from natural gas extraction. In response, however, the EPA has created new requirements for hazardous air pollutants from natural gas extraction under the CAA, which previously did not cover such emissions (Clark *et al*, 2012:10).

4.6 Conflict of authority for shale gas regulation

"Effective regulation of shale gas development must not only provide adequate protection of human health and the environment, but also build upon what has been developed previously" (Groat & Grimshaw, 2012:33). In the U.S., shale gas regulation has thus far been developed and achieved based upon a solid framework of laws developed for conventional oil and gas industries. Even though the majority of these laws were developed and enacted years prior to the advent of commercial shale gas production, they are still in many instances applicable. "Shale gas development is regulated at almost all levels of government, but in principal regulatory authority lies with the states" (Groat & Grimshaw, 2012:33).

In the U.S. a clear conflict of authority exists between federal, state, and local levels of government regarding the regulatory control of shale gas reserves. This conflict of authority, between different levels of government, is a key area from which policy lessons may be drawn regarding the management of government regulation of shale gas development. Examples of conflict between the EPA at the federal level and the State government of Texas have already been presented earlier in the chapter. The core argument from the Texas State government was that the EPA was overreaching in its authority regarding what the EPA considered to be the lax enforcement of a federal regulation within the state, namely the CAA. In spite of primacy to implement environmental laws concerning air and water being given to a state agency, in the end the EPA seized authority in the matter of the issuing of greenhouse gas permits under the CAA in Texas.

A conflict of authority can also be seen between state and local levels of government in states such as Pennsylvania and Texas. Ultimately state governments, having been awarded primacy to regulate shale gas within their borders by the EPA and federal government, also have the authority to determine the degree of authority delegated to local governments. In some cases where state governments have allocated certain controls to local governments, they ultimately rescind this authority due to conflicts of interest. For example in South Fayette, Pennsylvania, while state government allowed Range Resources to go ahead with shale gas development, zoning laws determined by the local government created 'buffer

zones' in their (local government's) favour. This proved difficult for Range Resources, ultimately resulting in de facto drilling moratoria in different areas (Infante *et al*, 2012).

There are, of course, also differing opinions regarding the balance of authority for shale gas regulation in the U.S. Willie (2011), for example, argues that so-called 'spotty' regulation—a combination of federal and state regulation, as is presently the case—is better than either pure federal regulation or pure state-level regulation of shale gas. The key arguments made, concern regional differences and federal regulatory failures. Willie (2011:1772) observes that:

> "In many respects, the more local and specialized the regulation, the better. This is true primarily because oil and gas extraction methods, and therefore hydrofracking techniques, are almost always geologic- and region-specific. This fact makes additional federal regulation unnecessary at best and potentially extremely problematic if it conflicts with local and state land controls."

State officials are better informed regarding local practices in comparison with federal agents, and are equally more accountable to citizens. Federal agents are also less receptive to local concerns about fracking, due to vested interests in federal level regulation, as opposed to somewhat distant state and local regulation (Willie, 2011). "Ironically, even proponents of federal regulation acknowledge the need for region-specific fracking rules" (Willie, 2011:1773). Stronger federal regulation could also spell conflict in terms of overlapping rules and controls between state and local level regulators, which could ultimately serve to "slow down domestic oil and gas production" (Willie, 2011:1776). Interestingly to this end Jenner and Lamadrid (2013) also advocate what they term 'hybrid regulation', arguing that federal and state regulators should work together to iron-out current loopholes and make use of the wealth of regulatory knowledge to create the best regulatory outcome possible.

Spence (2012) poses the question of deciding which level of government one can consider best suited to making regulatory judgements regarding shale gas development and production. In arguing the federal case, Spence (2012) makes three key points. Firstly, federal regulation is essential to addressing effects which may spill over across various state boundaries. Secondly, Spence (2012) presents the 'race to the bottom' argument, where economic forces push states to under-regulate relevant environmental risks, due to competition with other states for jobs and investments. This leads to the lowering of regulatory standards to less than ideal levels. Thirdly, Spence (2012) argues that when

Congress expresses national interest in regulating and promoting the development of a natural resource, that federal regulation is vital to ensuring success therein.

However, changing sides to argue for state regulation of shale gas development in the U.S., Spence (2012) refutes all of the above points, arguing that they are not applicable to shale gas. Effects from shale gas development are usually local in nature and rarely spill over into neighbouring states. Furthermore, the 'race to the bottom' argument is also not applicable, due to the fact that there are such vast reserves of shale gas geographically spread across the U.S., that multiple states are not actually competing for the same supplies (Spence, 2012). Finally, Spence (2012) argues that the kinds of federal licensing necessary for other types of energy resources are unnecessary for shale gas, because government is showing interest in shale gas as a means to enhance U.S. energy independence and as a transition fuel. Ultimately, in Spence's opinion, "shale gas production seems to be proceeding apace on its own in the absence of any federal regulatory regime" (Spence, 2012:4).

4.7 Conclusion

In conclusion, it is apparent, upon analysis of shale gas and hydraulic fracturing regulation in the U.S., that many opportunities exist for policy lessons to be drawn for implementation in other policy and national contexts. These lessons coincide with themes revolving around regulation and regulatory exemptions at all levels of government for shale gas and hydraulic fracturing; the roles played by regulatory agencies for shale gas and hydraulic fracturing at all levels of government; and finally, the influence of the underlying emphasis and orientation on the development of regulations for shale gas and hydraulic fracturing at all levels of government.

CHAPTER 5: Profit, People, Planet and Policy: South Africa's shale gas regulatory conundrum

5.1 Introduction

Having, up until this point, drawn inspiration from Richard Rose's lesson-drawing approach to policy learning and process, this research project has studied the U.S. regulation of shale gas extraction with a purpose of drawing possible lessons for their potential contextualisation and application to shale gas extraction in the South African policy and regulatory context. At this stage, having first conducted a close study of how shale gas extraction and development is regulated at different levels of government in the U.S., and thereafter extracting the so-called 'general' lessons out of this context specific situation, what is left to do is to discuss these general lessons in terms of their applicability to potential shale gas extraction in South Africa. In doing so, these general lessons are discussed regarding their potential to assist the South African government in developing sound and extensive regulation for potential shale gas development in this country.

It is further intended that these lessons lay the foundation for future development of contributions to potential cost-effectiveness of shale gas extraction, not only limited to economic terms, but also in terms of the development of a set of environmentally-conscious regulations specifically for shale gas and hydraulic fracturing. These regulations must avoid the repetition of unnecessary gaps in regulation and corresponding negative implications, as experienced in the U.S.

In light of the discussion on the contextualisation of these general shale gas lessons from the U.S. to the South African context, this chapter is divided into two sections. The first section of this chapter discusses the current situation in South Africa regarding potential shale gas extraction and development. The second section of this chapter discusses the potential lessons for South Africa from the U.S. These are discussed according to three themes: regulation, who is and should be regulating, and finally the underlying focus of the regulators. These themes and lessons are all inextricably interlinked.

5.2 South Africa's 'gift from God': Understanding the challenge for policymakers

South Africa, based upon estimated resources, is the fifth most shale-rich country in the world. With a history of mineral mining and other liquid natural gas development and refinement, South Africa is facing a new challenge on the oil and gas front. The country currently has no experience in terms of shale gas extraction and development, and also lacks

the necessary infrastructure for this to be done. Furthermore, the country also has no specific legislation or regulatory practices in place to deal specifically with shale gas and hydraulic fracturing. The South African government thus faces the challenge of drawing policy lessons from other experienced shale gas-producing nations, such as the U.S., in order to close regulatory gaps and to be able to exploit its national shale gas resources in an environmentally and economically responsible way. First, however, before these lessons can be discussed, on must understand how shale gas became a policy issue in South Africa, as well as comprehend the naturally-concerned responses to the potential extraction and development of these estimated shale gas reserves.

5.2.1 How shale gas got onto the South African policy agenda

According to the Department of Mineral Resources (2012 (a):15), in the mid-1960s the then state oil company, SOEKOR—now known at PetroSA—began with exploring for conventional onshore oil resources. However, by the end of the 1970s, this was abandoned due to the decision that there was no real possibility of success. Although there was knowledge that natural gas was rising to the surface through the boreholes on gold and coal exploration sites in Mpumalanga and the Free State, natural gas, at the time, was viewed as not possessing any real commercial value. Regardless of the abandonment of natural gas in South Africa, natural gas was being developed and adopted both as a cheaper alternative and a greener alternative to gas from coal elsewhere in the world.

In light of the tremendous success experienced by this new petroleum industry in the U.S., oil and gas companies began exploring other countries around the world, including South Africa. The advances made by various international oil and gas companies to the South African government for natural gas exploration purposes have served to renew interest in the Karoo region and the potential that it might hold for commercial gas extraction. “There are presently five applications for exploration rights under consideration, three of which are explicitly targeting shale gas in the Karoo Basin” (Department of Mineral Resources, 2012 (a):15). The three companies that have applied are Royal Dutch Shell, Falcon Oil and Gas Ltd and Bundu Oil & Gas (U.S. EIA, 2013 (a)).

5.2.2. Response of the South African government to potential shale gas reserves

As a consequence of resolute opposition to the applications made by Shell, Bundu and Falcon for exploration rights in the Karoo, a strong environmental activism movement has developed

in South Africa. Groups like the Treasure the Karoo Action Group (TKAG) contested these applications citing irreparable environmental damage to the Karoo's water sources and biodiversity from fracking (Dhliwayo, 2012). After this upon 1 February 2011, after this outcry from environmentalists, "Minister of Mineral Resources, Susan Shabangu, declared a fracking moratorium on new applications for reconnaissance permits, technical co-operation permits, exploration rights, and production rights…in the Karoo Basin" (Oberholzer & Molteno, 2013). This, however, did not extend to existing applications, such as the three parties previously mentioned, and thus, on 29 April 2011, Shabangu issued a further statement placing a moratorium on all new and existing applications until their feasibility could be determined by the Department of Mineral Resources (DMR). This 'hiatus' would serve to allow for the government to develop a plan for potential shale gas development in the Karoo (Maylie, 2012).

On 11 September 2011, during a press briefing, Minister Shabangu announced to the media and public that the moratorium had been lifted and that a report on the findings of an Inter-Ministerial Task Team on Shale Gas and Hydraulic Fracturing, established by the DMR, would be released on 18 September 2011 (Dhliwayo, 2012; Oberholzer & Molteno, 2012). The aim of the study was to "evaluate the potential environmental risks posed by the process of hydraulic fracturing as well as the negative and positive social and economic impacts of shale gas exploitation" (Department of Mineral Resources, 2012 (a):1). The Task Team comprised representatives of various national departments, as well as members of the Petroleum Agency of South Africa (PASA), Eskom, and other environmental organisations and councils. The Task Team also conducted a study tour to the U.S., visiting shale formations in Pennsylvania and Texas, as well as visiting the EPA and the RRC in Texas to learn from these regulatory agencies (Department of Mineral Resources, 2012 (a)).

Based upon the findings of the study, the Task Team proposed the conditional approval of fracking, along with a number of key recommendations, including: the allowance of normal exploration (excluding actual fracking) to proceed under existing regulation. It also announced the establishment of a monitoring committee for the development of regulation for fracking and supervision of operations; the augmentation of existing regulation to develop appropriate controls, regulations and co-ordination systems specific to fracking; and finally, agreed that, upon achievement of all recommendations, fracking be authorised under strict supervision of the established monitoring committee (Department of Mineral Resources, 2012 (a); Oberholzer & Molteno, 2012). It was furthermore proposed that ongoing research

be conducted to "to develop and enhance scientific knowledge", so as to later inform and be incorporated into relevant departmental programmes and the regulatory framework for fracking (Department of Mineral Resources, 2012 (b)).

5.2.3 The setting for potential shale gas development in South Africa

The primary area for the proposed extraction and development of South Africa's estimated 485 Tcf of shale gas is known as the Karoo (Figure 2) (U.S. EIA, 2013 (a); U.S. EIA, 2013 (b)). This semi-arid farming region of the country is the most sparsely populated area of South Africa. It is also well renowned for its unique characteristics and its classification as an internationally recognised biodiversity hotspot by the UNESCO World Heritage Centre due to its vast range of endemic flora and fauna (UNESCO, 2013). In this exceptionally water-scarce region, agricultural activities such as sheep farming, as well as eco-tourism are predominant and the degree of poverty is relatively high (Dhliwayo, 2012). According to the Department of Mineral Resources (2012 (b)):

> "It is a place where there are competing economic and other interests covering a diverse area such as farming; the site for SKA [The Square Kilometre Array radio telescope]; uranium reserves; potential for solar panels to drive renewable energy initiatives; as well as being the storechest of South Africa's fossils."

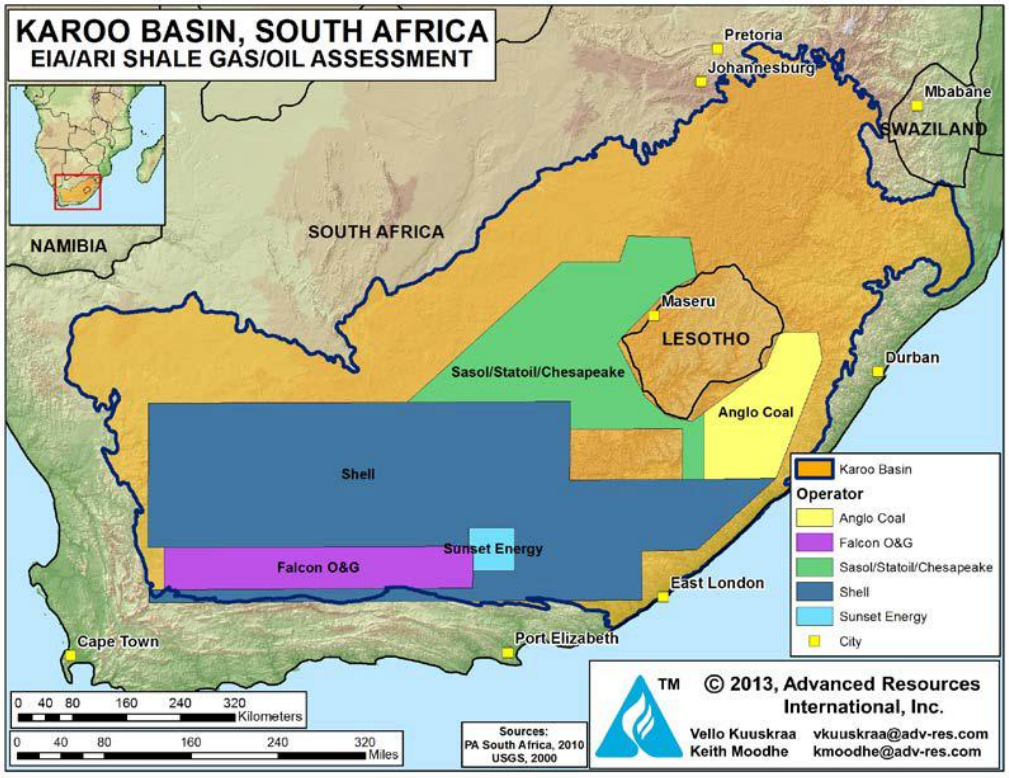

Figure 2. Karoo Basin, South Africa (U.S. EIA, 2013 (b):XIX-12).

Equally important in terms of contextualising the potential development of shale gas in South Africa is the energy crisis faced by the country. Even as Africa's biggest economy, South Africa is still running dangerously close to an energy shortage, and ever-increasing demand for electricity (Maylie, 2012). South Africa relies largely on fuel energy imports, while roughly 85% of its total energy comes from coal (Dhliwayo, 2012; U.S. EIA, 2013 (a)). While the country's current energy mix has been described as gas-anaemic, the Integrated Resources Plan (IRP 2010) advocates natural gas exploration in South Africa as a means to diversify its energy portfolio and an alternative to energy production from coal (Moolman, 2013 (a)). Specifically, the IRP 2010 made provisions for an increase in the gas makeup of the energy mix, however, sources to fill this gap have not yet been identified (Department of Mineral Resources, 2012 (b)).

"As a feedstock for electricity generation, shale gas could fill the gap", as well as fulfil the desire for a lower-carbon source of electricity for the country (Odendaal, 2013). Furthermore, former Minister of Energy Dipuo Peters published a determination in December 2012, indicating the department's plans to procure natural gas generation from 2021-2030, and thus speaks to an increased focus on infrastructure and development in the gas sector (Creamer, 2013; Moolman, 2013 (a)). In addition, Minister Shabangu stated that she was pleased that Cabinet had endorsed the lifting of the moratorium to allow for further exploration (Department of Mineral Resources, 2012 (b)). Consequently, "pressure to increase domestic energy output could force the government to look at possible ways to begin shale exploration while balancing environmental concerns" (Trefis Team, 2012).

5.2.4 Views on shale gas and fracking in South Africa: Fracker versus fracktivist

The fracking debate in South Africa appears to have taken the form of two clear sides: proponents and opponents of fracking. However, interestingly, it appears that the South African government has been awarded the status of proponent by the anti-fracking environmental activists and the media. Firstly, environmental activism against fracking in South Africa has developed quite a significant following, thanks to groups like Treasure the Karoo Action Group (TKAG) with Jonathan Deal, who have rallied support from the public. Media coverage has added to the critical view of government responses to fracking, while anti-fracking environmental activism has been portrayed more positively. Environmental activists have been adept at keeping national government's hands tied on the fracking issue and through campaigning and legal action, have been able to place enough pressure on

government for a moratorium to be put in place initially and then extended at a later stage (Walker, 2013).

Other environmental organisations, such as Greenpeace and the World Wildlife Fund, have also joined the TKAG, and have expressed disappointment at government's response to the potential reserves and the secrecy surrounding the Task Team report (Masondo, 2012; Schellhase, 2012). These groups have concerned themselves primarily with the potentially negative environmental and human health impacts of fracking and with advocating other renewable energy sources; all the while threatening, if necessary, to take the matter to the Constitutional Court to halt fracking on environmental grounds (Dhliwayo, 2012). Furthermore, environmental activists have also raised red flags regarding ANC ties with Royal Dutch Shell and the fact that it is the majority stakeholder in the gas reserves, a matter which has other South African political parties also crying foul (Artel, 2012).

It appears that the South African government, although somewhat precautionary due to the moratorium and Task Team report, has a relatively positive view regarding the potential shale gas reserves. Growing dependence on energy imports and the threat of an energy crisis could play a crucial role in determining the outcome of the fracking debate (Trefis Team, 2012). Shale gas development could clearly provide greater energy security for South Africa. Additionally, the goals of these forward-looking national development and energy plans could stand to indicate that the South African government would certainly be acting out of favour of its own energy objectives if shale gas were not positively pursued (U.S. EIA, 2013 (a)).

Energy and Environmental Affairs ministers have made statements indicating their positive views on fracking and shale gas (Maylie, 2012). "Motlanthe said it could be a useful alternative to nuclear power, while Peters went so far as to describe the estimated 485 trillion cubic feet shale gas reservoir as 'a gift of God'" (Pressly, 2012). National ministers have also expressed that if only ten percent (approximately 30 Tcf) of estimated shale gas reserves could be extracted, this could produce a burgeoning gas sector. It would be an economic game changer for South Africa, with an estimated worth of R1-trillion (Department of Mineral Resources, 2012 (b); Moolman, 2013 (a); Odendaal, 2012). Gas-to-liquids facility, Mossgas, was established on only 1 Tcf, and employs nearly 1600 people (Department of Mineral Resources, 2012 (b)). "On a national scale, the socio-economic development ripple effects envisaged from shale gas exploration would help redress the country's current

inability to meet the 2015 United Nations Millennium Development Goal target of poverty reduction" (Dhliwayo, 2012).

5.2.5 Key legislation related to shale gas and hydraulic fracturing

South Africa currently finds itself in a position of having a legislative lacuna for shale gas and hydraulic fracturing (Havemann, 2011). While some may argue that South Africa does have a proficient regulatory framework that regulations specific to shale gas and fracking can be developed out of, there are many sections of South African environmental law as they stand, that would not be able to cover efficiently and effectively shale gas and fracking (Oberholzer & Molteno, 2012).

According to the Task Team report, the following key legislative instruments regulate oil and gas exploration and production: the Mineral and Petroleum Resources Development Act (2002) (MPRDA); the National Environmental Management Act (1998) (NEMA); the National Water Act (1998) (NWA); the National Environmental Management Waste Act (2008) (NEMWA); the Mine Health and Safety Act (1996) (MHSA); and the Astronomy Geographic Advantage Act (2007) (AGAA) (Department of Mineral Resources, 2012 (a)). In terms of important regulatory agencies, the primary agency created in line with the MPRDA "to facilitate the exploration and development of South Africa's resources of oil and gas", is the Petroleum Agency of South Africa (PASA), established in 1996 (Havemann, Glazewski & Brownile, 2011:46). Furthermore, other important agencies and government departments include the Department of Mineral Resources (DMR), the Department of Water and Environmental Affairs, and the National Planning Commission.

The MPRDA and NEMA have been described as creating a fragmented regulatory environment, with cracks between them creating environmentally high risk opportunities due to there being a greater sense of confusion than cohesion (Gore & Erasmus, 2013; Rain Harvest, 2011). Numerous changes will be required for the statutes and regulations that will be affected by the introduction of regulations specific to hydraulic fracturing and shale gas before shale gas extraction is pursued (Havemann, 2011). While shale gas could fall under the definition of petroleum in the MPRDA, it is not mentioned anywhere in the Act, nor have any further regulations been promulgated in terms thereof. Similarly, NEMA does not address any fracking-related concerns specifically, with the same applicable to other South African mining laws. Ultimately, South Africa currently does not have an enviro-legal framework able to sufficiently regulate the shale gas industry (Havemann, 2011).

The MPRDA in particular is presently undergoing change in the form of an MPRDA Amendment Bill. The Bill has proposed changes, including the disbanding of the independent regulator, PASA. While the MPRDA vests the South Africa's mineral resources in the hands of the state, this change would see PASA's functions shifting to the Minister of Mineral Resources, giving her a great deal of discretionary power (Department of Mineral Resources, 2012 (b); Mining News, 2013). This also has implications at the regional level because the area for proposed exploration stretches over three provinces, and if PASA is disbanded, there will no longer be "a single point of entry and compliance requirements will be inconsistent" (Moolman, 2013 (web)). Ultimately, this would be a move away from what has up until this point been considered to be international best practice of having an independent petroleum regulatory agency (Mining News, 2013).

Furthermore, over a period of three years, the Bill proposes a transition from the DMR to the Department of Environmental Affairs as the competent authority on mineral activity regulation in South Africa (Gore & Erasmus, 2013). This could well be an indication of a move towards an underlying environmental focus behind future fracking-specific regulation for the country. While in the interim the DMR will play the role of competent authority, Minister Shabangu has indicated to industry that in the event of a PASA disbandment, "[she] would consider retaining a specialised unit within the DMR to regulate the sector" (Moolman, 2013 (b)). Finally, amendments to the Gas Act have also been proposed, allowing for "an expanded role for the National Energy Regulator of South Africa [(NERSA)]" and are intended to create a platform for the potential development of South Africa's projected shale gas resources (Odendaal, 2013).

Currently, according to Section 44 of the Constitution, the legislative authorities of the government lie with Parliament, provincial legislatures and municipal councils for the national, provincial and local governments respectively (Republic of South Africa, 1996). Furthermore, Parliament possesses the power to assign its legislative powers, which cover the environment, to any other legislative body within government. It may intervene on the legislation produced by these other legislative bodies by passing legislation in order to maintain essential national standards, according to Section 44 of the Constitution (Constitution of the Republic of South Africa, 1996). In addition, according to Section 104 of the Constitution, provincial legislative authorities may also assign their own legislative powers to Municipal councils within their provinces (Constitution of the Republic of South Africa, 1996).

According to Oberholzer (2013:185):

> "The principal regulatory and oversight bodies responsible for oil activities are the minister of mineral resources (the minister), the Petroleum Agency of South Africa (Pty) Ltd (the Petroleum Agency), and Minerals and Petroleum Titles Registration Office, the National Energy Regulator of South Africa (NERSA) and the Controller of Petroleum Products (the Controller)."

Furthermore, the Minister of Mineral Resources acts as the custodian of the country's petroleum resources on the State's behalf. According to Section 3 of the MPRDA, the Minister of Mineral Resources is responsible for ensuring the sustainable development of the country's mineral and petroleum resources, developing these resources within the framework of the national environmental policy, while at the same time promoting socioeconomic development (Republic of South Africa, 2002). The Minister of Mineral Resources also holds the power to designate an organ of State, or a State-owned, or a State–controlled company to act as the authority on mineral resource development, according to Section 70 of the MPRDA (Republic of South Africa, 2002).

5.3 Possible regulatory lessons for South Africa, based on U.S. experience

South Africa is potentially sitting atop estimated reserves of 485 Tcf of shale gas, which, if accurate and technically recoverable, could have a game-changing effect on its economy and a boost for social development in the country. Not only could these reserves help to ward off a potential energy crisis, but they could also stand to provide energy security for the nation. However, there are qualifying factors such as environmental, health and safety concerns.

Given the facts as viewed by the South African government, regarding policy plans to increase the role of natural gas in the energy mix, determinations committing to further exploration of estimated shale gas reserves, as well as the lifting of the moratorium on applications for exploration licenses, the general opinion held by interested parties is that it is merely a matter of time before shale gas development commences in South Africa. Therefore, the proposed regulatory lessons presented here are submitted, bearing this in mind. Furthermore, the following lessons coincide with the themes of 1) regulation, 2) who is regulating, and finally, 3) the underlying focus of the regulators, all of which are suggested to be inextricably interlinked in terms of creating a sound and comprehensive regulatory framework for shale gas development and hydraulic fracturing in South Africa, based upon

regulatory experience in this field as observed through study of relevant application and practices in the U.S.

While the systems of government in South Africa and the U.S. are distinctly different in some ways, they do however share similarities. Whereas the U.S. has a federal system of government, South Africa too could be described as possessing a type of federal system of government, with the decentralisation of state power based upon the principle of cooperative federalism or cooperative governance. However, one cannot ignore the impact had by the dominance of a single political party at the national, and to a large extent provincial government too (de Villiers, 2007). Nevertheless, the similarities do exist.

Furthermore, another similarity is the fact that shale gas development ultimately emerged out the oil crisis of the 1970s for the U.S., while South Africa too is now facing an energy crisis of its own and interest in developing the estimated substantial shale gas reserves has also emerged out of this. Ultimately, while Rose advocates learning from contexts and countries similar to one's own, he does not dismiss learning from those that are different. The U.S. is thus a fitting example from which to draw policy lessons for the development of a regulatory framework for shale gas and hydraulic fracturing in South Africa in spite of the differing systems of government, but at the same time due to the similarities that do exist between them.

Firstly, on the theme of regulation, it is important that regulation covering shale gas and hydraulic fracturing exist at all levels of government—national, provincial and local. However, these regulations must not overlap and in turn create redundancy and confusion, rather than cohesion, and equally must not impede forward-moving processes. Political affiliation and business relations or ties should not be allowed to influence broad regulatory exemptions for either shale gas or hydraulic fracturing and also regarding such things as waste management or environmental protection. Furthermore, regulation should directly refer to shale gas and hydraulic fracturing, which can be achieved through amendments to existing regulation or the promulgation of new regulation specific to the management and development of shale gas and hydraulic fracturing.

The reliance upon existing regulation should not be allowed to halt or delay the promulgation of new specific regulation for shale gas and hydraulic fracturing. In the U.S. most federal legislation applicable to shale gas and hydraulic fracturing was promulgated in the 1960s and 1970s, and is thus outdated and no longer appropriately applicable to the effective regulation

of shale gas extraction. Care must be taken to avoid the repetition of a similar occurrence in South Africa. In addition, the focus of legislation and regulation at the national, provincial and local levels of government should be developed along similar lines and must be complementary by nature, with the final goal of achieving multi-level regulation towards the same end. Furthermore, based upon the development of multi-level regulations, regulatory agencies should also be created at each level of government, in a similar fashion—for example, agencies could take on the form of government departments focused on shale gas extraction and development with underlying environmental foci.

Secondly also on the theme of regulation, lessons regarding the implications of regulatory exemptions for shale gas and hydraulic fracturing are key. With the U.S. example of the 'Halliburton loophole' and the resultant exemptions for hydraulic fracturing and shale gas in terms of the Safe Drinking Water Act, major environmental, health and safety implications have emerged as a consequence of this particular exemption, to name but one. Gaps in regulation from exemptions to the industry should not be allowed to develop in South Africa. This is over and above the fact that the country does not have a specific regulatory framework for shale gas and hydraulic fracturing.

The key lesson here is that the South African government must make use of policy research to aid in policy and regulatory development for shale gas and hydraulic fracturing. There is scope for this to happen and the South African government should make a concerted effort to 'invest' more in academic research on shale gas and hydraulic fracturing for South Africa, especially by South Africans. Different perspectives on shale gas development and management, as well as international best practices, exist and must be explored. Environmental impact assessments should be conducted to study more closely the concerns of various parties involved, particularly those directly affected. This needs to happen to obtain practical research which can in turn be used to bridge the gap to improve the flow of knowledge in the development of a comprehensive regulatory framework for shale gas and hydraulic fracturing.

Furthermore, on the same point of preventing and avoiding overarching regulatory exemptions for shale gas and hydraulic fracturing, it is important that the South African government develop unbiased and objective regulations and policies, as opposed to regulations for the benefit of the ruling party (ANC) or any other investors. This occurred in the U.S. with the example of the 'Halliburton loophole' and consequently exemptions for the

Safe Drinking Water Act. The development thereof should begin and be fully developed to the point of well-established regulation first at the national level, moving 'downwards' thereafter through to the provincial level of government, and thereafter the local level of government, before shale gas development and hydraulic fracturing are allowed to commence on South African soil. The U.S. presents one with a casebook example of how ad hoc policy development for shale gas and hydraulic development does not work effectively to regulate these matters without leaving gaps in regulation, which ultimately result in negative implications for the environment and public health and safety.

These kinds of implications have an even greater chance of occurring when, as in the U.S., ad hoc development of shale gas and hydraulic fracturing occurred at the state level. Individual states have ended up regulating the same thing in completely distinct ways, some more to the detriment of the environment and public health and safety than others. The U.S. government has now taken steps to await the findings of the EPA study on shale gas and hydraulic fracturing before further developing shale gas and hydraulic fracturing regulation on the federal level of government, which will ultimately impact state and local government regulatory decisions too. The same effort should be made and undertaken by the South African government to conduct a more in-depth study than that conducted by the Inter-Ministerial Task Team on Shale Gas and Hydraulic Fracturing, which can and should inform the development of a regulatory framework for shale gas and hydraulic fracturing in the country, before any further exploration and development of the estimated shale gas reserves are allowed to commence.

In line with the second theme of who will be doing the regulating of shale gas extraction and development, is an important lesson on cooperative governance. In the U.S. with regard to regulation of shale gas and hydraulic fracturing, a case of jurisdictional mismatch has developed, where the regulatory roles of state and local-level governments and federal-level government have almost inverted. What is important to learn from this is that in the U.S. the move toward state-based policies on shale gas and hydraulic fracturing has proven inefficient to a certain extent, with the current situation of a 'hodgepodge' of different state policies, yet, gaps in regulation still exist.

In developing regulation for shale gas and hydraulic fracturing, the South African government, although already displaying cooperative environmental governance or cooperative federalism, where the national and provincial governments and municipalities are

supposed to work together, needs to change its approach by implementing initiatives with aspects of interactive federalism in mind. Interactive federalism helps with the assessment of which level of government is best suited to handling certain aspects of regulation. In the South African context, this would mean deciding on the appropriate roles of national, provincial and local governments according not only to what they have been mandated to do by the Constitution, but also according to which level of government is best able to regulate a shale gas related issue. Furthermore, it also assesses the point at which the federal or national government should intervene, thereby creating an additional layer of regulation over and above state or provincial level efforts at regulation.

If the type of thinking aligned with interactive federalism discussed above is not embraced in the South African context, as opposed to a complete overhaul of the orientation of the system of government, the South African government runs the risk of developing a situation similar to the U.S. where the abundance of state statutes ultimately create a patchwork of inconsistent and conflicting mandates that result in distorting the market for energy companies and other investors. Thus, progress of shale gas development in South Africa stands to be hindered.

However, while adopting an interactive federalism approach to its thinking, rather than fully applying the concept in practice, the South African government must still encourage initiative and experimentation at provincial and local levels of government. Importantly, however, this regulatory initiative and experimentation must not be allowed to erode the oversight of the national government, as previously determined in accordance with the regulatory roles of each level of government consistent with the principle of interactive federalism. This must be done in such a way to ensure and create a set of checks and balances that will correspondingly be able to boost regulatory efficiency and success (Malloy, 2011). The key lesson here for the South African government would be that while division of power is good, the roles of each level of government and its corresponding regulatory agencies must be clearly and explicitly defined and adhered to, and furthermore, there must be clearly defined regulation application directly to shale gas and hydraulic fracturing. A balance must be struck between the presently to be embraced principle of cooperative environmental governance and interactive federalism.

Finally, the remaining lesson coincides with the third theme of the underlying focus of the regulators. In accordance with the aims of the South African government, the focus of both regulation and of the regulators of shale gas and hydraulic fracturing should be on

environmental protection and socio-economic development. In the U.S., the federal government has an environmental agency acting as the primary regulator of shale gas and hydraulic fracturing, but has regulatory exemptions in the interest of oil and gas developers and companies. Furthermore, at the state level, such as with Pennsylvania and Texas, there is also evidence of differing sentiments towards shale gas development and federal regulatory primacy in direct relation to the focus of the regulatory agency as well as their nature—in other words, the difference seen between a state environmental department or an oil and gas commission as regulator. Ultimately, in the U.S., there is no regulatory consistency on the state level, and even though states may be regulating the same thing, their approaches are focused in completely different directions.

The main lesson here for the South African government is that there must at least be an underlying uniformity and consistency in terms of the regulatory focus of regulatory agencies for shale gas and hydraulic fracturing. Without this, sub-national (provincial) level regulators will have different approaches to regulating the same resource, according to what they may deem to be important. This could lead to competition between provinces—or between states as seen in the U.S.—regarding regulation and development of shale gas resources, sacrificing the upholding of regulatory aims of the national government. All regulatory agencies and all levels of government need to be developed with the same focus in terms of development and production of shale gas, with variation being allowed on minor issues such as geological variance across the provinces. This ideological and regulatory uniformity must be achieved and maintained so as to avoid a case of redundancy for national level regulation of shale gas and hydraulic fracturing.

5.4 Conclusion

Having emerged onto the policy agenda of the South African government, potential extraction of estimated shale gas resources in the Karoo Basin has caused much debate. In spite of the South African government's response through the imposition and later lifting of a moratorium on shale gas and hydraulic fracturing, followed by a Task Team report on potential shale gas extraction in the Karoo, many feel that government response to shale gas is less than ideal. A strong environmental movement has developed and gathered momentum against potential shale gas extraction and development in the country, citing major environmental concerns over the Karoo region as reason for their opposition.

In light of the looming energy and electricity crisis facing the country, the South African government has indicated its desire seriously to pursue developing its estimated shale gas reserves as a way to avoid this crisis, and thereby also increasing the role of natural gas in the country's energy mix, offering it as an alternative to coal and nuclear power. Consequently, based on the assumption that shale gas extraction will occur in South Africa, policy lessons from the U.S. on the regulation of shale gas extraction have been drawn for the South African government for application in its own context. These lessons focus upon three themes: regulation on shale gas extraction and hydraulic fracturing; who is and should be regulating shale gas extraction; and finally, the underlying focus of the regulators.

CHAPTER 6: Conclusion

6.1 Introduction

The aim of this study is to conduct research on shale gas policy programmes in the U.S. for the purpose of investigating and potentially drawing valuable policy and regulatory lessons for South Africa with regard to its own estimated shale gas reserves. This was done by posing the question of "*what policy lessons can the South African government draw from the United States of America's regulation of shale gas extraction?"* By conducting this research, the findings thereof can be described as forming a contribution to the regulatory field for shale gas and hydraulic fracturing in South Africa, which is intended to lay the foundation for further and future contributions to policy research and literature on the topic. This research not only highlights concerns regarding the mitigating factors associated with shale gas development, extraction and hydraulic fracturing for the environment and public health and safety, but also attempts to draw policy lessons on the specific regulation of shale gas and hydraulic fracturing from the most established shale gas industry in the world. Secondly, this research draws policy lessons specific to the U.S. context and adapts and contextualises them for the consideration and application to the South African case and context for the purpose of laying the foundation for further research on the proposed development of regulation of shale gas extraction in South Africa.

6.2 Overview of research and findings

By using policy learning and Richard Rose's approach to it as a starting point, key lessons were also drawn out of so-called 'negative' lessons from the U.S. These policy lessons on the regulation of shale gas extraction were drawn by first taking context-specific lessons from the U.S. and then extracting key *general* lessons from this set of U.S. lessons, then repackaging and contextualising them for application in a completely different national setting. These 'negative' lessons highlight an important area of lesson-drawing for policy learning that is often ignored by policy scholars, but which is nonetheless extremely valuable in terms of policy knowledge.

Furthermore, specific regulatory lessons on shale gas and hydraulic fracturing are not commonly found in policy literature, especially in the case of South Africa. By drawing these policy lessons from the U.S. this research stands to contribute towards policy research required to help with informing the process of developing a regulatory framework for shale

gas extraction in South Africa. This is of particular importance in light of the fact that the opportunity exists in South Africa to conduct proper policy learning and research, potentially to influence policy development on shale gas and hydraulic fracturing before the exploration process has even begun.

The focus of this research has been on learning from the regulation of the U.S. shale gas industry. This includes studying current legislation and regulation applicable to shale gas and hydraulic fracturing at all levels of government in the U.S.—federal, state and local. Furthermore, this also involved studying who is regulating shale gas and hydraulic fracturing at each level of government and the relationship between these regulatory agencies, finally also studying the underlying regulatory emphases of the various regulatory agencies for shale gas and hydraulic fracturing, once again at all levels of government. This research was done through the use and application of case study research design and documentation review methods for data collection, and thematic analysis for the purpose of data analysis. Finally, focusing efforts directly at the U.S. shale gas industry, as opposed to policy programmes that Rose suggests, this provides a new and unique approach to lesson-drawing for the regulation of shale gas development and hydraulic fracturing.

While the aim of this study was to draw policy lessons on regulation of shale gas and hydraulic fracturing in the U.S. for South African application, it was the underlying argument and view of this thesis that due to evidence presented through South Africa's Integrated Development Plan and Integrated Energy Plan, as well as actions and responses of the South African government, shale gas development *is* going to happen in South Africa.

Ultimately, the findings from this study, based upon the aforementioned assumptions, revolve around four primary lessons, which have their own further sub-lessons. The first of these lessons, under the broader theme of regulation is that the South African government should invest in and commit to the development of new regulations specifically for shale gas and hydraulic fracturing. This is proposed as an alternative to the mere amending of current environmental, mining and petroleum legislation and regulation. Furthermore, the regulations for shale gas and hydraulic fracturing must be developed at all levels of government in South Africa: national, provincial and local, with the same governing aims and foci throughout.

Secondly, also under the theme of regulation, an important lesson in the promulgation of new regulation on shale gas and hydraulic fracturing is that overarching exemptions, specific to shale gas and hydraulic fracturing, should not be allowed in South Africa. Thus will examples

of this from the U.S., such as with the 'Halliburton Loophole', be avoided. Furthermore, ad hoc development of regulation after permission has been given, shale gas development has commenced and production started, will seriously undermine the industry, leading to a litany of intractable consequences. Once hydraulic fracturing leads to the thoughtless pursuit at sub-national levels of government and by sub-national regulators of shale gas and hydraulic fracturing of completely different and sometimes selfishly competitive aims by these different entities, despite the fact that they are all supposedly regulating the same resource, the industry and responsible authorities are in a quagmire. Therefore, policy and regulatory research should be used in good time to inform the development of these policies and aims.

Thirdly, in accordance with the broad theme of who is doing the regulating of shale gas and hydraulic fracturing, another important lesson is that the South African government needs to adopt an approach in thinking that is a combination of cooperative environmental governance (which is already playing an influential role in the regulation of petroleum and mineral resources in the country), with interactive federalism. Rather than the practical application of interactive federalism, it is suggested that the way of thinking associated with the concept will help to assess and define the roles of the South African government and its agencies at each level, according to which of these levels of government is best suited to the regulatory task at hand.

In so doing, it will be determined which level of government is best suited for the task of regulating certain shale gas activities, and furthermore at what point national regulators may be allowed to interject in the regulation of shale gas and hydraulic fracturing by other levels of government. Experimentation and innovation should nonetheless still be encouraged at other levels of government, but this must not impede or erode national government oversight and the previously-defined roles must still be maintained and adhered to. This common vision or goal will result in unified regulation for comprehensive cover against mitigating factors and concerns associated with shale gas and hydraulic fracturing.

Finally, in accordance with the theme of regulatory emphasis of shale gas and hydraulic fracturing regulators, the important lesson here is that regulatory focus of regulatory agencies at all levels of government must be consistent with national aims. While minor variances should be allowed at sub-national levels to contend with regional geological differences in the Karoo Basin, this must not be allowed to get out of control in the sense of undoing the defined roles of each level of government proposed in lesson three.

Ultimately, this study and its research findings fit into the field of policy studies and policy analysis because they contribute to it where presently such a gap in knowledge on shale gas and hydraulic fracturing policy in South Africa appears to exist. Therefore, through using policy research to influence policy and regulatory development for shale gas and hydraulic fracturing in South Africa the industry will be of a higher standard and more comprehensive in nature, having learned from the experiences of regulation of shale gas and hydraulic fracturing in the U.S. However, there are still existing limitations to the research. For example, this study applies specifically to the regulation of shale gas and hydraulic fracturing, but not to other sources of energy in South Africa, such as coal, coal-bed methane and liquid natural gas. These other energy sources also have the potential to influence the energy crisis in South Africa and the direction that the South African government chooses to follow in terms of regulation and policy development.

Furthermore, the methods used in this study allowed for lesson-drawing to be achieved, however, this could be taken a step further by travelling to the U.S. and immersing oneself into the shale gas policy environment. This study does not focus on the influence of political activity in the U.S. regarding shale gas development, but this kind of study could be done in the context of a PhD and focus on this influence rather than purely on specific regulation of the shale gas industry and hydraulic fracturing. There is also further scope for research on the implications that shale gas development holds for South Africa in terms of energy development and security, as well as for the wider Southern African region, and Africa as a whole. This being said, however, it still stands to reason that there is so much to learn from the findings of this study, especially in light of its aim to lay the groundwork and foundation for the kinds of further research touched on above.

6.3 Conclusion

In conclusion: in terms of what can at present be considered as the international best practice on the regulation of shale gas extraction, based on the U.S. regulation thereof, it would appear that the approach to developing South Africa's estimated shale gas reserves by respectively the South African government and the Task Team is presently not in alignment. Up to this stage, the South African government and the Task Team have indicated and proposed their intentions to 'simply' review and then amend existing regulation for environmental protection, mining and exploration rights, as well as proposing the establishment of a single monitoring committee for shale gas and hydraulic fracturing.

Instead, based upon the findings of this study, it is advocated that a comprehensive regulatory framework for shale gas extraction should be developed, through the development and promulgation of *new* regulations, specific to shale gas and hydraulic fracturing, to avoid potentially devastating gaps in regulation.

These new regulations must also trickle down from the national level to other levels of government and there should be regulatory agencies at all levels of government with the same underlying goals and foci. Ad hoc development of regulation does not yield a safe regulatory environment in terms of the various mitigating factors. It is also advisable that the South African government first promulgates regulations specific to shale gas and hydraulic fracturing before allowing shale gas exploration and development to commence in South Africa.

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