

Regulatory Approaches In The Unconventional Gas Sector

Scoping Study

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Key findings

A desktop review of the governance frameworks and the regulatory approaches for onshore natural gas from unconventional reservoirs, referred to here as unconventional gas (UG), was commenced in January 2015. That was followed by interviews with key stakeholders in ten selected jurisdictions in Australia, North America and Europe. Our findings show the following trends:

- Growing public concerns about the social and environmental impacts of UG operations are perceived in all governments studied, and they have stimulated legislative reviews and reforms of the frameworks that govern the exploration and extraction of hydrocarbons.
- Some jurisdictions (outside the scope of this research) have reacted by banning UG activities pending further study of the related risks, while others have allowed activities under existing regulatory regimes, adjusting those regimes to address particular risks and impacts, with a focus on water withdrawal and wastewater management, baseline water testing, chemical disclosure for fracturing fluids and air quality monitoring.
- The regulators' responses often encompass both technical and social justice elements (including land access, redistribution of benefits from resource extraction, public participation).
- The prospects for UG development in addition to the growth of the extractive resources sector have led some governments to consider innovative ways to address the cumulative effects of multiple land uses, for instance:
 - o In Canada, the Alberta Energy Regulator (AER) launched a play-based regulation (PBR) pilot in the Fox Creek area to test a new approach to govern unconventional oil and gas development.
 - o The Government of Alberta is developing an *Integrated Resource Management System* in order to meet development objectives without sacrificing environmental sustainability.
- Underpinning these reforms across jurisdictions is an aim stated by those interviewed and in the regulations reviewed to achieve more efficiency, transparency and effectiveness in the management of the UG sector, as well as aiming to satisfy the imperative to raise public trust.

1 Background

The research was initiated to provide an overview of the evolution of regulation in selected jurisdictions that either have a significant or developing UG industry. Our focus in this scoping study has been on identifying perceptions by different stakeholders in industry, government, NGOs, and the community of ‘effective regulation’ with regard to the risks associated with unconventional gas extraction, the gaps in regulatory practice and the trends in the governance of the resource sector – as they also affect the UG sector.

The aim of the scoping study was to assist the authors to prioritise further areas of research around the regulation and governance of UG development, as we seek to specify factors, principles and processes of effective regulation. The effort includes drafting a proposal for such further work, as well as identifying collaborators and funders for such an effort. This project represents a joint effort of University College London’s International Energy Policy Institute and The University of Queensland’s Centre for Social Responsibility in Mining.

2 Objectives

The scoping research provides – as originally proposed:

- A review and comparison of regulatory approaches¹ for UG development in selected Australian and foreign jurisdictions (US, Canada, Europe);
- Identification and prioritisation of particular aspects that warrant more detailed investigation and specification of potential collaborators and funders for future research;
- A proposed research team supporting an inter-institutional and collaborative proposal, including academics engaged in research on resource governance and the regulation of unconventional gas development.

3 Approach

The scoping study covered ten jurisdictions in Australia, North America and Europe. The jurisdictions were selected on the basis on their UG resources and potential to develop an UG industry.

Four jurisdictions were examined in Australia (Queensland, New South Wales (NSW), Western Australia (WA) and South Australia (SA)), three in the USA (Pennsylvania, Ohio and Texas), two in Canada (British Columbia (BC) and Alberta) and one in Europe, the UK.

Australia’s estimated shale gas recoverable resources are 467 trillion cubic feet (tcf) and proven coal seam gas (CSG) resources 203 tcf, as of 2015. Queensland has a significant onshore gas industry and substantial levels of CSG production;² NSW has several regions with the potential

¹ The objective of this scoping study was an overview of the governance systems, including regulations, policy and tools to manage the unconventional gas industry, and how they are perceived by stakeholders. Therefore, given the breadth of the analysis and issues and jurisdictions covered, we do not provide a detailed analysis of the risk management systems for each jurisdiction. Rather, we highlight the elements that our data and current literature suggest are critical in the governance of unconventional gas for enhancing public trust and acceptance of the industry.

² In 2014, Australia’s total UG production was 7.651 billion cubic feet (9bcm) (essentially from coal seam gas projects in Queensland). <https://www.eia.gov/analysis/studies/worldshalegas/>

for the development of a CSG industry.³ The states of WA and SA have significant onshore and offshore conventional gas production and what was, until the 2015 decline in oil prices, a growing shale and tight gas exploration industry.⁴

The UK has a developing shale gas industry.⁵

In the USA, the total production of UG is significant with 543.575 bcm of UG produced in 2014 (shale gas: 378.771 bcm, tight gas: 127.709 bcm, CBM: 37.095 bcm)⁶; Pennsylvania, Texas and Ohio are significant producers of natural gas from unconventional sources.

In Canada, the total production of UG was 86.041 bcm in 2014 (tight gas: 72.92 bcm, coal bed methane: 7.18 bcm and shale gas: 5.935 bcm)⁷. Alberta and British Columbia are significant oil and gas producers, both provinces having substantial unconventional oil and gas resources⁸ but relatively low levels of UG production⁹.

We structured our approach to incorporate the following steps:

A. Work plan and methods for data collection (December 2014).

B. A desktop analysis of laws and regulations governing UG development was carried out to identify regulatory approaches, the changes that have been made, or proposed changes, to the law that govern UG. A review of reports by organisations, NGOs, and from academic sources was also undertaken (January—February 2015).

C. Interviews with key stakeholders with the aim to identify regulatory trends and stakeholders' perceptions of regulatory capacity. We adopted a semi-structured approach for interviews, which included open-ended discussions with informants as well as more specific questions. This approach was chosen to allow informants to express their views on the topic, and for us to develop an understanding of the topic, issues at stake and perceptions of the issues by informants.

Over 55 interview sessions were held with stakeholders in 10 jurisdictions across Australia, the US, Canada and the UK. The jurisdictions we selected provide a broad overview of different regulatory systems and approaches for the regulation of UG development. Interviews were

³ NSW estimated resources of CSG are 511 billion cubic meters (located in the Sydney Basin, Clarence Moreton Basin, Gunnedah and Gloucester Basins) <http://www.resourcesandenergy.nsw.gov.au/landholders-and-community/coal-seam-gas/the-facts/exploration-and-production>

⁴ Shale gas: six assessed shale gas and oil basins of Australia hold an estimated 2,046 tcf of risked shale gas in-place, with 437 tcf as the risked, technically recoverable shale gas resource (May 2013). Source: US Energy Information Administration EIA/ARI World Shale Gas and Shale Oil Resource Assessment, September 2015

https://www.eia.gov/analysis/studies/worldshalegas/pdf/Australia_2013.pdf. Santos, Beach Energy and Senex Energy are testing the shale reservoirs in the Cooper Basin.

⁵ The UK has no production of shale gas. In 2014, the UK's total UG production was 0.655 bcm (tight gas: 0.598 bcm, and coal bed methane: 0.057 bcm). <https://www.eia.gov/analysis/studies/worldshalegas/>

⁶ <https://www.eia.gov/analysis/studies/worldshalegas/>

⁷ <https://www.eia.gov/analysis/studies/worldshalegas/>

⁸ In British Columbia, it is estimated 13.4 tcf of natural gas reserves exist in the unconventional Montney Play Trend, which represents 33 % of BC's remaining recoverable raw gas reserves. In Alberta, it is estimated that coal bed methane would contain 500 Tcf of natural gas <http://www.albertacanada.com/business/industries/og-natural-gas-and-coal-bed-methane.aspx>

⁹ In Alberta, natural gas production was 3.72 tcf in 2014 (8% CBM, 0.3% shale gas) <https://www.eia.gov/analysis/studies/worldshalegas/>

conducted with stakeholders in government, industry, academia and civil society organisations, as follows¹⁰:

- February – May 2015: Western Australia (Perth), New South Wales (Sydney, and coal seam gas regions in Clarence-Moreton, Gunnedah, and Gloucester Basins), South Australia (Adelaide),
- June 2015: USA: Pennsylvania (Philadelphia, Pittsburgh, Williamsport and Lycoming County), Ohio (Harrison County), Texas (Austin); Canada: Alberta (Calgary), British Columbia (Vancouver, Victoria).
- July 2015: United Kingdom (London, West Sussex).

Interviews

	Industry	Government	Local Government	Academia	Civil Society
Australia					
WA	✓	✓		✓	
NSW	✓	✓	✓	✓	✓
SA	✓	✓		✓	✓
QLD		✓		✓	
USA	✓	✓		✓	✓
Penn	✓	✓	✓	✓	✓
Texas		✓		✓	✓
Ohio	✓	✓		✓	
Canada	✓	✓		✓	
Alberta	✓	✓		✓	
BC	✓	✓		✓	✓
Europe	✓	✓		✓	✓
UK	✓	✓	✓	✓	✓

Issues and topics discussed in the interviews:

Regulatory capacity to mitigate impacts and minimise environmental risks

Trigger for and scope of environmental impact assessments

Monitoring, compliance and enforcement

Policy instruments for strategic planning and cumulative impact assessment

Prescriptive v. risk-based approach: what are the challenges associated with risk-based regulation?

Consultation with stakeholders

Access to information, notification and consultation (public participation in land-use decision-making and project approvals)

Stakeholder consultation for the development of technical and operational standards

Risk communication strategies

Interaction and communication between regulators across jurisdictions

¹⁰ Overview of the jurisdictions examined -- Annexes 1 and 2 provide an overview of the jurisdictions we have examined and, where applicable, some of the recent—and most salient—aspects in terms of policy and regulatory developments that affect the development of the unconventional gas industry.

Governance

Levels of jurisdictions involved in the regulation of unconventional gas

Elements within the governance system that have helped build confidence / public trust

Public inquiry or scientific review, scope and outcome

Characteristics of 'best practice' regulation

D. Summary of the review and interview outcomes.

4 Findings

4.1 The context

A consideration of the regulation of UG, and how it has evolved in various jurisdictions, requires some preliminary remarks. Crucial for the understanding of the public, policy and regulatory debates around UG development, the points presented below were raised by – and discussed with – our informants.

The specificities of unconventional gas

There are some unique features to UG that make it different from other types of resource extraction activities, notably:

- (i) natural gas that is considered unconventional is trapped in low permeability rock requiring stimulation and/or directional drilling techniques to flow gas at commercial rates;
- (ii) its development co-habits with rather than replaces other land uses;
- (iii) compared to conventional gas activities, its development involves a larger environmental footprint due to the intensity and scale of operations (e.g., in terms of water use, waste water, traffic, air quality and community disruption);
- (iv) its development involves a short burst of activity (exploration phase and then pipeline network/infrastructure construction) followed by a low level of activity for many years (production phase).

Although not a new technique as it has been used for decades for conventional wells, hydraulic fracturing has become a socially contentious issue with its use in the unconventional gas and oil industry in combination with horizontal drilling. A key component of hydraulic fracturing is the high pressure injection of hydraulic fracturing fluid to create passage that enable an increased rate of flow of gas or oil from the source rock. Hydraulic fracturing fluids consists of three parts: (1) the base fluid, which is the largest constituent by volume and is typically water; (2) the additives, which can be a single chemical or a mixture of chemicals, that serve to adjust pH, increase viscosity, limit bacterial growth; and (3) the proppant (generally sand) to hold open the cracks created by the pressurised fluid. Chemicals generally comprise a small percentage (typically 2% or less) of the overall volume of injected fluid. However, because over one-million gallons of fluids are typically injected per well, thousands of gallons of chemicals can be potentially stored on-site and used during hydraulic fracturing activities.¹¹

¹¹ US EPA, Hydraulic Fracturing Drinking Water Assessment, Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources (External Review Draft), June 2015

Some of the risks associated with hydraulic fracturing - including groundwater contamination, accidental chemical spills, and wastewater management - have been the subject of heated debate in resource communities. Although hydraulic fracturing is only one part of the overall process of gas extraction, the term has monopolised the public debate around UG development.

The need to undertake hydraulic fracturing in CSG projects is not systematic (but dependent on the geology and physical properties of the coal seams). However, the removal of underground water to de-pressurise the coal seams and allow the extraction of the gas has raised concerns. These concerns are about the risks of depletion or pollution of underground water, particularly in agricultural regions or areas highly dependent on bore water.

Extractive industries, social media and resource communities

UG operations have triggered various types of responses from impacted communities. Attitudes toward UG and acceptance of the industry vary depending on the region, context, communities' experiences with extractive industries and the licence holder's approach to community relations. Within a resource region, variations in community attitude and acceptance can be significant. In Australia, the Hawke Inquiry into Hydraulic Fracturing in the Northern Territory outlined that levels of community acceptance vary in different parts of Queensland.¹² Our observation across jurisdictions (New South Wales, SA, Pennsylvania, the UK) confirmed significant variations within resource communities with regard to the level of acceptance of the industry.

Significantly however, the development of - or prospects for - an UG industry has paralleled a growing social movement against the fossil fuel industry. The spread of factual and scientific information – and misinformation - through social media has transformed the public debate with regard to UG activities, connecting grassroots movements across the globe and placing local communities, at times, as central actors in the governance of extractive resources. Increasingly, communities are demanding more involvement in decision-making processes related to land and resources, safeguards for the protection of the environment and a greater share of the benefits from resource extraction. Pressure comes from diversified groups of stakeholders either directly affected by resource development activities or concerned about long term environmental sustainability and the environmental risks they perceive as being posed by UG development.

Energy security, energy transition and climate relevance

While governments emphasise the opportunities that a new industry would bring in terms of economic benefits, reduced GHG emissions (cf. coal) and long term energy security, the validity of the 'pro' unconventional gas arguments has been contested and the legitimacy of the industry has been questioned in a carbon-constrained world.

In the USA, a substantial increase in levels of shale gas production has led to natural gas overtaking coal as the top source of electric power generation in 2015,¹³ as well as to a significant decrease in net imports of energy.¹⁴ As shown in the case of the USA, increased

¹² Report of the Independent Inquiry into Hydraulic Fracturing in the Northern Territory, <http://www.hydraulicfracturinginquiry.nt.gov.au/docs/report-inquiry-into-hydraulic-fracturing-nt.pdf>

¹³ About 31% of electric power generation in April 2015 came from natural gas, (and 30 % from coal), according to a report released by SNL Energy, which used data from the U.S. Department of Energy.

¹⁴ According to the EIA, imports of energy in the USA declined from 30% of total energy consumption in 2005 to 13% in 2013, *EIA's Annual Energy Outlook 2015*, http://www.eia.gov/forecasts/aeo/section_energyprod.cfm

consumption of natural gas can help to phase out coal and therefore contribute to reductions in global CO₂ emissions over the long term. Nevertheless, the greenhouse carbon footprint of UG is still being debated.¹⁵ Ongoing scientific research in different extractive regions will help to determine the actual level of emissions over the life cycle of UG projects, and whether the development of UG contributes positively in the shift toward low carbon energy systems.¹⁶

Ecologically sustainable development, the science and the complexity involved

*Given the complexity of the science, and the dearth of clear, transparent, and enforceable standards, inadequate studies and limited statistical analysis have been allowed to provide potentially false assurances. The politically expedient bottom line dominates with little attention paid to the quality of the science or the adequacy of the standards.*¹⁷

This extract from a paper published in the *Virginia Environmental Law Journal* characterizes the view of a large number of stakeholders whom we interviewed in community groups [NSW, SA, British Columbia, Pennsylvania] in the various jurisdictions. The risks associated with UG development have been well documented, including in state-sponsored inquiries and scientific research¹⁸ - they include air pollution, surface water pollution, the depletion and/or contamination of groundwater, soil erosion, noise pollution and seismicity. It is perceived however that the complex nature of this extractive industry, combined with limited impact data, makes establishing possible effects and designing appropriate regulatory responses challenging.¹⁹

Hence, public concerns have emerged that current policy approaches favour economic growth at the expense of ecologically sustainable development. Such views have had an impact on the general perceptions of the industry – and its acceptance by the community. The perception by some stakeholders in resource communities that institutions are geared toward prioritising resource development activities for the purpose of economic returns over the protection of the environment has led to opposition, mobilisation and legal disputes around new extractive industries - and UG development projects in particular.²⁰ Such opposition has in part

¹⁵ Methane and the greenhouse-gas footprint of natural gas from shale formations, A letter Robert W. Howarth, Renee Santoro, Anthony Ingraffea, March 2011, <http://www.acsf.cornell.edu/Assets/ACSF/docs/attachments/Howarth-EtAl-2011.pdf>; Comparing Life-Cycle Greenhouse Gas Emissions from Natural Gas and Coal, World Watch Institute, August 25, 2011, https://www.db.com/cr/en/docs/Natural_Gas_LCA_Update_082511.pdf; Fugitive Greenhouse Gas Emissions from Coal Seam Gas Production in Australia. Stuart Day, Luke Connell, David Etheridge, Terry Norgate, and Neil Sherwood, CSIRO, October 2012

¹⁶ E.g., A team of researchers from the University of Texas, Austin's Cockrell School of Engineering and firms URS and Aerodyne Research have completed measurements at 190 natural gas production sites across the United States <http://www.che.utexas.edu/faculty-staff/faculty-directory/david-t-allen-phd/>. Measurements of methane emissions at natural gas production sites in the United States, <http://www.pnas.org/content/110/44/17768.full.pdf>

¹⁷ Rachael Rawlins "Planning for Fracking on the Barnett Shale: urban air pollution, improving health based regulation, and the role of local governments" (2013) 31 *Virginia Environmental Law Journal* 226 <http://lib.law.virginia.edu/lawjournals/sites/lawjournals/files/2.%20Rawlins%20-%20Barnett%20Shale.pdf>

¹⁸ Eg.: New South Wales's Report and Review of coal seam gas by the Chief Scientist (<http://www.chiefscientist.nsw.gov.au/reports>); Victoria's audit undertaken under section 16AB of the *Audit Act 1994* Unconventional Gas: Managing Risks and Impacts (<http://www.parliament.vic.gov.au/publications/research-papers/8927-unconventional-gas-coal-seam-gas-shale-gas-and-tight-gas>)

¹⁹ Brian G Rahm, Susan J Riha, "Toward strategic management of shale gas development: Regional, collective impacts on water resources", (2012) 17 *Environmental Science & Policy* 12.

²⁰ E.g., An analysis of litigation involving shale and hydraulic fracturing, published by Norton Rose Fulbright (2014), reveals that the number of civil cases involving hydraulic fracturing has risen. In Canada, British Columbia and Alberta, some legal challenges have been brought against extractive projects by First Nations claiming that the mismanagement of cumulative effects can negatively affect the exercise of recognised aboriginal rights to exclusive use and occupation of their native lands. On March 3, 2015, Blueberry River First Nation ("BRFN") sued the Province of British Columbia (BC) arguing that the cumulative impacts of industrial development has led to a violation of Treaty 8 rights. The outcome of the litigation will directly impact the development of BC's planned Site C hydroelectric dam on the Peace River ("Site C") and development of the Montney gas fields located within BRFN's traditional territory. A similar lawsuit was commenced in 2008 in Alberta by the Beaver Lake Cree Nation ("BLCN") alleging that the governments of Alberta

contributed to new policy developments toward approaches that seek a more publicly acceptable balance between industry, other land uses and environmental concerns.

A complex legal framework and heterogeneity amongst jurisdictions

The jurisdictions covered in this research have different experience with extractive industries and different administrative and legal structures. They have generally relied on existing legislation that covers hydrocarbon exploration and extraction activities for regulation and permitting procedures for UG activities. None of the jurisdictions studied have in place legislation or permitting procedures specific to UG activities.

Variations amongst jurisdictions are significant with regard to sub-surface rights and mineral ownership. In the USA, private ownership of subsurface rights has provided a strong catalyst for the development of UG given landholders are in a position to negotiate royalties directly with gas companies. In Australia and the UK, the separation of ownership between surface and subsurface rights has led to a situation where project proponents are granted authority by governments, but they have to negotiate land access with landholders. Variations between jurisdictions exist as well with regard to the industry structure. In the USA, the presence of many independent operators has been facilitated by third party pipeline access, whereas in Australia there are only a few major operators, and they have constructed their own pipeline networks as part of the development project.

4.2 Examining the risks, re-examining legislation and the capacity of the regulator

The rapid expansion of the UG industry—or the prospects for UG development—has prompted scientific inquiries and other studies into UG. These studies have been followed by the development of guiding principles, standards, ‘best management practice’ and regulatory developments across jurisdictions²¹.

Despite variations due to each jurisdiction’s experience with extractive industries and different administrative and legal structures, the potential development of UG has triggered a re-examination of the regulatory frameworks that govern petroleum activities and—in some instances—a re-examination of broader governance frameworks for resource development and land-use. This shift reflects pressures for change and underlying concerns about the competitiveness of the sector and its social acceptability—as we outlined above.²²

In the course of interviews conducted in the industry sector in Canada and Australia, our informants critically emphasized the complexity of regulatory regimes, complicated rules and processes that apply to UG development approvals. They have argued that if this complexity is not addressed, it has the potential to undermine the economic viability of major projects and

and Canada permitted the cumulative impacts of resource activities to violate BLCN’s rights under Treaty 6 to hunt, fish, and trap in their traditional territory. In the state of New South Wales in Australia, a local environmental group issued court proceedings in both the Supreme Court and the Land and Environment Court challenging the right of the gas company Santos to develop its ‘Leewood’ CSG wastewater treatment facility See: *People for the Plains Inc. v Santos NSW (Eastern) Pty Ltd* [2016] NSWLEC 93 (delivered 1 August 2016)

²¹ Annex 3 gives a snapshot of the various initiatives to improve the governance of the unconventional gas sector.

²² Australian Government, Productivity Commission, *Improving resource exploration in Australia*, August 2014, <http://www.pc.gov.au/news-media/pc-news/pc-news-august-2014/improving-resource-exploration-in-australia#key>; The Australia Institute, *Coal and gas mining in Australia Opportunities for national law reform Technical Brief No. 24 August 2013*, Prepared by the Australian Network of Environmental Defender’s Offices.

discourage new investment. In parallel, our informants in resource communities and environmental NGOs in Australia, Canada and the UK have critically emphasized the inadequacy of regulatory regimes to manage what they perceive as new risks associated with UG in light of the complexity of the new technologies and processes involved in UG operations.

4.2.1 Scientific inquiries and the development of standards toward 'best practice'

We provide here a brief snapshot of some of the scientific studies, public inquiries and other initiatives undertaken to identify—and mitigate—the impacts and risks associated with UG activities in the jurisdictions we examined:

■ *United Kingdom*

In Europe, since 2012, the European Commission has released a series of studies on unconventional fossil fuels focusing on the potential risks for the environment and human health, the potential energy market and climate impacts, and the regulatory provisions applicable in selected member states and the registration under REACH of certain substances potentially used in hydraulic fracturing (Annex).

In the UK, an examination of shale gas extraction was undertaken by the Royal Society and Royal Academy of Engineering in 2012 “Shale gas extraction in the UK: a review of hydraulic fracturing”.²³ In 2013, the UK’s Department of Energy and Climate Change released the “Regulatory Roadmap: Onshore oil and gas exploration in the UK regulation and best practice”, which focuses on clarifying the regulatory processes applicable to shale gas operations.

A Shale Gas Task Force was established in 2014 by Lord Chris Smith (former head of the Environment Agency) to undertake an independent examination of both the potential benefits and risks linked to shale gas extraction, with the support of experts spanning the scientific, academic, environmental, engineering and business communities.²⁴ In December 2015, the Shale Gas Task Force released its final conclusions on whether the UK should proceed with developing a domestic shale gas industry along with its recommendations. The Task Force on Shale Gas concludes that:

- Shale gas can be produced safely and usefully in the UK provided that the Government insists on industry-leading standards.
- The risk from shale gas to the local environment or to public health is no greater than for comparable industries.
- There is strong evidence compiled by the Department of Energy in the US that shows that standards have improved dramatically in the last few years.
- Baseline monitoring is essential to reassure local populations. Monitoring of air, land and water should begin as soon as a site has been identified.
- Failures of well integrity have been responsible for many of the problems associated with shale gas operations in other locations, particularly the US, therefore operators must be held to the very highest standards for well integrity.

²³ <http://www.raeng.org.uk/publications/reports/shale-gas-extraction-in-the-uk>

²⁴ <https://www.taskforceonshalegas.uk/>

- Independent monitoring of the site, with the community involved in an oversight role, to ensure that any indication of a failure of well integrity can be identified quickly and remedied.
- The process of “green completions”, recently made compulsory in the US, should also be mandated in the UK for production wells.
- In the exploratory phases, the Task Force would wish to see no venting of gases and, for the exploratory phases, time-limited flaring permissions granted only when necessary.

■ *Australia*

In 2011 the Australian Government established an Expert Panel (coordinated by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities) to provide advice regarding the water management issues associated with three Queensland CSG projects being assessed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Subsequently, the government established an Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) as a statutory committee under the EPBC Act in 2012. The stated aim was to provide scientific advice to decision makers on potential water-related impacts of CSG and large coal mining developments. This Committee has a wider technical scope than its precursor, and its advice and findings are also considered by a larger number of State regulators (Queensland, New South Wales, Victoria and South Australia).

In 2013, the former Council of Australian Government’s Standing Council on Energy and Resources (SCER) adopted the National Harmonised Regulatory Framework for Natural Gas from Coal Seams. The objective was described as providing guidance to the states with the development of regulation and standards for the management of natural gas from coals seams and to ensure that regulatory regimes are robust, consistent and transparent across all Australian jurisdictions. The Framework focuses on four key areas of operations, which cover the life cycle of CSG development:

- well integrity;
- water management and monitoring;
- hydraulic fracturing; and
- chemical use.²⁵

Another initiative to improve knowledge and understanding of impacts and risks of CSG operations is the Gas Industry Social & Environmental Research Alliance (GISERA). GISERA was established in Queensland with membership from a range of sectors (industry, federal government, and the federal government’s research organisation, the Commonwealth Scientific and Industrial Research Organisation - CSIRO). It funds research on the environmental, social and economic impacts of the natural gas industry in Australia and disseminates its findings.²⁶

New South Wales

In 2013, in a climate of community unease about CSG extraction, the Premier of NSW commissioned an independent review of CSG activities in NSW. The NSW Chief Scientist and

²⁵ <http://scer.govspace.gov.au/files/2013/06/National-Harmonised-Regulatory-Framework-for-Natural-Gas-from-Coal-Seams.pdf>

²⁶ GISERA has expanded into New South Wales, and its partners include Australia Pacific LNG, QGC, AGL, Santos, Origin Energy and CSIRO. GISERA also receives funding from the Australian and New South Wales Governments.

Engineer undertook an eighteen-month inquiry to assess the risks and issues associated with development of the state's CSG resources. Drawing from consultation with community groups, industry and government as well as experts from other jurisdictions, the NSW Chief Scientist released her final report in October 2014. The report concludes that the technical challenges and risks posed by the CSG industry can be managed through:

- careful designation of areas appropriate in ecological and land-use terms for CSG extraction;
- high standards of engineering and professionalism in CSG companies;
- the creation of a State Whole-of-Environment Data Repository so that data from CSG industry operations can be interrogated as needed and in the context of the wider environment;
- comprehensive monitoring of CSG operations with ongoing automatic scrutiny of the resulting data;
- a well-trained and certified workforce; and
- the application of new technological developments as they become available.²⁷

South Australia

Since 2012, the state government has organised the Roundtable for Unconventional Gas Projects in SA²⁸ to provide stakeholders with an opportunity to exchange information and to make recommendations for improving the governance of the UG industry. In October 2014, the Roundtable became the *Roundtable for Oil and Gas Projects in South Australia* to encompass a wide range of aspects of the oil and gas industry and to create an avenue for dialogue between government agencies and companies involved in the oil and gas sector.

The SA Parliament's Natural Resources Committee (NRC) Inquiry into Unconventional Gas (Fracking) was referred by the Legislative Council to the Committee on 19 November 2014. The terms of reference for the Inquiry include exploring potential risks and impacts in the use of hydraulic fracture stimulation to produce natural gas in the South-East of South Australia. The focus was on: - the risks of groundwater contamination; the impacts upon landscape; the effectiveness of existing legislation and regulation; and the potential net economic outcomes to the region and the rest of the state. Their Interim Report was released in November 2015.²⁹

Queensland

In Queensland there has not been a parliamentary inquiry. However, the regulatory framework has been influenced by the scientific input of the Independent Expert Scientific Committee and its precursor, the Expert Panel (Australian Government entities), which have advised on conditions of approval under the EPBC Act. The regulatory framework has also evolved as part of regulatory improvement processes and through election commitments of successive governments. Key initiatives have included:

1. Introduction of legislation in 2010³⁰ to declare Cumulative Management Areas (CMA) and provide an adaptive framework for the purpose of managing the cumulative groundwater impacts of multiple tenure holders. This legislation (and amendments) have resulted in the development of a groundwater flow model for Surat Basin CMA, which is revised at intervals of three years to incorporate new data and new scientific knowledge regarding hydrogeology, geology and modelling techniques. The associated Underground Water Impact Report for the Surat Cumulative Management Area

²⁷ http://www.chiefscientist.nsw.gov.au/_data/assets/pdf_file/0005/56912/140930-CSG-Final-Report.pdf

²⁸ http://petroleum.statedevelopment.sa.gov.au/roundtable_for_oil_and_gas

²⁹ <https://www.parliament.sa.gov.au/>

³⁰ An amendment to the *Water Act 2000*

- (referred to as the UWIR, published in 2012 and 2016) outlines estimates of immediate and long-term impact (e.g., areas where bore water levels are expected to drop by a certain amount) and the regional monitoring strategy.
2. Release of the Coal Seam Gas Water Management Policy in 2010 and reviewed in 2012. The use of evaporation dams, for saline water emerging from CSG wells, as a management option was discontinued under this policy in 2010. The current policy (2012) outlines a hierarchy for i) managing and using CSG water and ii) managing saline waste, with a preference for beneficial use.
 3. The introduction of legislation to exclude areas of high value agricultural land from resource development³¹, which relies on detailed scientific assessment of the agricultural potential of the land.

There has also been a study into the use of water produced as a consequence of UG activities; namely the *Coal Seam Gas Water Feasibility Study*, conducted by the Queensland Department of Natural Resources and Mines as part of the Australian Government funded Healthy Headwaters Program, a study completed in 2013.³² The feasibility study examined the opportunities and risks of using coal seam water in the Queensland Murray–Darling Basin (QMDB), and it provided data about the likely volumes of production of coal seam water, the potential impacts of its disposal on surface and groundwater systems as well as options for using it in the QMDB, having regard to economic and environmental benefits. One of the many reports in the Study examined the cumulative impacts of CSG production in the Surat and Bowen Basins on local and regional groundwater systems.³³

A further source of scientific information regarding the CSG industry is The University of Queensland’s Centre for Coal Seam Gas³⁴. This research centre was established by the university and original member companies—Arrow Energy, QGC and Santos—in late 2012. Australia Pacific LNG joined the Centre in 2014. The Centre coordinates and conducts research on technical and social challenges associated with the development of CSG resources in Australia, spanning four areas: water; social performance; geoscience and petroleum engineering.

A direction in 2013 by the Queensland Government to the Queensland Competition Authority (QCA) to review the State’s regulation of the CSG industry, including options for regulatory reform, resulted in a final report in January 2014.³⁵ The Report recommends improvements to the regulatory framework in the interests of increased effectiveness. These recommendations include the adoption of outcome-based regulations, the reduction of regulatory duplication and inconsistencies, and the removal of excessive reporting requirements (seen as unnecessary complexity). Some criteria for good regulatory design are listed in the Report,³⁶ as are other (then) ongoing reviews/projects aimed at improving the CSG regulatory regime.³⁷ There is also the suggestion that a single State department be responsible for CSG development and its facilitation along with the oversight of the CSG regulatory regime.

³¹ Initially this protection was conferred under the *Strategic Cropping Land Act 2011*, which has since been replaced by the *Regional Planning Interests Act 2014*.

³² <https://www.dnrm.qld.gov.au/water/catchments-planning/healthy-headwaters> (accessed 12 September 2016)

³³ Worley Parsons for the Department of Natural Resources and Mines *Groundwater risks associated with coal seam gas development in the Surat and southern Bowen Basins Final Report* (March 2013); accessed 12 September 2016 at: https://www.dnrm.qld.gov.au/_data/assets/pdf_file/0013/106015/act-5-groundwater-risks-report-text.pdf

³⁴ <http://www.ccsq.uq.edu.au/>

³⁵ Queensland Competition Authority, 2014 *Coal Seam Gas Review: Final Report* (last accessed 12 September 2016 at: <http://www.qca.org.au/Productivity/Productivity-Projects/Coal-Seam-Gas> (hereafter ‘the QCA Report’)

³⁶ *Ibid*, at p.27

³⁷ *Ibid*, at pp.28-30

■ *United States of America*

Government

In April 2012, a Memorandum of Agreement between the U.S. Departments of Energy and Interior and the US EPA was signed to promote interagency collaboration for the identification of research priorities and sponsoring of research. The state aim was to improve understanding of the impacts of unconventional oil and gas extraction and to ‘ensure the safe and prudent development of these resources’.

In June 2015, the US EPA released its study, “Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources”. The study reviewed available scientific literature and data to assess the potential for hydraulic fracturing for oil and gas to impact on the quality or quantity of drinking water resources. It also identified factors affecting the frequency or severity of any potential impacts.³⁸

Multi-stakeholder organisations

In 2013, the Center for Sustainable Shale Development³⁹ developed fifteen performance standards for UG operators to assure or improve environmental performance with a focus on air quality, water resources and the climate. These standards were developed to drive leading industry practices and to go beyond the regulatory requirements established by Appalachian states (specifically, Pennsylvania, Ohio and West Virginia) and the federal government. The standards are also purported to represent a consensus between industry and the environmental community on what is achievable, doing so in the interest of the protection of human health and the environment.

In 2013, the Boston Common Asset Management (Boston Common), the Investor Environmental Health Network (IEHN) and the Interfaith Center on Corporate Responsibility (ICCR) (representing 55 major investment organizations and institutional investors with nearly \$1 trillion in assets under management) together developed guidelines, “Extracting the Facts: An Investor Guide to Disclosing Risks from Hydraulic Fracturing Operations.”⁴⁰ Their stated aim is to support “best practices” for the development of shale gas.

³⁸ The scope of this assessment is defined by the hydraulic fracturing water cycle, which includes five main activities: (1) Water acquisition – the withdrawal of ground or surface water needed for hydraulic fracturing fluids; (2) Chemical mixing – the mixing of water, chemicals, and proppant on the well pad to create the hydraulic fracturing fluid; (3) Well injection – the injection of hydraulic fracturing fluids into the well to fracture the geologic formation; (4) Flowback and Produced water – the return of injected fluid and water produced from the formation to the surface, and subsequent transport for reuse, treatment, or disposal; and (5) Wastewater treatment and waste disposal – the reuse, treatment and release, or disposal of wastewater generated at the well pad, including produced water. Source: <https://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=244651>

³⁹ Created in 2011, and originally called the Institute for Gas Drilling Excellence, the Center for Sustainable Shale Development is described as having been conceived as a platform for promoting improved communication and engagement between civil society organisations and industry around shale gas development. CSSD operates in the US, essentially across the Appalachian Basin (Marcellus Shale formation). Its membership includes environmental organizations, philanthropic foundations, energy companies and other stakeholders committed to “safe, environmentally responsible shale resource development”. Strategic Partners of CSSD include Benedum Foundation, Chevron, Clean Air Task Force, CONSOL Energy, Environmental Defense Fund, EQT Corporation, Group Against Smog and Pollution (GASP), Pennsylvania Environmental Council, Shell. <https://www.sustainableshale.org/>

⁴⁰ <http://www.iehn.org/documents/frackguidance.pdf>

In 2015, STRONGER⁴¹ (State Review of Oil and Natural Gas Environmental Regulations) issued guidelines. The guidelines are to assist states in assessing and improving their regulatory programs for waste management, abandoned sites, naturally occurring radioactive materials (NORM), storm water management, hydraulic fracturing, air quality, and reused and recycled fluids.⁴²

4.2.2 Regulatory developments across jurisdictions

Some governments have reacted to community concerns – and the prospective risks - by banning UG activities pending further study of the related risks. Others have allowed activities under existing regulatory regimes, adjusting those regimes to address risks that they had previously not addressed explicitly. The review of regulatory frameworks has been underpinned by the aim to achieve more efficiency, transparency and effectiveness in the management of the UG sector, as well as the imperative to raise public trust. The focus has been on:

- water withdrawal;
- baseline water testing;
- disclosure of chemical for fracturing fluids;
- wastewater management; and
- fugitive emissions and air quality monitoring.⁴³

Efforts by governments to improve regulatory practice have also involved considerations for the role of the regulators and regulatory approaches, as demonstrated by recent initiatives undertaken by the Canadian Province of Alberta.

Alberta, Canada

In March 2010, the Government of the Province of Alberta released a report *Energizing Investment: A Framework to Improve Alberta's Natural Gas and Conventional Oil Competitiveness*, which outlined a series of actions and initiatives to place Alberta as a competitive jurisdiction in North America for upstream oil and gas development. Following on the report, the Regulatory Enhancement Task Force was established in 2010 to focus on regulatory issues with the goal of creating a system that provides “clarity, predictability, certainty and efficiency for upstream oil, gas, oil sands and coal in the Alberta”.⁴⁴ One of the recommendations of the Task Force was to establish a single regulatory body with responsibility for oil, gas, oil sands and coal activity. With the adoption of the Responsible Energy Development Act (December 2012), the government of Alberta created an arms-length regulator for the energy sector. The Alberta Energy Regulator—AER—was established as lead regulator and a one-stop shop for regulatory approvals. Its mandate was to “regulate energy resource development within Alberta and ensure the safe, efficient, orderly, and environmentally responsible development of hydrocarbon resources over their entire life cycle”. Since its creation, and following on the recommendations of the Regulatory

⁴¹ State Review of Oil and Natural Gas Environmental Regulations, Inc. (“STRONGER”) is a non-profit corporation that was formed in 1999 as a multi-stakeholder organization to educate regulators and the public as to the appropriate elements of a regulatory program for state oil and gas exploration and production, one that protects public health, safety and the environment.

⁴² <http://www.strongerinc.org/guidelines/>

⁴³ Nathan Richardson, Madeline Gottlieb, Alan Krupnick, and Hannah Wiseman, *The State of State Shale Gas Regulation*, Resources for the Future, June 2013, <http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-Rpt-StateofStateRegs_Report.pdf>.

⁴⁴ <http://www.energy.alberta.ca/initiatives/regulatorvenhancement.asp>

Enhancement Task Force, the AER has sought to improve its performance as a regulator and its effectiveness in managing the oil and gas sector in Alberta.

Some of the initiatives presented here have been discussed in our interviews with officers at the AER in June 2015:

■ The *best-in-class regulator* project

With the vision to provide “a world leading regulatory organization that has a ‘best-in-class’ mindset, attitude, capabilities and regulatory system”, the AER has funded the University of Pennsylvania’s ‘Penn Program on Regulation’ to define the attributes that make a *best-in-class regulator* and develop criteria and assessment methods for improving regulatory practice.⁴⁵

■ The ‘play-based’ regulation pilot project (PBR)

With the objective to improve the regulatory approach for unconventional energy development, the AER launched a play-based regulation (PBR) pilot in the Fox Creek area to test a new approach to govern unconventional oil and gas development.⁴⁶ PBR establishes requirements for subsurface reservoir management for the pilot area that are relevant to unconventional resource development. The intent is to better manage the cumulative impacts of resource development through an application process that will allow energy companies to submit one application for all activities of an energy development project (for wells, pipelines, facilities, access roads, and water use), rather than submitting separate applications for each of these developments.

Officers at the AER informed us as follows:

- The AER seeks to encourage applicants to collaborate on surface development plans in order to minimize the number of facilities and other surface impacts, and to ensure that effective practices are employed to minimize fresh water use and optimize water reuse;
- The AER will encourage collaborative planning to underpin this approach to risk management associated with unconventional oil and gas development at the level of a ‘play’, and operators will be collectively responsible to mitigate and minimize the effects of development; and
- The AER will work with industry to learn the benefits and challenges that this regulatory approach creates, to gain understanding of stakeholders’ perspectives and to achieve compliance.

Toward risk based regulation

An observable trend in regulatory practice in various sectors has been to move away from prescriptive to risk-based or objective-based approaches. This shift has been occurring in the oil and gas sector, as well.

The Alberta Energy Regulator has defined a risk-based regulation as “a decision-making framework used to ensure that a regulatory response is applied at a level that is proportional to the severity of the risk”. Risk-based regulation is underpinning the AER ‘play-based’ regulation initiative.

⁴⁵ <https://www.law.upenn.edu/live/files/4946-pprfinalconvenersreport.pdf>

⁴⁶ <https://www.aer.ca/about-aer/spotlight-on/pbr-pilot-project>

Similarly in Australia, state governments have reviewed regulatory frameworks for UG with a shift toward risk-based approaches. In *New South Wales*, the government introduced a comprehensive reform of the state's resource exploration regime in 2015 based on the Improved Management of Exploration Regulation (IMER), the Resources Legislation Package and several codes of practice for rehabilitation, environmental management, produced water management, storage and transfer, and community consultation.⁴⁷ In *Western Australia*, the prospect for shale gas development has triggered efforts to streamline WA's approval regime for resource exploration and development. A comprehensive review of the EIA system was undertaken in 2008.⁴⁸ In December 2009, the WA EPA released its draft Environmental Assessment Guideline entitled, "Towards Outcome-based Conditions",⁴⁹ which was followed by the government's release of a new set of Petroleum Environment Regulations to be enforced by DMP.⁵⁰ In *Queensland*, the QCA Report of January 2014 noted that good regulatory design includes reducing levels of prescription in favour of objectives-based or risk-based regulation, and it recommended the adoption of regulations and standard conditions that are outcome-focused as well as guiding principles for rehabilitation that are risk-based.⁵¹

The challenges with implementing risk-based regulation

A shift toward a risk-based approach to regulation, from a more prescriptive approach, entails moving away from a system that prescribes the methods to be used to manage the risks toward a system that sets the outcomes (limits and targets) for operators to achieve. In the context of rapid technological change and complex processes associated with the UG industry, it appears to be a sensible approach in that it enables innovation and efficiencies in achieving desired goals. It has generally been welcomed by industry in Canada and Australia. However, regulators as well as project proponents whom we interviewed have noted some of the challenges and difficulties that arise when transitioning from prescriptive to risk-based regulation. They have noted particular challenges in the implementation of a risk-based approach in the context of UG—we provide a brief overview of some the comments that were made:

⁴⁷ http://www.resourcesandenergy.nsw.gov.au/_data/assets/pdf_file/0009/565956/Exploration-Code-of-Practice-Community-Consultationv1.1.pdf;

https://www.nsw.gov.au/sites/default/files/miscellaneous/sc000218_nsw_gas_plan_government_response_to_the_chief_scientist_web.pdf; http://www.resourcesandenergy.nsw.gov.au/_data/assets/pdf_file/0004/583960/INT15-85967-imer-industry-presentation.pdf

⁴⁸ http://epa.wa.gov.au/EPADocLib/2898_EIARReviewReportFinal30309.pdf Two pilot projects are under way using the risk-based method, including an offshore petroleum production proposal at the Environmental Review and Management Programme level of assessment and an iron ore mining proposal at the Public Environmental Review level of assessment. The proponents have conducted workshops with stakeholders to assist in the scoping of their documents, and they have engaged independent facilitators to assist with the application of the new piloted approach.

⁴⁹ The Guideline describes a method for the development of outcome-based conditions for use when preparing the EIA documentation. It also describes the issues to consider when developing the outcome-based conditions to ensure that the intended outcome is delivered. These conditions are likely to be highly specific to each proposal. Each condition will describe the required environmental outcome as it relates to the environmental issue and will include instructions on how the achievement of the outcome is to be demonstrated. The guideline provides examples of outcomes, such as, "the avoidance of particularly significant vegetation or habitat, or the progressive rehabilitation of an area". The move away from prescriptive conditions to outcome-based conditions will enable proponents to be more creative in ensuring environmental protection, but it will still require extensive monitoring and reporting.

⁵⁰ They comprise the *Petroleum and Geothermal Energy Resources (Occupational Safety and Health) Regulations* 2010, the *Petroleum and Geothermal Energy Resources (Management of Safety) Regulations* 2010, the *Petroleum and Geothermal Energy Resources (Environment) Regulations* 2012 Petroleum and Geothermal Energy Resources (Environment) Regulations 2012, *Petroleum Pipelines (Environment) Regulations* 2012, *Petroleum and Geothermal Energy Resources (Resource Management and Administration) Regulations* 2014. The RMA Regulations cover a range of resource management and administration matters, such as well management plans for approval of all drilling activities (including shale and tight gas), field development plans, approvals of petroleum recovery, and notification and reporting requirements for petroleum discovery.

⁵¹ Op cit n.32 at p.6 ff

Capacity of the regulator

- A thorough understanding of technology and processes involved is a crucial element that will contribute to achieving effective regulation—cost-efficiency, streamlined approval processes and environmental protection;
- Human and financial resources need to be allocated proportionally to the existence of risks;
- Consistent risk assessment methodologies need to be in place.

Despite initiatives to streamline approval processes under risk-based frameworks, some industry representatives whom we interviewed in Australia (WA and NSW) and Canada (BC and Alberta) expressed the opinion that regulatory regimes are still too cumbersome and rigid. In order to overcome difficulties arising in the context of shifting regulatory approaches, it is crucial that the regulator engages effectively with industry to determine how best to develop a risk-based approach, for the identification of risks and the determination of risk assessment methodologies. In WA, the Department of Mines and Petroleum has engaged with industry stakeholders in the interest of improving the regulatory system and the risk-based framework to achieve a better regulatory balance for risk mitigation and environmental protection.

Capacity of the operator

As risk-based regulation allows for greater flexibility for innovation and cost effectiveness (compared with conventional prescriptive requirements), it also puts small operators with fewer resources and limited capacities under greater pressure when it comes to meeting regulatory objectives.⁵²

Need for exchange of information amongst regulators

According to our informants in Australia and Canada, increased dialogue and communication between regulators would help to improve regulation and regulatory practice. In Canada, for instance, the Western Regulators Forum, which includes provincial energy regulators from Alberta, British Columbia and Saskatchewan (and the National Energy Board), is working toward the harmonisation of provincial regulations to increase efficiency in the process of approving energy projects. The Western Regulators' Forum was established in 2014 to promote collaboration and pursue mutual priorities amongst oil and gas regulators in Western Canada.⁵³

4.3 The emergence of a new paradigm for resource governance

A major factor behind the opposition to onshore gas development activities—and hydraulic fracturing in particular—is the perception by these opponents that current policy approaches favour economic growth at the expense of ecologically sustainable development. This perception has become widespread across resource communities in Australia and Canada, and it has had an impact on the perception of the industry—and its acceptance by the community. Concerns about the expanding UG industry have translated into environmental conflicts and grassroots movements opposing the development of a UG industry (e.g., in the UK, Northern

⁵² Interviews with WA's Department of Mining and Petroleum, APPEA and resources companies in Perth.

⁵³ <https://www.neb-one.gc.ca/bts/nws/whtnw/archive/2014/2014-09-29-eng.html>

Rivers of NSW, South Australia). The analysis of litigation involving shale gas and hydraulic fracturing published by Norton Rose Fulbright (2014) shows that the number of civil cases involving hydraulic fracturing in the USA is rising, too.⁵⁴

As a response across UG jurisdictions, we are observing a shift in policy language and approaches toward ‘strategic land use planning’, ‘cumulative effects assessment’, ‘integrated resource management’, ‘area-based analysis’ to inform decision making related to UG and more broadly extractive resource projects. Whilst efforts will still be needed to improve methods, mechanisms and tools to achieve the stated policy objectives, this trend seems to characterise a paradigm shift in the governance regimes for UG projects and more broadly extractive industries (discussions with BC Oil and Gas Commission, Canadian NGO’s West Coast Environmental Law, New South Wales civil society organisations (CSOs)).

In the jurisdictions that we examined, environmental impact assessment systems vary with regard to the assessment authority’s responsibilities, the triggers and the scope of environmental impact assessments (EIA). Regardless, through the course of our interviews with informants in Australia, the US and Canada, we observed growing momentum for change in environmental regulation in the context of extractive industries, including UG. Pressures come from industry as well as CSOs, driven by different agendas. On the one hand, from an industry perspective, environmental regulation needs to be streamlined but also improved to allow for synergies to be created between project proponents in the management of natural resources.⁵⁵ On the other hand, from a CSO’s perspective, current environmental regulation of UG activities (and extractive industries more broadly) is inadequate to assess the cumulative effects⁵⁶ of multiple projects in an area. The latter would also advocate for a landscape management approach to safeguard the carrying capacity of the land and manage competing interests in land use and conservation.⁵⁷

We present below a snapshot of some of the comments that were made in our interviews. They describe initiatives recently undertaken in Australia and Canada that highlight momentum for change in environmental regulation and natural resource governance.

Australia

In Australia, several initiatives undertaken at the state and federal levels since the early 2010s demonstrate the intent to improve natural resource management frameworks and improve the capacity of regulators to manage the environmental risks associated with UG development.

At the national level, the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework for the protection of matters of national environmental significance. In 2013, the EPBC Act was amended to provide that water resources are a matter

⁵⁴ This study reveals as well that no allegation of contamination of groundwater resources resulting from drilling and extraction activities have actually been confirmed by a judgment against a well operator, drilling contractor or service company. <http://www.nortonrosefulbright.com/files/20140101-analysis-of-litigation-involving-shale-hydraulic-fracturing-104256.pdf>

⁵⁵ Interviews with CAPP (the Canadian Association of Petroleum Producers⁵⁵) revealed an interest in the development of mandated integrated land management approaches to create an impetus for developers to work together (i.e., create synergies for waste water management, construction of roads and other infrastructures for instance) and the definition of a liability system (to clarify liability issues in the co-management of resources, infrastructures and other assets). According to CAPP, regulatory frameworks designed in isolation reduce efficiency in an industry’s operations. In Alberta, for instance, under current regulatory frameworks, water reuse is not allowed. CAPP suggested the need for revising and integrating regulatory frameworks to address this type of issue.

⁵⁶ Cumulative effects can be defined as the added and interactive impacts that result from activities that are occurring in a particular area over a period of time.

⁵⁷ Such comments have been made by academics, CSOs representatives and individuals in resource communities in New South Wales, SA, Alberta and British Columbia.

of national environmental significance in relation to CSG and large coal mining development.⁵⁸ The ‘water trigger’ allows the impacts of proposed CSG and large coal mining developments on water resources to be comprehensively assessed at the national level of government. In addition, bioregional assessments were conceived as a key mechanism to provide a baseline level of information on the ecology, hydrology, geology and hydrogeology of a bioregion to inform the assessment of the potential direct, indirect and cumulative impacts of CSG and coal mining development on water resources.⁵⁹ Such assessments would assist the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) in developing advice to relevant government agencies. Some of our informants have, however, pointed to the fact that while bioregional assessments will provide extensive baseline information of key water-dependent ‘assets’ at the regional level, it is not a requirement that they inform project-specific EIAs. And of course, bioregional assessments do not provide an analysis of the economic or social impacts and risks of CSG and coal mining development—as these areas are outside the scope of the IESC’s responsibilities.

In *Queensland* and *New South Wales*, concerns have been raised by environmental groups and individuals in resource communities that domestic EIA systems fail to consider the potentially significant environmental impacts that may result from the combined effects of multiple CSG projects at a range of spatial and temporal scales. These concerns were to be addressed in relation to surface water⁶⁰ in *Queensland* as part of the Healthy HeadWaters Coal Seam Gas Water Feasibility Study, with the production of a *Cumulative impact assessment framework*.⁶¹ Here, ‘cumulative impacts’ are defined as ‘impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions’ and that they result ‘when the effects of an action are added to or interact with other effects in a particular place and within a particular time’.⁶² Although an EIS is a requirement for CSG development under Queensland’s *Environmental Protection Act 1994*,⁶³ the guidance to project proponents for cumulative impacts analysis and assessment is to be found in the *Generic draft terms of reference for an environmental impact statement*, under the heading “Further requirements of an EIS”.⁶⁴ The term ‘cumulative impact’ is defined as ‘combined impacts from all relevant sources (developments and other activities in the area)’.⁶⁵

In *New South Wales*, the 2015 Resources Legislation Package introduces a new framework for the release of land for resource exploration and the granting of titles (Strategic Release Framework). The release of land is based on preliminary assessments to be undertaken by relevant government agencies to assess regional circumstances (including social, economic and environmental issues). While the NSW Strategic Release Framework characterises a more

⁵⁸ <https://www.environment.gov.au/epbc/what-is-protected/water-resources>

⁵⁹ Bioregional assessments are conducted within a specified area (termed a ‘bioregion’) that contains identified key water-dependent ‘assets’ within which are located ‘receptors’. <http://www.iesc.environment.gov.au/system/files/resources/139a0230-d4ed-43f1-b919-8c2f5f5da3d2/files/methodology-bioregional-assessments.pdf>

⁶⁰ This definition was developed in relation to the cumulative impact on aquatic ecosystems of discharging treated coal seam water to surface waters. Typical impacts include changes to flow regimes, turbidity and salinity levels.

⁶¹ The State of Queensland (Department of Natural Resources and Mines) March 2013 *Cumulative impacts of coal seam gas water discharges to surface streams in the Queensland Murray-Darling Basin: Cumulative impact assessment framework* https://www.dnrm.qld.gov.au/_data/assets/pdf_file/0009/106020/act-9-cumulative-impacts-assess-framework.pdf

⁶² *Ibid*, p.v

⁶³ section 37

⁶⁴ State of Queensland, Department of State Development, August 2015 *Generic draft terms of reference for an environmental impact statement*. It states: “To the extent of the information available, the assessment should endeavour to predict the cumulative impact of the project on the environmental values over time and in combination with impacts created by the activities of other adjacent and upstream and downstream developments and landholders – as detected by baseline monitoring. This will inform the decision on the final EIS and the setting of conditions. The absence of a comprehensive cumulative impacts analysis need not be fatal to the project. The EIS should outline ways in which the cumulative impact assessment and management could subsequently be progressed further on a collective basis.”

⁶⁵ *ibid*

strategic approach to resource exploration, some of our informants have pointed to shortcomings of the new system to improve scientific and ecological knowledge, given that the ‘Preliminary Regional Issues Assessment for Potential Coal and Petroleum Exploration Release Areas’ are solely based upon existing scientific data.⁶⁶

Canada

Our desktop analysis and interviews in Canada have revealed that new policies, mechanisms and tools have been developed to reconcile the interests pursuing or in favour of resource development with the need for environmental protection and a sustainable development agenda. In Canada, UG production is significantly less than in the USA (2014 figures), but the expansion of the extractive sectors – and growth of the unconventional oil and gas industry - in parallel of a growing momentum around climate and sustainability issues - have triggered increased public scrutiny of the policy and regulatory frameworks for oil and gas activities. This increased attention has led regulators to “work towards enhancing their ability to manage the environmental impact from oil and gas activity” (British Columbia) and to review the governance frameworks for natural resources management. In British Columbia and Alberta, our informants in government and industry have emphasised efforts, but also the challenges, of developing policies, processes and regulatory tools to enable the assessment and management of impacts from cumulative land uses at a regional scale. Our purpose here is not to provide a detailed analysis but an overview of the some of these policies and tools developed in Canada recently.

Under the Canadian Constitution, the power to pass laws relating to the environment is divided between federal and provincial governments. At the Federal level, the requirements to identify and address cumulative effects were introduced in the Canadian Environmental Assessment Act in 1995. When applicable, federal environmental law hence requires the assessment of “any cumulative effects likely to result from a project in combination with other projects that have been or will be carried out”. In parallel, each Province has its own system for EIAs, with different requirements for cumulative effects assessment.

In 2009, the Canadian Council of Ministers of the Environment (CCME)⁶⁷ released the *Regional Strategic Environmental Impact Assessment in Canada, Principles and Guidance Report*.⁶⁸ Following on the Report’s recommendations, CCME has set up a Cumulative Effects Working Group to undertake a review comparing Canadian provinces’ approaches and policy frameworks for the assessment and management of cumulative effects (2015).⁶⁹ Amongst the recommendations put forward by the Working Group, Canadian jurisdictions are encouraged to work collaboratively with the CCME in identifying common considerations, goals, and methods and tools for assessment, monitoring, and managing of cumulative effects (whilst

⁶⁶ “Preliminary Regional Issues Assessments will focus on identifying the high level, environmental, economic and social considerations readily evident at the regional or sub-regional level, utilising data contained in existing data sets or accessible from other information sources identified as relevant; and examining potential risks associated with exploration and development at the point in time at which the preliminary regional issues assessment is conducted (e.g.. significant environmental concerns and land use conflicts; potential burdens on existing and future developments and infrastructure, risks to Government”
http://www.planning.nsw.gov.au/Policy-and-Legislation/Mining-and-Resources/~/_media/5245788C67194876BAAD8CDFCCE854FE.ashx

⁶⁷ CCME is an advisory group that identifies aspirational policy objectives, without any of its recommendations having binding effects. Provincial agencies can adopt and make legislative changes based on recommendations, if they are so inclined, or use the recommendations in a way that serves as a longer-term guiding vision.

⁶⁸ Regional Strategic Environmental Assessment in Canada: Principles and Guidance, Canadian Council of Ministers of the Environment, 2009, http://www.ccme.ca/files/Resources/enviro_assessment/rsea_principles_guidance_e.pdf

⁶⁹ Released 29 May 2015 [not for citation or publication], Project 565-2015, Cumulative Effects Approaches, Implementation Challenges and Opportunities and Lessons Learned, CCME Cumulative Effects Working Group 2015

maintaining jurisdiction-specific considerations). “[...] we believe a structured and harmonized approach can still be useful in testing assumptions (assessment), monitoring, and management of cumulative effects.”

British Columbia

Various mechanisms have been developed in BC to adjust to a shift toward unconventional oil and gas development and address the cumulative effects of multiple resource development activities, such initiatives include the following:

- The Oil and Gas Activities Act (OGAA) 2010

Brought into force in October 2010, OGAA sets out a new regulatory framework to govern oil and gas activity within the Province. It constitutes a significant change to the legal regime, simplifying the previous framework (consolidating and modernizing the requirements that previously existed under several acts and regulations) and addressing new societal expectations with regard to environmental and socially sustainability. A key feature of the OGAA is the expanded set of consultation and notification requirements that identify who must be consulted before an application is submitted to the Commission.⁷⁰

- BC Oil and Gas Commission “Area-Based Analysis” (ABA)

The oil and gas regulator in British Columbia, the BC Oil and Gas Commission (BCOGC), has also been seeking to improve the management and oversight of oil and gas activities and environmental outcomes. A major initiative of the Commission was to develop an Area-Based Analysis (ABA) for the assessment of oil and gas projects. The stated objective is to transition from reactionary, project-by-project assessments to a more proactive planning approach. Developed in collaboration with the Ministry of Forest Lands and Natural Resources Operations, ABA serves as a decision support tool to measure the impact of proposed oil and gas activity and other activities on a particular region. The analysis builds a landscape-level picture of the impacts of all development activities on defined ecological values. It also enables all new development applications to be measured and assessed against defined criteria.⁷¹ The underlying objective of ABA is to provide clarity to industry whilst allowing resource development activities only within the limits of pre-defined acceptable change.⁷²

- BC Cumulative Effects Framework

In parallel, the Government of British Columbia is developing a cumulative effects framework that includes policy, procedures and tools to enable the assessment of cumulative effects at a regional scale.⁷³

Although cumulative effects assessment is not prescribed in provincial legislation,⁷⁴ BC has a long history with regional strategic land use planning. Currently, Land Use Plans (LUPs) are

⁷⁰ These requirements do not however replace the established processes for consultation by the Commission with First Nations.

⁷¹ <http://www.bco.gc.ca/node/12693/download>

⁷² A specific ABA was completed in December 2014 for the Northwest Region of BC. From September 14, 2015 additional information regarding ABA will be required in the permit application process. The new application process will prompt industry to indicate if ABA has been considered in the planning process, and it will require a mitigation strategy where ABA risks are identified.

⁷³ <<http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework>>

⁷⁴ On project by project basis, cumulative effects assessments can be requested under section 11 (1) (b) of the British Columbia Environmental Assessment Act.

covering approximately 90 per cent of the Province. The Plans allocate land to specific zones, including protected areas where no resource development is allowed and other areas allowing various intensities of extractive resource activities.⁷⁵

Alberta

In the same way, the Province of Alberta has developed policies and tools to improve the regulation of oil and gas (including UG) activities to give effect to the objective of ‘responsible resource development’.

■ Land Use Framework

In 2008, the government of Alberta released its Land Use Framework proposing a new approach to manage the Province’s land and natural resources. The Framework establishes seven land use regions and calls for the development of regional plans for each region.⁷⁶ Through its regional land use planning scheme, the government of Alberta has committed to “manage the cumulative effects of development on air, water, land and biodiversity at the regional level”. However, our informants in industry and civil society pointed to the fact that the government has failed as yet to develop criteria, methods, and thresholds for assessing the cumulative effects of development.

Other recent initiatives demonstrate the government’s intent to improve the resource management system.

■ Integrated Resource Management System (IRMS)

The government of Alberta is currently developing an Integrated Resource Management System (IRMS) with the aim to integrate the management of all resources - inclusive of energy, minerals, forestry, agriculture, land, water, air and biodiversity. IRMS is based upon the integration and alignment of natural resource and environmental policies and law. It is also based upon the principles of cumulative effects management (understood as the management of combined effects of past, present and foreseeable future activities on the environment, society and economy).

■ “Play-based” regulation initiative (PBR)

As noted above, the Alberta Energy Regulator (AER) has adopted a new framework for the assessment and management of risks and impacts of unconventional oil and gas development. Alberta’s ‘play-based regulatory initiative’ seeks to improve efficiency in the management of oil and gas activities through a collaborative planning approach to mitigate and minimize the effects of multiple operations in a ‘play’ area.⁷⁷ Designed to provide a more holistic approach to managing cumulative impacts of energy resource development,⁷⁸ the AER’s play-based

⁷⁵ Jaccard, M, et al, ‘Institutions and processes for scaling up renewables: Run-of-river hydropower in British Columbia’, *Energy Policy* 39 (2011)

⁷⁶ <https://landuse.alberta.ca/LandUse%20Documents/Lower%20Athabasca%20Regional%20Plan%202012-2022%20Approved%202012-08.pdf>

⁷⁷ According to the AER, a play represents a three-dimensional entity that is the target of oil or gas development. It has a number of characteristics that can be used to describe it, including the specific geological formation, a geographic area, the types of fluids in the rock, other geological and reservoir characteristics. The definition often targets the source rock. Based on the characteristics of a play, the level or type of risk is determined and appropriate regulatory responses developed. Existing regulatory requirements and processes remain in effect unless modified for a specific play.

⁷⁸ Cal Hill, executive vice president strategy and regulatory division.

regulation is to be tailored to the characteristics of a resource play to enable the assessment and management of the risks against broader considerations for the environmental, economic, and social outcomes set by the government of Alberta.⁷⁹

Challenges with cumulative effects assessment

Discussions with informants in Canada and Australia (regulators and industry representatives) also highlighted the challenges for undertaking assessments of cumulative effects of multiple activities and land uses. Comments in various jurisdictional contexts often echoed what we found in the literature.⁸⁰

There is general agreement in the scientific literature and amongst our interviewees that the assessment of cumulative effects (whether project-based or at a strategic level) presents some unique challenges that require a departure from conventional assessment methodology but also difficulties for identifying and accounting for cumulative impacts. Following the introduction of cumulative effects as a legislative requirement in some jurisdictions (in the USA and Canada), guidance material has been developed in response to concerns that the legal requirements may exceed the ability of the science to deliver.⁸¹ Our interviewees in industry have however stressed the difficulties when having to consider the cumulative effects of multiple activities if required in project-based EIAs and in the absence of regulatory guidance or support (access to information, data).

Despite pro-active policies in Canadian jurisdictions, challenges for the implementation of policies on cumulative effects persist. For instance, the report of British Columbia's Auditor General, "Managing the cumulative effects of natural resources development in BC" (May 2015), highlights the absence of legislation or other government directives to explicitly require relevant government agencies to manage cumulative effects when authorizing the use of natural resources. The Report concluded that Government needs to provide relevant agencies with "clear direction or the powers necessary to manage the cumulative effects when deciding on natural resources use". Our interviewees in industry and CSOs (in Canada, and Australia) have reiterated the importance of an integrated and whole-of-government approach to the assessment and management of cumulative effects. They also expressed the opinion that governments need to take a more pro-active role in the development of processes and frameworks for the assessment and management of cumulative effects through a coordinated approach—in setting values, defining processes and strategies and in monitoring outcomes.

4.4 The 'social' dimension: from Corporate Social Responsibility to the regulatory realm

The dispersed environmental footprint of the UG industry—in often populated areas—has triggered new policy and regulatory considerations in relation to social issues. Without defining the term 'coexistence', the Australian Chief Economist's Review of the Socioeconomic

⁷⁹ <<https://aer.ca/documents/manuals/Manual009.pdf>>.

⁸⁰ Gunn, J, Noble, B. Conceptual and methodological challenges to integrating SEA and cumulative effects assessment, [Environmental Impact Assessment Review](#) 31 (2011); Hegmann, G, et Yarranton, G.A., Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management, *Environmental Impact Assessment Review* 31(5):484-490, September 2011

⁸¹ Emerging guidelines include: the "Cumulative Effects Practitioners Guide" issued by the Canadian Environmental Assessment Agency (1999), the "Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions" issued by the European Commission (1999), and the USA Council on Environmental Quality document "Considering Cumulative Effects Under the National Environmental Policy Act" (1997). The latter two documents also provide guidance on various methodologies such as modelling, networks

Impacts of Coal Seam Gas in Queensland (2015) also emphasized the “strong need for sustainable coexistence between the gas industry, local landholders and communities”.⁸² The Report points toward the economic and social changes that are likely to occur in a region and the need for governments to ensure that “mechanisms are in place to support coexistence”—whether those mechanisms would relate to land access and compensation, the protection of agricultural land, or the well-being of communities.

Our interviewees in the US, Canada and Australia—in government, industry and resource communities—have generally emphasised the importance of having in place structures (legal, policy, or other governance mechanisms) to ‘improve coexistence’ between the industry and impacted communities. The drive toward ‘best regulatory practice’ in some UG jurisdictions has demonstrated that social issues—stakeholder relations, land access, community well-being as well as regulators’ interactions with stakeholders—have become central to governments’ considerations in relation to policies and regulatory reforms.

Across the jurisdictions we covered in this scoping study, we observed that social issues are increasingly the focus of attention by regulators—and critical elements in the governance of the UG industry and its social acceptance. We will provide an overview of the issues that have been discussed with our informants.

4.4.1 The need to rethink processes and methods of engagement with stakeholders

The need to ‘engage communities’ is undisputed and has been reiterated in many policy documents / guiding principles:

In 2012, the International Energy Association (IEA) published a set of “Golden Rules” for UG with the objective to assist governments in developing a governance approach for UG projects.⁸³ The “Golden Rules” of the IEA are based on the consideration of a full range of issues related to the development of UG. They emphasise the need for companies to more fully engage communities to secure their social license to operate and to respond to community concerns and reporting fully on operational practices.

Also in 2012, as mentioned earlier, the Boston Common Asset Management (Boston Common), the Investor, Environmental Health Network (IEHN) and the Interfaith Center on Corporate Responsibility (ICCR) adopted Guidelines, “Extracting the Facts: An Investor Guide to Disclosing Risks from Hydraulic Fracturing Operations”⁸⁴ with the aim to improve industry practice. Principle 11 of the Guidelines is about securing community consent, it emphasises the need to “identify all communities impacted and address major concerns central to community acceptance of company operations; establish community engagement process and third party conflict resolution mechanisms during the site selection processes”.

⁸² *Review of the socioeconomic impacts of coal seam gas in Queensland*, Australian Department of Industry, Innovation and Science, October 2015

⁸³ International Energy Agency, 2012. Golden Rules for a Golden Age of Gas. IEA, Paris. (http://www.worldenergyoutlook.org/media/weowebiste/2012/goldenrules/weo2012_goldenrulesreport.pdf accessed 4 January 2015)

⁸⁴ The Boston Common Asset Management (Boston Common), the Investor, Environmental Health Network (IEHN) and the Interfaith Center on Corporate Responsibility (ICCR) represent 55 major investment organizations and institutional investors with nearly \$1 trillion in assets under management that support “best practices” for the fracking of shale gas. (<http://www.iehn.org/documents/frackguidance.pdf>)

The need for project proponents to ‘be transparent’ about the activities to be undertaken, ‘inform and explain’, and ‘listen’ to concerns expressed by the communities has been widely reiterated across the regions where we have conducted interviews. It has been stated as a recommendation from government as well as a wish expressed by community members. Existing public participation processes—as part of a policy process or required for project approvals—have been criticised by some stakeholders in resource communities and environmental groups (NSW, Alberta, BC), and they are increasingly subject to scrutiny by academics.⁸⁵

In committing to ‘*Regulatory Excellence*’, the Alberta Energy Regulator has reiterated the centrality of the regulator’s relationship with the public:

It’s about transforming ourselves into a regulator that continually improves our work, builds strong relationships with Albertans, and leads the next era in energy regulation. Excellence is the means that creates what Albertans expect and deserve: a strong, fair, transparent, and inclusive regulator that delivers measureable results.

As part of the ‘Best-in-Class Regulator Initiative’ funded by the AER, the University of Pennsylvania’s Penn Program on Regulation⁸⁶ has developed a framework for defining ‘regulatory excellence’ and measuring its attainment. The report, *Listening, Learning, and Leading: A Framework for Regulatory Excellence*,⁸⁷ specifies the three core attributes of excellence:

- (1) Utmost Integrity. “This is about much more than just a lack of corruption; it is also about the regulator’s commitment to serving the public interest, to respecting the law, and working with duly elected representatives”;
- (2) Empathic Engagement. “This is about transparency and public engagement, but also about how respectfully the regulator and its personnel treat regulated entities, affected landowners, and other concerned citizens”;
- (3) Stellar Competence. “This is about the actual delivery of outcomes that maximize public value and the capacities built and actions taken to achieve a high level of performance”.

‘**Listening**’ and ‘**Responsiveness**’ were highlighted in the report as essential elements in the characterisation of ‘an excellent’ regulator.

The University of Pennsylvania’s Penn Program on Regulation (PPR) insisted on the ‘social nature of regulation’ (2015):⁸⁸

Too often regulators today view regulation as primarily a technical enterprise and underappreciate the essentially social nature of regulation, which demands

⁸⁵ Public Participation in Environmental Assessment and Decision Making, Editors, Dietz T, Stern, P, Panel on Public Participation in Environmental Assessment and Decision Making, National Research Council, National Academies Press, 2008; Webler, T, Tuler, S, Four Perspectives on Public Participation Process in Environmental Assessment and Decision Making: Combined Results from 10 Case Studies, Policy Studies Journal, Volume 34, Issue 4, pages 699–722, November 2006.

⁸⁶ <https://www.law.upenn.edu/live/files/4946-pprfinalconvenersreport.pdf>

⁸⁷ <https://www.aer.ca/documents/about-us/PPR_Executive_Summary_09172015.pdf>.

⁸⁸ <https://www.law.upenn.edu/live/files/4946-pprfinalconvenersreport.pdf>

more than just stellar competence but also a high level of integrity and **truly empathic forms of public engagement** too.

The AER released its Stakeholder Engagement Framework in June 2015 with a stated aim to “build strong partnerships and relationships with stakeholders” and to provide stakeholders with the opportunity to engage and collaborate in “developing sound regulations for energy development”. The regulator acknowledges that “stronger stakeholder relationships [...] help build a foundation of trust that enables the relationships to withstand the inevitable issues that arise and allow stakeholders to be brought into the decision making process earlier”.⁸⁹ The Stakeholder Engagement Framework provides a common framework as a ‘standard for engagement’ outlining the principles for engagement, to help the regulator “understand the concerns, values, and interests of stakeholders and collaboratively developing solutions to mitigate any harm to those values and interests”.

In October 2015, the AER released, *The AER and You: The Alberta Conversation on Regulatory Excellence Engagement Workbook* to “engage Albertans, stakeholders, and AER employees to test our own understanding, to make sure we get it right, and to develop a made-in-Alberta version of this framework for regulatory excellence”.⁹⁰

However, there are risks inherent in formulating new regulations for UG development in the interests of managing community and environmental impacts without attending to existing regulatory provisions. As the QCA Report noted, fast-paced efforts at regulation of the emerging UG development industry can lead to duplication, confusion for all stakeholders, and complex and expensive compliance.⁹¹

One approach to improving community engagement between landholders, communities and the gas industry, including through legislative reform, is to establish a separate independent entity charged with this task. This approach was taken in Queensland where the Gasfields Commission Queensland was established in 2013 as an independent statutory body with functions including (1) facilitating better relationships between landholders, regional communities and the onshore gas industry and (2) recommending that legislation and regulation affecting the onshore gas industry be reviewed or amended.⁹² The Queensland Government announced an independent review of the GasFields Commission in March 2016, with the aim of “improving and strengthening” the regulatory framework⁹³. The final report of the review was submitted to the government for consideration on 29 July 2016, and the outcomes of the review are unknown at this time. The Terms of Reference⁹⁴ were broad ranging, including seeking recommendations regarding community engagement and dispute resolution functions, opportunities to gain procedural efficiencies and improve legislation, and opportunities to improve landholder access to information.

⁸⁹ <https://www.aer.ca/documents/about-us/StakeholderEngagement_Framework.pdf>. According to the AER, quality stakeholder engagement can: lead to more sustainable energy development; bring diverse perspectives together and encourage collaborative problem solving; increase efficiency; enable informed decision-making; reduce environmental and social risk; help the AER learn from stakeholders, resulting in process and system improvements; inform, educate, and influence stakeholders to consider the full spectrum of energy development issues; and contribute to the development of trust-based and transparent stakeholder relationships.
⁹⁰ http://www.ppforum.ca/sites/default/files/AER_RegulatoryExcellence_Workbook_1.pdf

⁹¹ Op cit. n.32

⁹² The Gasfields Commission Act 2013. See also www.gasfieldscommissionqld.org.au (last accessed 12 September 2016)

⁹³ <http://www.statedevelopment.qld.gov.au/industry-development/gasfields-commission-review.html> (last accessed 24 October 2016)

⁹⁴ <http://www.statedevelopment.qld.gov.au/resources/terms-of-reference/terms-of-reference-gfcq-review.pdf> (last accessed 24 October 2016)

Our informants in Canada, UK and Australia emphasised the importance of re-thinking the engagement process with communities, highlighting that:

- Early engagement with communities—by government and industry—is crucial to create a climate of trust⁹⁵. Research in the USA and Canada found that “Mistrust of natural gas companies is common”,⁹⁶ a conclusion that was reflected in the opinion of some of our interviewees in NSW, SA and Pennsylvania. The regulators we interviewed in Australia and Canada have emphasised the difficulties associated with ‘engagement’, and the need to improve the system of public participation in decision-making processes around land use and resource extraction activities.
- Engaging in a non-emotive dialogue with communities around UG issues has proven to be a complex issue in most jurisdictions,⁹⁷ both for industry and government (interviews with regulators in Alberta, British Columbia, NSW, South Australia and the UK).
- In Alberta and British Columbia, discussions with industry revealed the recognition of the need to involve the community at an early stage in risk assessment processes, specifically in the definition of values and metrics that support risk assessment processes.
- Given the complexity of issues raised in UG operations, collaborative governance mechanisms have been suggested as an option by some stakeholders that we interviewed as a way to improve stakeholder relations and build community trust.⁹⁸ Further research would be required on existing models of collaborative governance for natural resources management and their applicability in the context of UG projects. In NSW, the proponents of UG projects are required to establish a Community Consultative Committee (CCC)⁹⁹ to provide a platform for discussions around a project’s activities to enable the community to be engaged regularly with the proponent on matters that affect it. Interviews with stakeholders in NSW onshore gas regions (Narrabri, Gloucester and the Northern Rivers) revealed that the involvement of government is crucial to build trust in the process. Although the CCCs are established by project proponents, industry representatives that we interviewed also acknowledged the importance of the role that government must play in the process. This opinion resonates as well with statements by a number of interviewees in the communities, who state a preference for seeing a process led by government rather than by the project proponent. The four CSG companies in Queensland formally established Regional Community Consultative Committees as part of their social impact management strategies. In some instances, where multiple companies are dealing with the same communities, they have established joint committees. The RCCCs include representatives from community groups, farmer organisations, environmental groups, State government departments, local government authorities and the CSG companies.

⁹⁵ In the US, for example, where environmental impacts have been unaddressed, information relayed by the media can create fears in the communities.

⁹⁶ M4ShaleGas - Measuring, monitoring, mitigating and managing the environmental impact of shale gas – “Public perception of shale gas operations in the USA and Canada – A review of evidence”, November 2015

<http://www.m4shalegas.eu/downloads/M4ShaleGas%20-%20D18.1%20-%20Public%20perceptions%20of%20shale%20gas%20operations%20in%20North%20America%20-%20Nov.%202015.pdf>

⁹⁷ Interviews with industry and state government in NSW, BC Oil and Gas Commission

⁹⁸ On collaborative governance: Jo-Anne Everingham

⁹⁹ <http://www.planning.nsw.gov.au/en/Assess-and-Regulate/Development-Assessment/~/_media/7E75DCADB0D6457B8D7242F5EE9030B5.ashx>.

4.4.2 Land access

The jurisdictions that were covered by the scoping study have fundamentally different constitutional positions with regard to resource ownership (ranging from private ownership by individuals to state/Crown ownership on behalf of the people). The legal frameworks for land access are therefore difficult to compare, varying within each context.

Private ownership of subsurface rights in the (relevant parts of the) USA has constituted a key positive advantage for the UG industry as it provides strong financial incentives for landholders to accommodate UG activities. In contrast, in the UK and Australia, petroleum – and other mineral - resources are vested in the Crown represented by a government that may grant a title to third parties to explore and develop sub-surface resources. The consequences of the separation of the rights to subsurface resources from the rights inherent in land ownership, in tandem with the legislation governing resource exploration and development, are that landholders have no right to exclude access across their land pursuant to an exploration or extraction authorisation (although they may have some say in how access takes place).

Australia

In Australia, the land access regime is determined in each state by the laws of the state. Statutory safeguards for landowners are limited—and have been regarded by some in the resource communities as highly inadequate in the context of CSG development. The issue of land access – and coexistence with an industry that has such a dispersed geospatial footprint - has become a major source of contention for CSG projects on the East Coast of Australia (e.g., New South Wales’s Gunnedah, Clarence-Moreton and Gloucester Basins) and exploration for shale gas in the south east of South Australia.

Land access issues have received a high level of attention recently in Australia, including from Federal Ministers. The Australian Energy Minister promised to place the issue of landholder rights on the agenda of the Council of Australian Governments—COAG—at their 2015 December meeting, for state and federal resources Ministers to discuss the issue.¹⁰⁰ COAG has stated that it will be supportive by improving coexistence via the Multiple Land Use Framework and Harmonised Framework for Natural Gas from Coal Seams.¹⁰¹ The right for landowners to refuse access to their land has however not received bipartisan support.¹⁰²

Queensland

■ Land Access Code

The *Land Access Code* made as a regulation under the *Petroleum and Gas (Production and Safety) Act 2004* was published in November 2010 and revised in September 2016. The Code does the following:

- (a) sets out best practice guidelines for communication between the holders of a petroleum authority and the owners and occupiers of private land; and

¹⁰⁰ <http://www.northerndailyleader.com.au/story/3536968/landholders-want-right-to-say-no/>. The Meeting Communiqué makes no mention of the issue, however <<https://scer.govspace.gov.au/files/2014/05/Energy-Council-Communique-4-Dec-2015-FINAL.pdf>

¹⁰¹ <<http://www.scer.gov.au/files/2013/09/National-Harmonised-Regulatory-Framework-for-Natural-Gas-from-Coal-Seams.pdf>>.

¹⁰² <http://www.theguardian.com/environment/2015/oct/30/labor-warns-coalition-not-to-change-land-access-rights-over-csg-mining>

(b) imposes mandatory conditions on authority holders concerning the conduct of authorised activities on private land.

The aim of the Code is to balance the interests of landholders and resource authority holders, with a focus on compensation arrangements and the need for good communication and relationships. The Code works in conjunction with the *Mineral and Energy Resources (Common Provisions) Act 2014* and the *Mineral and Energy Resources (Common Provisions Regulation) 2016*. The Queensland government land access guide¹⁰³ summarises the requirements provided by this collective framework. Its features include the following:

- The provision of entry notices to landholders for ‘preliminary activities’.
- The requirement for a resource authority holder to negotiate a CCA before accessing land to undertake ‘advanced activities’.
- The right of landholders to refuse access to restricted buildings and area (some exemptions do apply)
- The option for a landholder and a resource company to enter into an Opt-Out Agreement and negotiate a legal agreement outside the statutory Conduct and Compensation Agreement negotiation process.
- A statutory graduated negotiation and dispute resolution process for CCAs, with the Land Court being the forum of last resort.
- The compensation of landholders for reasonable and necessary accounting, legal and valuation costs incurred in negotiating or preparing a CCA.

The *Land Access Code* was independently reviewed after 12 months of operation, resulting in a report that proposed reforms, released by the Queensland Government in March 2014.¹⁰⁴ Several of the proposed reforms were adopted in September 2016 following amendment of the Act and the introduction of the *Mineral and Energy Resources (Common Provisions Regulation) 2016*. For example, the provisions relating to use of alternate dispute resolution, opt-out agreements and recording the Conduct and Compensation Agreement/s on the property title.

New South Wales

■ Land Access Arbitration Act 2015

As part of the recent legislative reform of the resource exploration regime, the state government has sought to improve the legislative framework with regard to rights and responsibilities for landholders and titleholders¹⁰⁵. Additional to the *Mining Act 1992* and the *Petroleum (Onshore)*

¹⁰³ Online guide available at: <https://www.business.qld.gov.au/industry/mining/land-access-environment/land-access-requirements>; *A guide to land access in Queensland*: https://www.dnrm.qld.gov.au/_data/assets/pdf_file/0004/480388/guide-land-access.pdf

¹⁰⁴ The *Land Access Implementation Committee Report* (accessed 12 September 2016 at <https://www.dnrm.qld.gov.au/our-department/corporate-information/policies-initiatives/land-and-property-initiatives/land-access-policy-framework>). The recommended reforms include: a) A review of the heads of compensation to ensure no cost or erosion of landholder rights; (b) Expanding the Land Court’s jurisdiction to include matters concerning conduct; (c) Introducing a single accredited form of alternative dispute resolution (ADR) process, independent of government, that is recognised by, and can be integrated seamlessly into the Land Court process without duplication of process; (d) Noting the existence of Conduct and Compensation Agreements (CCA) on the property title by resource companies; (e) Parties being able to agree to opt-out (at the election of the landholder) of the requirement to negotiate a CCA, at the election of the landholder, provided that the condition of the Code continue to apply as a minimum.; (f) Development of standard CCAs for mineral, coal and coal seam gas industries in partnership with the resource and agricultural sectors; (g) Providing better information about the process of negotiating a CCA – combining all information into a single, comprehensive and plain language resource for landholders and resource companies.

¹⁰⁵ In 2014 the Government commissioned Mr Brett Walker, SC, to undertake an independent examination of the land access arbitration framework under the Mining Act and the Petroleum (Onshore) Act. The Government sought recommendations from Mr Walker on the governance arrangements for appointments of arbitrators, best practice arbitration processes, and the roles and responsibilities of the parties to an arbitration. Mr Walker found that the fundamentals for arbitration are sound. However, he said

Act 1991 in relation to land access procedures, the *Mining and Petroleum Legislation Amendment (Land Access Arbitration) Act 2015*¹⁰⁶ clarifies the rights of landholders and provides a framework for the resolution of land access disputes¹⁰⁷.

■ Land Access Code

The NSW Government intends to introduce a Land Access Code containing some guidelines that explorers must follow when negotiating land access arrangements for petroleum exploration and general guidance as to the process for land access negotiations and conduct while accessing land to undertake activities.

4.4.3 Maximising the benefits of resource development

The impacts of the range of activities associated with UG projects on local communities, including the degradation of local infrastructure, have pushed some jurisdictions to consider mechanisms for redistributing wealth from resource development. Ensuring a fair redistribution of benefits from UG development activities is an issue that has been raised recurrently by our interviewees in resource communities (including local government representatives) in Canada, the USA and Australia.

Pennsylvania

During the interviews that we held in Lycoming County, in North West Pennsylvania, interviewees from the local government underlined the importance for policy and regulatory frameworks to allow for the profits raised from UG production to be redirected toward enhancing community well-being. A pro-active role of local government - within their areas of competence - was emphasised as a determining factor in successfully providing for wealth redistribution within the local communities. To what extent a community is benefiting from the development of resources largely depends on the local government using its power to mitigate the impacts [through zoning or noise ordinances, for instance] and re-directing benefits toward the community. In the case of the Lycoming County, an impact fee was imposed (for well impact) that raised US\$5.9 million in 2014. That fund was partly used to remediate the impacts of shale gas development and partly used to contribute to enhancing the welfare of the local community. Redistribution of revenues to the local community for projects within defined categories, such as employment creation, place making/enhancement and social services, has proven an important factor in the county in terms of the betterment of industry-community relations.

Australia

In Western Australia and Queensland, each state government established a ‘Royalties for Regions’ program to support economic growth and social development in affected regional areas. In WA, since December 2008, the ‘Royalties for Regions’ program has invested \$6.1 billion of the state's mining and onshore petroleum royalties for more than 3,600 projects and programs, including transfers to the Future Fund and other Special Purpose Accounts.

that improvements were needed to address weaknesses relating to transparency, accountability and consistency. Mr Walker made 31 recommendations, which the Government substantially endorsed. Implementation of these recommendations, referred to as the Walker recommendations, is an action under the NSW Gas Plan.

¹⁰⁶ The Mining and Petroleum Legislation Amendment (Land Access Arbitration) Act 2015

¹⁰⁷ <http://www.crikey.com.au/2012/02/20/land-use-and-csg-what-rights-do-property-owners-have/>

In **Queensland**, the Royalties for the Regions program committed to funding new and improved infrastructure. It commenced in 2012-13 with funding continuing through to 2015-16. Following the close of the Royalties for the Regions program, the government continues to be committed to supporting regional Queensland through a \$375 million regional infrastructure program—the Building our Regions Regional Infrastructure Fund.¹⁰⁸ That program has an aim to provide funding for critical infrastructure in regional areas of the state (for local government projects in regional cities and nearby rural areas, resource producing communities, and remote and indigenous communities).

The **NSW** Gas Plan proposed the creation of a Community Benefits Fund in NSW with the aim to redirect economic benefits from the development of CSG projects toward the local communities. Another intent of this initiative is to provide for a mutually beneficial relationship between project proponents and affected communities and to involve communities in decisions related to the allocation of the Fund.¹⁰⁹

5 Conclusion

The development of regulatory frameworks for UG activities is ongoing. The objective of this scoping study was not to provide a detailed analysis of regulation in each jurisdiction but rather to highlight some recent regulatory developments and the elements that seem critical – as we were informed by those interviewed – to improve the governance frameworks. These frameworks apply to exploration for and the extraction of UG in the interest of public confidence, the respect for landholders and resource communities, environmental and ecosystem protection and the interest of the industry on whom governments rely to develop the resources.

In summary:

- Legislative reviews and reforms of the frameworks that govern the exploration and extraction of hydrocarbons are ongoing in jurisdictions where there is a potential for UG development.
- Jurisdictions have allowed UG activities under existing regulatory regimes, adjusting those regimes to address new risks and impacts, with a focus on water withdrawal and wastewater management, baseline water testing, chemical disclosure for fracturing fluids and air quality monitoring.
- The regulators' response often encompasses both technical and social justice elements, including land access, the redistribution of benefits from resource development to communities, and public participation in decision-making processes.
- The prospects for UG development in addition to the growth of the extractive resources sector has led some governments to consider innovative ways to address the cumulative effects of multiple land uses in order to meet development objectives without sacrificing environmental sustainability.

¹⁰⁸ See: <http://www.statedevelopment.qld.gov.au/regional-development/building-our-regions.html> (last accessed 12 September 2016)

¹⁰⁹ <http://www.resourcesandenergy.nsw.gov.au/landholders-and-community/coal-seam-gas/community/community-benefits-fund>

- Underpinning the reforms across jurisdictions is the aim to achieve more efficiency, transparency and effectiveness in the management of the UG sector, as well as the imperative to raise public trust.

6 Future Research

Building on the findings of this scoping study, the authors propose to develop a research project to further the research collaboration between the University of College London's School of Energy and Resources and The University of Queensland's Sustainable Minerals Institute, involving research partners in North America (in industry¹¹⁰, academia¹¹¹ and CSOs¹¹²) and an international organisation.¹¹³

The research team will build on existing research,¹¹⁴ expertise and its networks to undertake this collaborative research project that will help to inform decision making with regard to unconventional gas regulation and deliver benefits to communities, government and industries.

The findings of this scoping study have shown that addressing heightened social concerns with technologies (e.g., hydraulic fracturing) that are being applied in new areas and to an increased extent has become a meaningful priority in many jurisdictions. That is giving rise to an unprecedented level of regulatory attention toward improving current regulatory frameworks to manage the environmental – and social - impacts of the emerging unconventional gas industry. Discussions around the concept of social licence to operate has gradually led to consideration of the role that governments may play in arbitrating stakeholder relations and providing a supportive policy and regulatory environment to improve the quality of the relationship between project proponents and communities.

Increased regulatory oversight (e.g., SIMPs in Queensland, NSW's SLUP) has however not necessarily proven to be the most effective way to achieve policy objectives. Growing momentum for the sustainable and 'responsible' management of resources worldwide, and in Australia, have pushed for a reframing of the debate beyond the industry's 'social licence' and governments' regulatory role. Attention is being directed toward a multi-stakeholder approach to devising mechanisms to achieve the objectives of inclusive and participatory natural resource management.

With the expansion of the unconventional gas industry, approaches for (social and environmental) impact assessments have been under increasing scrutiny by CSOs and environmental NGOs. With an increasing significance of systemic risk factors - such as water availability, degradation of ecosystems, climate change, decline of biodiversity - the traditional

¹¹⁰ Canadian Association of Petroleum Producers (CAPP), Sherry Sian, Manager Land Policy and Integrated Resource Management, Alex Ferguson (Vice President).

¹¹¹ University of British Columbia, Institute for Resources, Environment and Sustainability (IRES); Simon Fraser University, Tom Gunton, Professor and Director of Resource and Environmental Planning; Chair of the Sustainable Planning Research Group (<http://research.rem.sfu.ca/sustainableplanning/>).

¹¹² National Health Forum in the US host of the Health Impact Project (a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts), designed to promote the use of health impact assessments (HIAs) as a decision-making tool for policymakers. (Aaron Wernham).

¹¹³ World Health Organisation, Department of Public Health and Environment, WHO's Unit "Interventions for Healthy Environments"

¹¹⁴ Research that has been undertaken by various organisations in Australia (such as GISERA, UQ's SMI), the USA and in Canada (University of British Columbia, Institute for Resources, Environment and Sustainability (IRES), Sustainable Planning Research Group, Canadian Institute of Resources Law at the University of Calgary).

approaches for impact assessment have been perceived as insufficient to support the goal of environmentally sustainable development and meet community expectations.

As outlined in this report, some jurisdictions have developed new approaches to assess impacts of resource development activities at a regional scale, with an aim to achieve the sustainable management of natural resources. The challenges for the implementation of such approaches have also been highlighted by regulators, industry and academics that we interviewed. Notably, difficulties arise around the need to provide a whole-of-government approach to integrated resource management, develop the tools and methods to define social, economic and environmental values, support agencies coordination and integrated decision making processes.

Given that the unconventional gas industry remains relatively under-developed in most parts of Australia (except Queensland), regulators are in a position to build upon the experience of other jurisdictions and consider a new (governance) model, developed in consultation with stakeholders, to support the sustainable - and responsible - development of resources (including unconventional gas). Collaboration amongst jurisdictions - and within jurisdictions between regulators, academia, industry and civil society - will be important for developing a governance model that is effective in achieving these objectives and efficient in supporting the goals of resource development in a competitive global market.

On this basis, we propose to develop a research project that aims to identify what are the key elements (policy, regulatory, corporate practice) in a resource management system that influence / affect the unconventional gas industry's social licence to operate.

The research, specifically, will aim to:

1. Identify strategies for regulation (comprising regulatory and non-regulatory tools) that 'work' and figure out factors that contribute to their success ('appreciative inquiry');
2. Compare – and critically analyse - the conceptual frameworks, tools and methodologies that have been developed to support more inclusive and participatory resource management systems (e.g., British Columbia, Alberta);
3. Identify policy areas where strategies have been implemented for overcoming hurdles;
4. Make suggestions for a governance model suitable in the Australian context.

Annex 1: Jurisdictions covered in the scoping study

	Lead Government Agencies	Key legislation
Australia	Department of the Environment National Native Title Tribunal	Environment Protection and Biodiversity Conservation Act 1999 [If impact on a matter of national environmental significance or invoke the water trigger] Native Title Act 1993
WA	Dept of Mines and Petroleum WA Environmental Protection Authority Dept of Water	Petroleum and Geothermal Energy Resources Act 1967 Environmental Protection Act 1986 Rights in Water and Irrigation Act 1914
NSW	Dept of Industry, Resources & Energy NSW Environmental Protection Authority Dept of Planning and Environment NSW Office of Water	Petroleum (Onshore) Act 1992 Environmental Planning and Assessment Act 1979 Protection of the Environment Operations Act 1997 Water Management Act 2000
SA	Dept of State Development (DSD) (formerly the Department for Manufacturing, Innovation, Trade, Resources and Energy) SA Environment Protection Authority Dept of Environment, Water and Natural Resources (DEWNR)	Petroleum and Geothermal Energy Act 2000 Environment Protection Act 1993
QLD	Department of Natural Resources and Mines QLD Environment Protection Agency	Petroleum and Gas (Production and Safety) Act 2004 State Development and Public Works Organisation Act 1971 Water Act 2000 Waste Reduction and Recycling Act 2000 Regional Planning Interests Act 2014 Gasfields Commission Act 2013 Environmental Protection Act 1994
USA	Environmental Protection Agency (EPA)	US (Federal) National Environmental Protection Act (NEPA) 1970
PENN	Pennsylvania's Dept of Environmental Protection (PADEP) Office of Oil and Gas Management (Office of Mineral Resource Management)	National Environmental Protection Act (NEPA) 1970 Oil and Gas Act (1984)

Texas	Railroad Commission of Texas (RRC) – (3 elected commissioners / quasi-judicial role) Texas Commission of Environmental Quality	Texas Natural Resources Code National Environmental Protection Act (NEPA) 1970
Ohio	Division of Mineral Resources Management (DMRM) Ohio Dept of Natural Resources (DNR) Ohio Environmental Protection Agency	Title 15 Ohio Revised Code (under Ohio Administrative Code (Conservation of Natural Resources), Chapter 1509 (Division of Mineral Resources Management — Oil and Gas) National Environmental Protection Act (NEPA) 1970
Canada	Environment Canada	Environmental Assessment Act (1995)
Alberta	Alberta Energy Regulator	Environmental Protection and Enhancement Act (2000) Responsible Energy Development Act (2012) Oil and Gas Conservation Act (2000)
BC	BC Oil and Gas Commission (formed as Crown corporation and a single-window regulatory body)	Environmental Assessment Act (SBC 2002) Oil and Gas Activities Act (SBC 2008)
Europe		
UK	Dept of Energy & Climate Change (DECC) Oil & Gas Authority (OGA) Office of Unconventional Gas and Oil (OUGO)	Environmental Protection Act 1990 Petroleum Act 1998

Annex 2: References

2008, Australian Productivity Commission, Review of Regulatory Burden on the Upstream Petroleum (Oil and Gas) Sector: Productivity Commission Issues Paper
http://www.pc.gov.au/_data/assets/pdf_file/0018/82026/upstream

2009, Ground Water Protection Council: “State oil and Natural Gas Regulations Designed to Protect Water Resources”
http://www.gwpc.org/sites/default/files/state_oil_and_gas_regulations_designed_to_protect_water_resources_0.pdf

2012 Guidelines, “Extracting the Facts: An Investor Guide to Disclosing Risks from Hydraulic Fracturing Operations”
<http://www.iehn.org/documents/frackguidance.pdf>

2012 Petroleum Technology Alliance Canada and the Science and Community Environmental Knowledge Fund
<http://www.capp.ca/getdoc.aspx?DocId=210903>

2012, Potential Risks for the Environment and Human Health Arising from Hydrocarbons Operations Involving Hydraulic Fracturing in Europe
http://www.cedelft.eu/publicatie/support_to_the_identification_of_potential_risks_for_the_environment_and_human_health_arising_from_hydrocarbons_operations_involving_hydraulic_fracturing_in_europe/1274

2012, Shale gas extraction in the UK: a review of hydraulic fracturing, Royal Society and Royal Academy of Engineering report
<https://royalsociety.org/~media/policy/projects/shale-gas-extraction/2012-06-28-shale-gas.pdf>

2012, Climate Impact of Potential Shale Gas Production in the EU
http://ec.europa.eu/clima/policies/ecep/docs/120815_final_report_en.pdf

2012, Unconventional Gas: Potential Energy Market Impacts in the European Union
<https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/unconventional-gas-europe-potential-energy-market-impacts>

2013, Overview of hydraulic fracturing and other formation stimulation technologies for shale gas production (updated in 2015)
<http://publications.jrc.ec.europa.eu/repository/bitstream/JRC98582/an%20overview%20of%20hydraulic%20fracturing%20and%20other%20stimulation%20technologies%20-%20update%202015.pdf>

2013, UK DECC “Regulatory Roadmap: Onshore oil and gas exploration in the UK regulation and best practice”
<https://www.gov.uk/government/publications/regulatory-roadmap-onshore-oil-and-gas-exploration-in-the-uk-regulation-and-best-practice>

2013, Responsible Shale Development, enhancing the knowledge base on shale oil and gas in Canada, Energy and Mines Ministers’ Conference

https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/www/pdf/publications/emmc/Shale_Resources_e.pdf

2013, Study on the Assessment of Land and Water Use Scenarios for Shale Gas Development: Poland and Germany

http://skp.jrc.cec.eu.int/skp/scientific_outputs/scientificOutput/showPub.do?requestNo=JRC83619

2013, The State of State Shale Gas Regulation, Resources for the Future, (Richardson N, Gottlieb M, Krupnick A & Wiseman H)

http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-Rpt-StateofStateRegs_Report.pdf

2013, Assessment of the use of certain substances in hydraulic fracturing of shale gas reservoirs under REACH

http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/29386/1/req_jrc83512_assessment_use_substances_hydraulic_fracturing_shale_gas_reach.pdf

2013, Study on the regulatory provisions governing key aspects of unconventional gas development in eight Member States

<http://ec.europa.eu/environment/integration/energy/pdf/Final%20Report%2024072013.pdf>

2014/70/EU: EC Commission Recommendation on minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high-volume hydraulic fracturing

<http://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:32014H0070&from=EN>

2014, Mitigation of climate impacts of possible future shale gas extraction in the EU: available technologies, best practices and options for policy makers

<http://bookshop.europa.eu/en/study-on-mitigation-of-climate-impacts-of-possible-future-shale-gas-extraction-in-the-eu-available-technologies-best-practices-and-options-for-policy-makers-pbML0414368/>

2014: Norton Rose Fulbright, Houston, Texas: “Analysis of litigation involving shale & hydraulic fracturing”

<http://www.nortonrosefulbright.com/files/20140101-analysis-of-litigation-involving-shale-hydraulic-fracturing-104256.pdf>

2015, UK Shale Gas Task Force – Final Report

<https://darkroom.taskforceonshalegas.uk/original/d6f5f84dbfecbe9c22bddbc7f93d31bc:cb2ee01d6a9d7a96cd7d10262971d586/task-force-on-shale-gas-final-conclusions-and-recommendations.pdf>

2015, Center for Sustainable Shale Development Performance Standards and Regulatory Standards Across the Appalachian Basin

<https://www.sustainableshale.org/wp-content/uploads/2015/03/CSSD-Performance-Standards.pdf>

2015, Guidelines for UK Well Operators on Onshore Shale Gas Wells “Onshore Oil and Gas Exploration and appraisal phase”

<http://www.ukoog.org.uk/images/ukoog/pdfs/ShaleGasWellGuidelinesIssue3.pdf>

2015, Scottish EPA: “Regulatory guidance: coal bed methane and shale gas”

https://www.sepa.org.uk/media/139706/unconventional_gas_guidance.pdf

2015, US EPA Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources (External Review Draft)
<https://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=244651>

2015, M4ShaleGas - Measuring, monitoring, mitigating and managing the environmental impact of shale gas – “Public perception of shale gas operations in the USA and Canada – A review of evidence”,
<http://www.m4shalegas.eu/downloads/M4ShaleGas%20-%20D18.1%20-%20Public%20perceptions%20of%20shale%20gas%20operations%20in%20North%20America%20-%20Nov.%202015.pdf>

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