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Coal Seam Gas Mining and Stakeholder Management

This paper discusses challenges presented to management teams of coal seam gas (CSG) companies as a result of undesirable social, environmental and cultural outcomes. In Australia, CSG mining is a developing non-renewable energy industry that impacts on air and water quality, landscape, community health and traditional sacred sites. Consequently, business management in CSG is becoming increasingly difficult due to clash of values between business outcomes, government policy and community ethics. Using stakeholder theory, the paper argues that managers in CSG must view the communities surrounding CSG sites as definitive stakeholders rather than business nuisances. The paper concludes that the negative impact of CSG mining has no limited extent and the true magnitude of its effects are not yet known, creating an unstable management environment and unpredictable legacy issues.

Keywords: coal seam gas, fracking, environmental risks, cultural loss, social impacts, sustainability, ethics, social responsibility, stakeholder theory, management, legacy

Introduction

Coal Seam Gas mining (CSG) or fracking, is a process by which natural gas is extracted from low value coal layers in the earth. Wells are drilled and the resulting shafts are a combination of vertical and horizontal boreholes, to achieve effective coverage of the seam. The borehole is encased in cement to separate the fracking fluid from soil, ground water and unstable geological layers. A mixture of high temperature, high pressure water and chemicals are then injected into the borehole. The temperature of the fracking fluid is higher than the melting point of the coal rock, allowing the fluid to dissolve the coal. The mixture is then forced back to surface level, where it is cooled down and the product of coal seam gas is separated from the fracking fluid. The fluid can then be reused in the process[1].

There is, however, more to CSG than the engineering process. Concerns about the environmental and social impacts of fracking are found in many countries. All countries that mine for CSG have dealt with numerous pollution problems including gas and water emissions, air quality, water and land contamination, land use, and the adverse effects such pollution has on the health of the surrounding community. The stakeholder rural communities surrounding

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[1] See Howarth et al., 2011a, p.272 for an illustration of the fracking process.

CSG mining sites often agitate, creating friction against the power companies who mine CSG. Such communities regularly clash with government policy over ethical considerations, where the financial interests of the government and their decision-making are placed against the environmental and social impacts of the policy. This ethical dilemma places monetary gain over long term sustainability, and therefore CSG managers face increased difficultly in fulfilling social responsibility that communities demand.

Stakeholder Management

CSG managers thus must be equipped to balance multiple stakeholder interests. This paper considers challenges presented to managers of CSG companies using the research model of Mitchell et al. (1997)[2], where the activity of the stakeholders can be classified through their levels of power, legitimacy and urgency.

Communities surrounding CSG sites have legitimacy in their concerns. Community interest in the location or potential location of a CSG mining site can determine their level of involvement and therefore importance. Technology has allowed an ease of communication that assists rural communities to form a strong voice against the CSG companies. For example, the community group Lock the Gate Alliance extends influence across Australia, giving rural communities more power and increasing their perceived stakeholder importance (Lock the Gate, n.d.). Communication between groups with similar concerns is facilitated by Lock the Gate Alliance creating both power for the smaller stakeholders and a sense of urgency through effective publicity. The importance of community stakeholders is therefore increased, labeling them as 'Definitive Stakeholders' and creating a benefit for the CSG companies to treat them as valuable stakeholders (Mitchell et al., 1997).

Financial interests of business and government policy will often clash with the vision of the community. Families who have worked on the land for generations are concerned for future sustainability and land value. The social issue of separation in land and community has no monetary value for the members involved but it has strong emotional and social value. Often mining policy challenges community interest, and confronts societal values placed on the future legacy of the landscape. The land is viewed in different ways, pitting those who live there against those who develop or mine it. A major issue in the management of CSG is combining these interests, and creating value for both parties.

The development of CSG may also be viewed as an ethical problem. The separation of land, and one's life's work can cause an individual to disconnect and develop mental health issues. This mental state has been identified as 'solastalgia', or the distress caused by environmental change (Albrecht et al., 2007). Solastalgia can be felt by individuals and communities, through practices that are not healthy or sustainable. This increases the ethical responsibility of CSG company

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[2] Illustrated in Mitchell et al., 1997, p.874, Figure 2.

management for the resulting social problems in CSG areas. Management may need to create and focus a team to mediate with the community, and effectively concern themselves with the sociocultural segment that surrounds mining areas (Hanson et al., 2014).

Air Quality

Deterioration of air quality surrounding fracking sites contributes to community health concerns. Largely caused by the emissions from the fracking process and the set-up process, harmful gasses that contribute to global warming are released into the community and environment. CSG companies are often so focused on developing the asset that they forget to engage social responsibility. However, "values are critical to sustainable development' (Bansal & Howard 1997, p.41). It is difficult to achieve sustainability when the parties involved have alternate major concerns. CSG companies are often not satisfying their social responsibility to the environment and community. This relationship does not show ethical initiative.

Emissions

Emissions from the process of CSG mining affect the environment and community health. During the process of CSG fracking, low levels of nitrous oxides, sulfur dioxide and methane are released into the environment; known as fugitive gases. These chemicals are known to contribute to climate change and can produce harmful acid rain. Sulfur dioxide dissolves in water and becomes sulfuric acid. The inhaling of these chemicals has been linked to breathing difficulties and respiratory illnesses (Clean Air Trust, 1999). However, as seen in Table 1[3], compared with the burning of coal, CSG produces less mercury, particulates, nitrous oxides and sulfur dioxides, making it a more desirable choice.

Emission factor	CO_2	CH_4	NO_x	SO_2	BC	CO	Hg	PM
Coal								
Primary energy[a] (kg/GJ)	25.00		0.196	0.240	0.040	0.089	6.90E −06	1.179
Electricity[b] (kg/GJ_e)	78.10		0.614	0.750	0.130	0.279	2.10E −05	3.684
Fugitive[c,d]	7.22	7.06						
Natural gas								
Primary energy[e] (kg/GJ)	15.00		0.040	3.00E −04	2.20E −07	0.017	0.000	0.003
Electricity[b] (kg/GJ_e)	25.00		0.066	5.00E −04	3.70E −07	0.029	0.000	0.005
Fugitive[d,f]	1.5 0	13.33p						

Table 1. Emission factors of coal and natural gas.

[3] Based on Jenner and Lamadrid, 2013, p. 445, Table 2.

Methane

Methane is a major component of natural gas that has no colour or odour. It is released from the coal during the fracking process, and this disturbance can result in uncaptured gasses escaping to the atmosphere[4]. Methane is 86 times more potent than carbon dioxide at trapping heat in a 20-year period (Myhre et al., 2013). Any uncaptured methane has a severe negative impact on the environment, which may outweigh any benefits over conventional energy sources.

It is estimated that up to '7.9% of the methane from shale gas (a term used to refer to CSG) production escapes to the atmosphere in venting and leaks over the lifetime of a well' (Howarth et al., 2011b, p.679). The drill-in and phase-out process of CSG release a significant portion of these emissions. Before the borehole is in use, the preparation and establishing groundwork can disturb pockets of methane, allowing uncaptured to escape in the atmosphere.

Water Quality

An issue identified with CSG mining is the way the industry handles water quality concerns, and in this way the industry may fail ethical responsibilities. Contaminated water drastically impacts the community, eco-system and environment. By negatively affecting the quality of water, the community's quality of life and human needs are disregarded. CSG management should work with environmentalists and health experts to monitor waterways in attempt to retain water quality and avoid contamination.

Contamination

Research suggests the movement of materials in the fracking process presents risks of environmental contamination. All stages of preparation and development of the CSG extraction site present possibilities of spillage and improper disposal of substances (Kovats et al., 2014). Chemical contamination, emissions from processing equipment, by-products, cement casing structural integrity, returning back-flow, onsite storage, and heavy transport to move materials, are all examples of risks to water quality in an area that CSG mining was, is or will be.

Fracturing Fluid

The process of fracturing requires highly pressured, high temperature water, which is pumped into the borehole where the coal seam has been confirmed. Typically, three to twelve chemicals of varying toxicity are added to the water. These chemicals have varying purposes in creating the greatest efficiency in extraction such as friction reducers, foamers, pH control and gellants (Colborn et al., 2011). Inadequate resources and processes of waste treatment, fluid disposal and storage is likely to lead to contamination of surface water. This water used to carry the gas out of the well is not required to be pure, may be reused and carry other potential environment contaminate such as sodium chloride. These wastewater chemicals and other sediments may remain after treatment (Entrekin et al., 2011).

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[4] See Howarth et al., 2011b, Figure 1A for a comparison of greenhouse gas emissions.

The risk is that this fluid comes in contact with an underground aquifer (a permeable rock that transports ground water) which could be used as potable or irrigation water for food crops. Allowing ground water to become contaminated produces liability though legacy issues and pollutes current surface water reservoirs. This impacts regional agriculture, local industry and potentially, national water systems and rivers (Jenner & Lamadrid, 2013).

By-products

The borehole is separated from the soil around the area by a casing of cement. If the cement does not properly isolate the fluid from the soil, methane seepages occur (Jenner & Lamadrid, 2013). Not only do methane seepages damage and contaminate the land and soil surrounding the area, it can be carried to nearby water systems and drinking wells. A study in northeastern Pennsylvania in New York by Robert B. Jackson found that the methane contamination in private wells rose with the proximity the fracking site. Furthermore, the study found that was not uncommon for these close sites to have flammable levels of methane in the water (Holzman, 2011).

Sludge

The returning fluid that is carried to the surface during the fracking process can contain naturally occurring radioactive materials (NORMs) (Jenner & Lamadrid, 2013). The radiation is at a low level, however it can build up through the food chain in a process called bioaccumulation. When the returning sludge has an inadequate treatment process, the radioactive material can be released on the land surface in a condensed form and consumed by local food chain. People then eating large fish from rivers can also accumulate this radiation in their body, which leads to an increased risk of cancer (NETL, 2009).

Land Usage

CSG mining takes place under the earth's surface; because of this many of the environmental impacts of fracking many not be obvious for several years.

The Fracking Footprint

'Land clearing, excavating and grading, pad construction, pipeline and utility installation, related road construction, sump hole excavation, and hydroseeding as well as soil stabilization are the main construction activities that impact the local landscape' (Meng & Ashby 2014, p.125). During construction and preparation for CSG mining vast quantities of land are stripped of trees, to make way for construction equipment and transport. The roads and travelling routes of transport vehicles amount to a large surface area or footprint on the environment (Kovats et al., 2014).

Effects

The process of developing a new site, and in continual use, the landscape becomes fragmented. Fragmentation divides the larger habitat and eco-region into small isolated areas that are unlike the original. The segmented areas can displace and isolate the fauna and flora from their original ecosystems, decreasing local biodiversity and harmfully affecting some species at a large scale (Jordaan et al., 2009). The drilling can affect land forms, soil, and cause small scale earth quakes; where the earth shifts to fill the space left after gas extraction, which could damage infrastructure and property (Jenner & Lamadrid, 2013). CSG company management are faced with potential legal situations over the loss of land and buildings on private property.

Use of heavy vehicles also adversely effects the soil by compacting and minimizing the soil aeration, leading to a reduction in microbial health of the soil. These microbes increase the resilience of the environment and are vital in the ecosystem. This fragmentation can limit diversity and increase soil recovery time (Kovats et al., 2014).

Legacy Issues

Contamination of the land and the scars that CSG mining leaves behind could take centuries to recover. "Used land can mostly be restored but reforestations can take up to 300 years" (Jenner & Lamadrid 2013, p.444). This long cycle to restore the land leaves the environment vulnerable in the short term, and many contracts and budgets of CSG mining do not extend to the years required for completion. The top soil disturbance and site clearing can lead to high levels of soil erosion, often making the site decreasingly unstable.

Contamination of the land can create an environment with pockets of extreme pH levels, damaging the ecosystem in the area. There is also potential long term damage to the region's future agricultural stability.

It is seen as the social responsibility of management to leave the environment in a way that can meet the needs of future generations (Schermerhorn et al., 2014). The sustainability of CSG is limited and does not extend to the environmental impacts. The landscape is likely to have dramatically changed post-mining and the total rehabilitation may take hundreds of years.

The large surface area may cover significant indigenous sites. In Australia these sites are not always explicitly protected and the destruction of these sites can lead to the loss of cultural heritage. Post-mining, the landscape may recover, however the loss of specific sites with substantial cultural meaning breaks the connection with land and ancestors.

Community Health

Fracking may have increased health risks for the surrounding community compared to methods of extracting oil and gas (Kovats et al., 2014). This is due to the closer proximity to the population and the movement of machinery and materials.

The health of those living near CSG sites in Australia is concerning. Of particular concern to the community are air quality, water quality, land usage and land contamination.

Air quality

As discussed above, sulfur dioxide is released into the environment during the fracking process. When sulfur dioxide comes into contract with water it creates acid rain causing corrosion of buildings and the acidification of soils, and water ways. Similarly, when breathed, sulfur dioxide is absorbed by the moisture in the lungs converting into sulfuric acid and causing significant damage. Short exposure to sulfur dioxide can cause wheezing, shortness of breath and breathing difficulty for the asthmatic. Prolonged exposure can cause serious respiratory problems and aggravate existing cardiovascular disease (Clean Air Trust, 1999). For these reasons, a community around a fracking site would be concerned about air quality.

Water Quality

Methane contamination travels into homes through water. This is especially the case in small towns where the water is retrieved from individual family wells. Wells within 1km of the mining site can reach potentially explosives levels of methane (Meng & Ashby, 2014). If a leak occurs in the fracking process, it can contaminate the ground water, and potentially the whole environment and ecosystem in the surrounding areas.

Holzman (2011) suggests more studies are urgently required to understand the depth of the social impacts of fracking, as 'no peer-reviewed studies have investigated health effects of chronic ingestion of small amounts of methane'. Fracking fluid and the chemical compounds used in the process may contaminate community water access and storage. In this way, the health of the community for generations to come may be at risk due to the lack of research into methane exposure as well as exposure to fracking chemicals.

Land Usage

With high land usage comes heavy vehicles, deforestation and the fragmentation of physical community. Heavy vehicles and increased road traffic leads to safety concerns for the community. The small towns that are often the subject of mining, see an increase in traffic and with it the concern of road safety. The capacity for understanding and politeness of the heavy vehicle drivers on the roads may be a distress for the community.

The community may also feel fragmented due to the physical location of the gas wells separating members of the community. The contamination of water supplies can impact irrigation methods and render crops and land unusable, impacting the livelihood of rural communities. Support, or lack of support for CSG can also spilt a community in two, and can affect the mental wellbeing of the community.

Stakeholder Communication

CSG management must address the concerns of all stakeholders and be prepared to defend and possibly change their controversial industry. With fossil fuels extraction, especially CSG, one extraordinary disaster could negatively impact the whole industry. Bad events can create extensive publicity around the industry and provoke the ire of government officials, outside regulators and environmentalists. Management must attempt to create stability, with minimum risk of disaster for both the sociocultural and physical environment (Hanson et al., 2014). Understanding the physical environment response, is a measure of the company's reaction to the physical, potential and actual changes in the environment. CSG may require a forecasting strategy to provide alternative action if mining does not go to plan and the mining site is compromised. Strategic action after potential disaster can also be challenged by the external environment and associated pressures. Stakeholders often view a quick and able response as a measure of reliability (Hanson et al., 2014).

Management of stakeholder interests is displayed through an understanding of the impact of language and visual communication. Communication conveyed by diagrams and figures can be misleading and misrepresent the actual effects on the landscape and environment. Simple avoidance of phrases such as 'coal seam gas', 'shale gas' and 'fracking' can be misleading and displays evasion of ownership (see Santos, n.d. and AGL, n.d as examples). Some sites, such as Petrel Energy (n.d.), lack any information on the origin of their energy. A good example of a more open and respectful interaction with the community is the company Comet Ridge which considers cultural heritage and the significance of land. Management can initiate the conversation and express their desire to interact with community and update their policies if necessary (Comet Ridge, n.d.). Comet Ridge finds a balance of truthful information for their stakeholders, increasing the ease of information access available on business websites, lowering rates of rational ignorance and allowing the costumer to make a more informed decision. Such a management approach to a truthful portrayal of information on their website and in printed documentation, is a strong indication of the perceived importance of community stakeholders.

Conclusion

CSG management must recognise that their industry may produce undesirable social and environmental outcomes. Understanding how these outcomes arise will help CSG management to mitigate and/or avoid legacy issues. This article has discussed the many impacts CSG mining has on both the environment and the community and explores how managers in CSG must view the communities surrounding CSG sites as definitive stakeholders. The process to extract the fuel source has greater immediate negative effects than positive and the sustainability of the environment, ecosystem and economy are affected by the impacts that CSG mining causes. Ethics surrounding mining and the health of the community are unclear and the community seems to expect more social responsibility than is currently displayed by the industry. Managers face difficulty balancing monetary gain over long term sustainability, as well as the protection of social and cultural sites. The damage fracking causes to the environment has no limited extent and the true magnitude of its effects are not yet known creating an unstable management environment and unpredictable legacy issues.

Recommendations

Currently CSG extraction is causing Australian communities disruption. From a business perspective, an investment in non-renewable energy sources is of limited duration considering the rise of energy from renewable sources. CSG management and investors should display an ethic of support for the community dislocation caused by their industry and demonstrate a responsibility for the damaging impacts of CSG extraction. Regulation around social, environmental and cultural responsibility must be developed and implemented to limit the legacy issues. CSG management should be bound by the decisions made in consultation with community groups and indigenous representatives. Without such accountability of CSG management, the intentions of mining companies cannot successfully align with those of the surrounding community.

Further Research

There is further research required to fully understand the impacts of CSG mining. An investigation for identifying a realistic radius of impact around the fracking site can help to determine the approximate after-effect of CSG. The health of the communities surrounding CSG sites should be studied to determine the long-term effects of ingestion of methane and other fracking fluids. The cost of full rehabilitation of land affected by CSG mining should be investigated.

The cultural significance of current and potential extraction sites should be researched, and traditional sacred ground should not be considered for CSG, owing to it having extreme cultural importance.

Acknowledgements

The author gratefully acknowledges the guidance of Garry Haworth, John Dugas and James Jackson in the preparation of this paper.

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