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Abstract

As global energy demand increases, the rapid expansion of the unconventional fossil fuel sector has triggered an urgent need for social, economic and policy research to understand and predict how this sector affects host communities and how governance systems can respond to changes presented by this sector. In response to this need, this paper addresses three linked objectives. The first is to review the literature on regional impacts of energy extraction, presented in the form of a framework of hierarchical effects. The second is to consider how these are playing out differently in the context of conventional compared with unconventional fossil fuels. The third is to draw attention to the institutional avenues for addressing these impacts, including an overview of the lessons from existing research on the human and policy dimensions associated with conventional energy industries. In particular, we consider the importance of multi-stakeholder dialogue, which plays an important role in how regions respond to the challenges brought about through extractive industries. Overall, we demonstrate that experiences from conventional energy development provide a useful starting point for navigating the human and policy dimensions of unconventional energy for host communities and discuss how these experiences differ when unconventional energy seeks to co-exist with other land uses such as agriculture. The paper draws attention to the dispersed nature of impacts (positive and negative) and how this may shape winners and losers from unconventional energy development, particularly in regions with pre-existing land uses such as agriculture.

Keywords: unconventional energy, shale, community impacts, dialogue, governance

1. Introduction

Global demand for energy continues to expand and has raised important questions as to how global society will meet the growing need for energy (Kerschner et al., 2013). Within this context, substantial interest and concern has developed in the domain of 'unconventional' fossil fuels. Some authors have claimed that the extraction of unconventional energy through 'fracking' is socially problematic (Kerschner et al., 2013). Others have observed that 'fracking' represents a convenient catch all for overly-simplistic negative connotations (Evensen et al., 2014). Economists who have examined industry-funded reports about the economic benefits of shale gas have found these to be exaggerated (Kinnaman, 2011). Of particular interest has been a focus on how the socio-economic effects (both positive and negative) are distributed between local and state scales, which are likely to vary on a case-by case basis (Barth, 2013). For these reasons, concerns have been raised about the potential for asymmetrically allocating the costs and benefits of extractive industries across regions in what some consider to be a 'within country' resource curse effect (Cust and Poelhekke, 2015). In this paper we extend this body of thinking by firstly synthesising knowledge on the regional impacts of energy extraction in general, then proceeding to consider how regional impacts are playing out differently in the context of conventional compared with unconventional fossil fuels, drawing on a review of the rapidly-emerging body of case studies, many of which have been published since Barth's (2013) exploratory review. Moreover, we consider some of the factors which help explain the differences between case studies, focusing on the importance of governance arrangements.

Diverse environmental concerns have been raised about unconventional fossil fuel development. These include general concerns such as the threat of increased invasive pests, loss of wildlife and reduced air quality (Bergquist et al., 2007; Brasier et al., 2011). They also include specific concerns, held by farmers and environmentalists, about land subsidence and the risks of damage to aquifers by raising salts to the surface and pollution through the use of chemical additives in gas extraction (Lawrence et al., 2013). On the other hand, part of the rationale for supporting the expansion of unconventional gas put forward by the business and policy community has been that it may serve as a 'transition' fuel, as a step from more carbon intensive fuels such as coal to low carbon energy such as wind and solar (Kargbo et al., 2010). However, a widely discussed topic is whether the full life cycle of carbon emissions of shale gas remain lower than those for coal with particular concern over the role of fugitive methane emissions which are many times more potent greenhouse gases compared to carbon dioxide (Brandt et al., 2014; Vickas et al., 2015). In contrast to these concerns, it has been observed that, following the development of shale energy in the USA, net carbon emissions reduced over the period 2007 to 2012. Furthermore, there is a suggestion that the development of the shale industry has had a higher-level effect, by way of legitimising policy discussion in the USA over emissions. In particular, the industry has made it easier for US policy makers to overcome resistance to reducing carbon emissions, at least in part because emission reduction may be more compatible with economic growth than previously thought (Bang, 2015).

1.1 An expanding global industry

Unconventional fossil fuels, and in particular shale gas, have grown substantially since the 1990s in response to changes in drilling technology and fracturing

(fracking) techniques. Much of this development has occurred in the USA, where increasing domestic natural gas extraction has been a major component of policies aimed at increasing energy self-sufficiency (Stedman et al., 2012; Gunter et al., 1997). Unconventional natural gas is methane trapped in geological formations including shale, coal seams and tight rock formations (Law and Spencer, 1993; Wright, 2012). While 'tight gas' remains in early exploratory phases, extraction of methane from shale formations and coal seams occurs in several countries including the USA, Canada, Australia, India and China, with recognised potential in Argentina, Austria, Brazil, Germany, Mexico, Norway, Poland, Romania, Sweden, Turkey and the UK (Schulz et al., 2010; Selley, 2005; Weijermars, 2013; Wiśniewski, 2011; Ross and Bustin, 2007; Wright, 2012).

While these issues raise further questions for research as to the appropriateness of unconventional energy development, we nonetheless observe that this type of industry has expanded rapidly in recent years and continues to do so as global energy demand continues to grow rapidly (Kerschner et al., 2013). Unconventional shale gas is already extracted in substantial volumes at the Marcellus and Barnett shales of the USA, with growing or foreseen production in many countries across the globe which have rich endowments. Figure 1 shows the potential footprint of unconventional energy extraction and how it overlaps with established human settlements and croplands, demonstrating the potential conflict that may arise when resource governance issues and potential compensation are not planned for carefully (Cust and Poelhekke, 2015).

[Figure 1 here]

Historically, much of the socio-economic literature concerned with fossil fuels has focused on the broader macro-economic effects of minerals and energy-led economic development calculated at the national scale, such as the widely-recognised phenomenon summarised as the 'Dutch Disease' (Larsen, 2006;

Reeson et al., 2012). The macro-economic effects of unconventional fossil fuels have also been noteworthy for national energy markets in places such as the USA and Australia, with broader implications for the global energy system resulting from changes to supply generated in different regions of the world (Johnson and Boersma, 2013; Simshauser and Nelson, 2015). While acknowledging these impacts, our focus in this paper is on sub-national effects. As Figure 1 demonstrates, the differences within countries are at least as relevant as the differences between countries. On this basis, the focus of this paper is to unpack the local and community impacts of the new extractive industries. Moreover, we assume that the macro-economic effects from unconventional gas are unlikely to differ much from other forms of resource extraction. Local and community environmental and social impacts may be quite different, however, to conventional energy extraction.

The paper addresses three inter-linked objectives. The first is to review the literature on regional impacts of energy extraction and distil these into a framework of hierarchical effects that may be useful to policy audiences. The second is to consider how these effects play out differently in the context of conventional compared with unconventional fossil fuel extraction. The third is to draw attention to the institutional avenues for addressing these impacts, synthesising lessons from existing research on the human and policy dimensions associated with conventional energy industries. In doing so, we explore whether the development of unconventional gas may necessitate changes in governance to manage regional social and economic implications and achieve better community outcomes. When considering examples of regions that have dealt with these changes first hand, the importance of full and frank dialogue, combined with a focus on delivering shared value to local communities, is emphasised.

2. A framework to understand impacts of energy extraction on host regions

In countries such as Canada, Australia and the USA where extractive industries have been prominent for many decades, the extraction of gas from shale formations and coal seams represents another step in the development of the energy industry, or its expansion to other regions within these countries, and is likely to be associated with similar types of economic, social and environmental impacts associated with conventional energy sources. In other countries where the resources sector is absent from the landscape, or has been dormant for decades, the development of unconventional gas may bring unfamiliar impacts. The purpose of this review is to synthesise the existing knowledge about the impacts of unconventional energy extraction and consider this literature in relation to the wider body of knowledge of impacts associated with energy extraction from conventional sources such as coal and oil.

In order to contextualise our understanding of how unconventional energy extraction affects regional communities, it is useful to first present an overview of how conventional energy extraction has been affecting regional communities. There is already considerable literature on the effects of conventional energy extraction on host communities. However, much of this literature is focused on particular 'hot' issues in particular places and in this paper we have distilled this into a conceptual schema of cascading effects. Much of the literature focuses on issues of immediate concern, such as labour demand and wages paid to workers (Black et al., 2005; Caselli and Michaels, 2013). These immediate impacts tend to have follow-on effects, some of which may be seen as positive (stimulating the local economy) and others that may be seen as negative (straining local development). Beyond these, there are a whole series of other effects, often

considered to be as much social issues as economic issues, such as changes to the types of people who move into an area, rising social conflict between long-term residents and new arrivals in the community, substance abuse and domestic violence.

These issues engage other types of research in the social sciences beyond economics, and lead to the formation of new alliances among opponents to the industry, bringing together farmers and conservationists for example (Colvin et al., 2015). In summary, these issues are sometimes represented as the social 'cost' of development, but in our schema they comprise effects which may be seen as either positive or negative (or both), including increased housing costs, provision of new types of services, changes to demographic profiles and changes to income distribution. The framework is represented visually in Figure 2. Before applying the framework specifically to the unconventional energy industry, we first review these effects in relation to conventional energy.

[Figure 2 here]

2.1 Primary impacts: Labour demand shock and income

For conventional energy, new employment is generated as the extractive industry develops, often generating great hopes of employment opportunities for local communities (Conde and Kallis, 2012). However, demand for labour usually exceeds local supply very quickly (Black et al., 2005) and workforces often need to be attracted from far beyond the region. The demand for labour is particularly strong for certain types of experience and skills and tends to attract male-dominated workforces from far beyond the region, such that local labour forces and particularly female workforces may miss out on high paying jobs (Obeng-Odoom, 2015; Ballard and Banks, 2003). These effects usually lead to substantial

disparities in local incomes between those working in energy extraction and those in other sectors (Halseth, 1999).

Many studies have found a positive correlation between employment growth and energy resources extraction. For example, Black et al. (2005) investigated employment growth in local economies of areas where coal mines were operating in the US between 1970 and 2000. These authors found that employment increased in counties hosting the coal industry while the boom lasted. Further, Caselli and Michaels (2013) examined data from Brazil and analysed the effect of the expansion of petroleum extraction in western areas of the country on employment, finding a positive link between oil extraction and employment. Marchand (2012) also observed the employment changes that emerged during the natural gas and coal boom and bust in Canada during the 1990s.

It should be noted that not all energy sector employees will reside in the region (sometimes very few), however those that do contribute to increased local wages are injecting income into the regional economy (Storey, 2010; Ivanova and Rolfe, 2011). The positive initial income effects may diminish over time, such that regions with long-term involvement in the energy sector may see declining levels of income effects over several decades (Chapman et al., 2015; Haggerty et al., 2014) as labour supply adjusts to meet demand.

Fossil fuel extraction may involve the acquisition of land previously used for other economic activity, and may also reduce the market value of surrounding land in some circumstances (Obeng-Odoom, 2014). Effective governance arrangements for managing these impacts include direct financial compensation to those directly affected by gas extraction. Around the world there is considerable variation in legislative systems to provide a basis for determining appropriate levels of compensation, even between neighbouring states within the same nation

(Jacquet and Stedman, 2011). Moreover, it is important to note that tension over what represents an appropriate level of compensation is common (Connell, 1991; 2012). Discussions around compensation may invoke aspects beyond market values to include loss of privacy, noise and various types of nuisance (Kinnaman, 2011). For this reason, the importance of collective dialogue as to what counts as appropriate compensation is important (Jacquet and Stedman, 2011). The process for determining compensation may lead to follow-up issues, which we represent as secondary or tertiary effects in Figure 2.

Despite appearing to have a positive influence on local economies, many studies have found that when comparing regions where fossil fuel extraction occurs with those where it does not, the former often perform worse in income growth, which can be understood as a sort of regional resource curse (Fleming et al., 2015; Paredes et al., 2015; Douglas and Walker, 2013). Headwaters Economics (2008) found that in US county economies based on fossil fuel extraction, the average growth of real personal income was 2.3% per year, while in counties without fossil fuel industries it was 2.9%. Further, James and Aadland (2011) compared real personal income growth from 1980 to 1995 in Maine, where energy extraction does not occur, and Wyoming, where a substantial fossil fuel industry exists. They found that real personal income in Maine grew by 1.8% over this time while it contracted by 0.2% in Wyoming. Interestingly, Haggerty et al. (2014) found that in counties where energy resource extraction was a short event, income per capita was indeed positively influenced. However a longer term specialisation in energy resource extraction can lead to an overall negative effect in average per capita income, due to decreased entrepreneurship and limited growth in other areas of coal-dominated economies (Betz et al., 2015).

2.2 Secondary impacts: People movement, local growth and job spillovers

New employment and income sources are likely to attract people and increase population, either as permanent or temporary residents, to resource-extractive regions (Black et al., 2005). This increase in population is a phenomenon to be observed in the short to medium term and is sourced from counter migration and immigration.

As income, employment and population close to resource extraction development increase, higher levels of consumption are observed (Michaels, 2011). In particular, demand for local goods and services increases. Housing and land are particular local goods that present increased demand in these cases, which is triggered by two sources: higher demand for accommodation for the new temporary and resident population, and income and price effects in local areas translates to people with more disposable income looking for real estate investments. The increase in population and income will also translate into higher demand for non-local goods, which may be supplied by local firms or imported. Infrastructure demand will also grow as an increase in (temporary or permanent) population will require more goods and services. As new employment and income in local areas boost consumption, employment in sectors providing goods to new residents is also likely to increase (Black et al., 2005).

Analysing the resource curse hypothesis, Fleming et al. (2015) discuss the role of crowding-out generated by labour demand in resource extraction industries that can affect regional economic growth by weakening competitiveness in the tradable good sectors, as the higher costs of production (given the likely increase in local wages generated by labour demand) hastens the shutdown – or size reduction – of firms whose products (manufactured goods, food and similar) can be imported from elsewhere at cheaper prices. To reduce this effect, governance arrangements can encourage local supply chains for inputs wherever this is feasible as a means of supporting wider community benefits from energy booms

(Warhurst, 2001). In the case of tradable goods the forward and backward linkages can have positive effects if regions have the capacity to maintain and expand local firms specialising in dealing with inputs and/or outputs of extractive industries. Thus, if forward or backward linkages occur, job spillovers can be positive into the tradable goods sectors, netting or overriding labour crowding-out potentially happening in other manufacturing firms (Fleming and Measham, 2014).

Ultimately, the effect of a resource boom on the unemployment rate of a region can be positive, zero or even negative. Negative employment figures can emerge if the decrease in competitiveness in local manufacturing (and similar industries) translates into the closing of firms that affect a substantial number of employees, outweighing total employment gains by locals in the resource extraction and services sector. This negative effect is in addition a potential long-term resource curse effect in local areas, as regions may lose firms that sustain 'learning by doing' (Kilkenny and Partridge, 2009). On the other hand, a decrease in unemployment will occur when resource extraction employment and job spillovers exceed the number of jobs lost in the manufacturing and agricultural sectors.

2.3 Tertiary impacts: New infrastructure, demographic change and boomtown effects

In-migration and strain on existing services require the development of new infrastructure which may include new or updated transport infrastructure (e.g. roads, rail networks), upgrades to utilities (e.g. water and sewerage), expansion of services (e.g. new healthcare facilities) and potentially other types of services previously unavailable in the region (Obeng-Odoom, 2014). In many cases the governance requirements may stretch beyond the capacity of local and regional institutions in terms of planning, implementing and maintaining these facilities.

As such, the provision of this new infrastructure may invoke the roles of higher scales of governance to work with regional communities on these needs, ideally supported by dialogue between different levels of governance (Schandl and Darbas, 2008).

A common effect of a boom in resource-led regional development is increased housing costs as supply changes and struggles to keep up with demand for housing by new residents (Ennis et al., 2014; Haslam McKenzie and Rowley, 2013) especially in highly deregulated housing markets. This issue may be particularly acute for local tenants who have not benefited from the direct income benefits associated with the resource boom. This in turn may cause outmigration, especially of lower income households, single parent families and elderly people. Poverty can increase for the same reasons: rising property and rental costs increase the cost of living for everybody, but not all the local population is benefiting from higher incomes. There is a clear role for the private sector in terms of meeting housing needs in energy boomtowns, often through public-private partnerships. However, if the public sector is weak, these arrangements may be ad-hoc, lacking adequate planning in terms of impact on surrounding areas. Conversely, a stronger public sector can help manage housing impacts in a more coordinated way (Morrison et al., 2012).

Jobs in the energy extraction industry are predominantly occupied by males, leading to different impacts for men and women (Baker and Fortin, 2001). In boom conditions the influx of male workers can increase the male proportion of the population (Carrington et al., 2010). Black et al. (2005) found that the ratio of men to women in the 20 to 39 age range increased with the boom in the energy resource extraction industry in the US. Highly paid jobs in the energy sector which require particular skills tend to go to men while women tend not to get the same level of pay increases for existing jobs or spillovers into other sectors such as

hospitality and other service sectors. One sector associated with conventional energy booms that does not exclude women is the sex industry, however, it is important to note that this sector is often stigmatised (Obeng-Odoom, 2014). When looking at income effects across multiple resource regions, there is evidence that income inequality decreases among men and increases among women where the resources sector is a large employer (Reeson et al., 2012).

Concentrating a predominantly male workforce, often on short-term contracts, can lead to high levels of social disruption and related unintended socio-economic outcomes such as alcoholism, drug abuse, prostitution and violence, often referred to as boomtown effects (Lawrie et al., 2011; Stedman et al., 2012). Frantál and Nováková (2014) examined coal extraction in the Czech Republic and found increased unemployment, homelessness, and crime rates in extraction regions. Further, Haggerty et al. (2014) found that with a longer specialisation in oil and gas, the crime rate rose in these regions as well.

Another potential consequence of natural resources dependency in the long term is a loss of entrepreneurial spirit in local areas. This is produced when employment and income levels generated by the resource extraction industry reduce the marginal benefits of education and innovation (Glaeser et al., 2012). This is accentuated with the loss of 'learning by doing' generated by a potential reduction in manufacturing, which is crucial for the productivity gains that underpin long-term economic development (van der Ploeg, 2011). Loss of entrepreneurial spirit in energy resource extraction regions was found by Haggerty et al. (2014), who demonstrated that with a higher level of income attributed to a resource boom, there was a decrease in the growth of the percentage of college educated adults in the region because students would

abandon education to take up well-paid employment in the fossil fuel extraction industry. Lower levels of schooling with increased resource abundance are also evidenced by Gylfason et al. (1999), Gylfason (2001), Black et al. (2005), and Papyrakis and Gerlagh (2007).

Nonetheless, boomtown effects can play out in different ways which are not always negative. Brown et al. (2011) found that the expansion of the offshore oil extraction industry in South Louisiana was associated with increased violent crime in the area (Gramling and Brabant, 1986), however it also brought new ideas to the community that expanded residents' worldviews, goals and aspirations. This, along with demand for an improved education system from new members of the community and industry, promoted the mobility of youth and provided them many more options for further study and work (Brown et al., 2011).

If the revenues generated by resource windfalls are shared with local authorities in terms of local taxes and transfers, the likelihood of more local public expenditure increases (Cotton, 2015; Obeng-Odoom, 2014). In such cases which look more favourable for local and community development there is, however, also a greater likelihood of increased corruption, especially in regions where institutional arrangements are weak. Weak institutions can also lead to a relaxation of regulation, which is often caused by 'rent seeking' behaviour of local authorities that can end up affecting long-term economic performance as an outcome of poor planning and ineffective governance (Söderholm and Svahn, 2015). This can result in 'unsustainable regional policies', where resource windfalls are used to cover short-term goals, such as the construction of football fields or swimming pools, and hence do not bring long-term investments such as in education and training.

2.4 The parallel effects in resource downturns

During a time of resource development downturn, the order of (opposite) effects is likely to be similar, but not identical. A decline in resource extraction activity will reduce oil and gas employment, which will reduce income opportunities and overall income in the region, decreasing its population, the demand for services and goods and finally affecting job generation in other sectors. Employment in agriculture and manufacturing may indeed increase after resource windfalls have ended, as the labour market for these sectors would become more competitive (Jacobsen and Parker, 2015).

One important difference for regions facing resource downturns is that in some cases, the secondary effect can be bypassed so tertiary effects may be felt without immediate decreases in population, or at least not at the same level as it increased during the time of resource windfalls (Petrova and Marinova, 2013). Black et al. (2005) found this to be the case, where the impact of booms on population levels across all gender and age demographics changed more significantly than in bust periods. This phenomenon can be explained by people's expectations of a resurge of energy extraction activity in a region, by an attachment to place beyond economic factors, or by social programmes/services and housing that may restrict people's mobility. Energy extraction can bring significant population growth to particular areas (even creating cities in some cases), and people will not necessarily leave once extraction activity is finished, producing multiple socio-economic consequences such as unemployment and (paradoxically) more boomtown-type effects.

Impacts of bust periods on employment and income in local regions have been examined in the literature. Black et al. (2005) found that for every energy extraction job lost during the bust, 0.35 local sector jobs were lost too. Marchand

(2012) found that while employment may not be significantly influenced by a bust period in a region, total earnings per worker do decrease, especially in the construction sector. As expected, Marchand (2012) also found that the manufacturing sector experienced increases in earnings per worker during the bust, implying that crowding-out may be an important factor throughout the life cycle of the energy resource extraction industry.

Additionally, investments made during a resource boom may have positive impacts during a bust. If there is industrial diversification during a boom period and life of a mine, a safety net can be created, which has been the case, for instance, in the Gulf region in relation to the oil industry (Tolbert, 2006). Seydlitz et al. (1995) even suggest that due to service industries not being completely dependent on extraction, some communities in the Gulf actually fared better during the bust period.

Structuring the multiple and often complex socio-economic interactions that characterise fossil fuel led economic development into a hierarchy of effects allows for a much clearer attribution of responsibilities and timing for intervention. In the next section we consider the applicability of our framework for unconventional energy sources and we ask whether there is a need to adjust the framework to reflect the main characteristics of this emerging sector.

3. Application of the framework to unconventional energy

3.1 Primary effects for unconventional energy

The growing knowledge base for primary economic and social impacts of unconventional energy extraction echoes findings for conventional extraction for income increases during the construction phase (Marchand, 2012; Weber, 2012). An important difference between conventional energy extraction and

unconventional energy extraction is the nature of the shift from construction to operation phases of projects. For conventional energy (e.g. a coal mine), the shift from construction to operation occurs as a single large event, almost like flicking a switch. Conversely, a basin of gas wells involves multiple smaller events – a construction team may move across a region installing wells which progressively start producing gas, one by one – such that the shift from construction to operation the region is more like a wave that progressively spreads across a landscape (Measham and Fleming, 2014a).

With regards to the issue of compensation, the literature on unconventional energy extraction diverges significantly from that for conventional energy extraction. Conventional energy extraction projects have tended to take the form of highly intense operations with small spatial footprints, such as coal mines and offshore oil wells (Measham and Fleming, 2014a). When conventional energy extraction has been spread over a relatively wide area, it has tended to occur in rural areas with relatively sparse populations (Weber, 2012), however there are other cases where fossil fuel development has occurred close to dense urban areas (Obeng-Odoom, 2014).

By contrast, unconventional energy extraction at the Marcellus Shale in the US and the Surat Basin in Southern Inland Queensland, Australia has tended to be spread out over a much wider area of often thousands of square kilometres, which has important implications for compensation (Jacquet, 2012). Moreover, extraction has occurred in relatively densely populated localities which are based on well-established rural industries, notably agriculture and services supporting the agricultural sector, with the effect that there are more people with a claim to compensation for diverse impacts (Stedman et al., 2012). This goes hand in hand with a more powerful community base to lobby for political responses to representation to defend such claims (Jacquet and Stedman, 2011).

Compensation claims may not be restricted to those places where extraction occurs, but may also include loss of business in other sectors (e.g. tourism) and nuisance issues where roads, pipelines or other infrastructure interfere with existing regional economic activity, potentially affecting incomes of a wider portion of the community (Turton, 2015).

3.2 Secondary effects for unconventional energy extraction

At one level, the secondary effects of unconventional energy extraction are similar to those for conventional energy extraction. The general trend is for regional populations in extraction areas to increase, also driven by additional employment in the service sector (Rolfe, 2013). In Australian regions where coal seam gas (CSG) extraction has been growing more recently, employment in other sectors increased on average by 32 per cent higher than a control group of regions without CSG from 2001 to 2011. Local multipliers were particularly strong for the construction and professional services sectors during the construction phase of a gas development, generating more construction employment and jobs related to the provision of technical services such as electricians and other trades (Fleming and Measham, 2015).

Considering that compensation effects extend to more people over wider areas it is not surprising that there is some evidence of wider spillover effects resulting from this income. While empirical data for these effects is currently quite rare, there is some evidence that farmers with additional income may invest in additional equipment or agricultural services (Brasier et al., 2015), which can also have a negative effect on agricultural labour demand through rationalisation but would on the other hand be rewarded with productivity gains.

3.3 Tertiary effects for unconventional energy

One of the main observations of tertiary effects for conventional energy projects has been a substantial increase in the male population leading to a gender imbalance in a region. There is evidence that this gender imbalance may not occur to the same extent in unconventional energy production regions. Specifically, migration observed in areas of coal seam gas development in Australia demonstrates that migrants, and particularly youth migrants, comprised equal numbers of males and females (Measham and Fleming, 2014a).

Like its conventional energy counterpoint, the unconventional fossil fuel industry tends to have a gendered workforce with a distinct role for male itinerant workers (Filteau, 2015). Therefore the explanation for more gender balanced population growth may not be directly related to the energy projects themselves but to the economic context in which they took place. When unconventional energy extraction occurs in a region of viable agricultural economic growth, and does not substantially constrain growth in the agriculture sector and its downstream industries, employment multiplier effects of agriculture and energy extraction can add up and reinforce each other (Measham and Fleming, 2014a). The role of gender in unconventional fossil fuel development is an important area for further research.

Recent research looking at 'boomtown' effects in the shale industry suggests that these factors may play out differently where unconventional fossil fuel development occurs in more densely settled rural contexts (Jacquet and Kay, 2014). The notion of an isolated remote community absorbing a few thousand workers is not applicable in established rural and even suburban regions with higher densities. For example, in the case of housing, accommodating a few thousand workers is a different scale of problem in a place like Pennsylvania

compared with more remote regions. Similarly, the issue of 'social disruption' is dissipated across a wider range spatial area. These differences have led scholars to critically review and update the boomtown model as it relates to unconventional fossil fuels (Jacquet and Kay, 2014).

Whereas some forms of energy extraction such as coal mining, uranium extraction or oilfields tend to displace other land uses, unconventional gas extraction tends to co-exist (potentially in conflict) with pre-existing land uses (de Rijke, 2013; Measham and Fleming, 2014a). This means that much of the infrastructure to support a more diverse population is already in place, and attracts a wider range of people with more diverse skills and backgrounds such that gender ratios may remain relatively stable and human capital may rise (Measham and Fleming, 2014a). In terms of governance implications, it is important to draw on this wider range of people and skills and seek to develop harmonious economic development (Obeng-Odoom, 2014).

However, the challenge of achieving harmonious development should not be underestimated and it is important to recognise that developing unconventional gas in regions with pre-existing industries can lead to higher levels of conflict over the terms of co-existence. This may be particularly difficult in communities which have not previously had much exposure to the resources sector and where new arrangements required between existing industries and the new energy extraction industry are perceived as unfair. This can cause substantial tension, social conflict and legal challenges (Sherval and Hardiman, 2014; Perry, 2012; Turton, 2015), all of which are classified as negative tertiary effects within the schema presented in our framework. An overview of the main differences between the regional effects of conventional and unconventional energy extraction is presented in Table 1.

The unconventional fossil fuel sector is relatively new and hence there is little experience and literature on how economic downturns play out. Until we have empirical experience of downturn effects it is not possible to determine whether downturns will follow a similar path as they do for downturns in conventional energy extraction. We do expect, however, that the differences outlined in this paper will characterise the experience of resource downturns: in particular that they will affect a wider range of people over a wider area.

Table 1. Summary of main differences: conventional and unconventional energy development

	Conventional	Unconventional
Differences in primary impacts	Smaller spatial footprint, therefore fewer landholders with claim to compensation	Wider spatial footprint therefore more landholders with claim to compensation
Differences in secondary impacts	Conventional energy projects tend to displace pre-existing industries and communities, therefore fewer people can take up job spillover opportunities	Unconventional gas tends to co-exist with pre-existing industries and communities, providing additional demand for goods and services and attracting workforces outside the energy sector
Differences in tertiary impacts	Displacement of local residents may change social profile, e.g. change gender ratio	Retention of local residents may lead to tension over regional identity

4. Implications for regional-level governance

When considering the effects presented in the framework and how these may play out in the unconventional gas sector, it is important to consider the extent to which these issues are within the control of local to regional institutions. Formal institutions such as counties, or local councils, tend to have some power in managing local infrastructure but the evidence from the conventional resource extraction literature suggests that the scale of impacts is overwhelming in the face of the resources and skills pre-existing within these institutions.

The scale of governance responsible for managing many of the effects presented in our framework is often the province or state. However, it is frequently the case that provincial or state governments are not capable of effectively managing regional-scale impacts of resource extraction, or they have abrogated their responsibilities for service provision in resource regions (Solomon et al., 2008). In reaction to the limited response from state and provincial governments and the changing nature of services required, in some cases resource companies are acting as 'surrogate' public service providers due to incapacity in the formal governance system (Cheshire, 2010).

Resource companies have become significant actors in areas that extend far beyond direct impacts, including supporting medical and dental services, road maintenance, entertainment, school facilities, local recreation and sport facilities and providing children's playgrounds. While in some instances this may provide short-term solutions to rapidly changing demands, it may also lead to reduced public investment and raises questions over the legitimacy of strategic directions for regional planning (Petrova and Marinova, 2013; Cheshire, 2010).

In the case of a vacuum created by a lack of formal governance intervention at the regional scale there is a propensity of private sector institutions to engage directly

with regional communities to maintain a 'social licence' based on informal acceptance of extractive industry development by affected communities and residents (Morrison et al., 2012; Bice and Moffat, 2014). To be effective at managing these impacts beyond the public relations needs of private companies, the key to legitimacy in this context is a process involving tripartite dialogue between local governments who experience the impacts, state/provincial governments who are formally responsible and financially resourced for managing impacts and investing in infrastructure, and private companies who create the impacts and may have additional financial resources and a shared interest in addressing them (Söderholm and Svahn, 2015). This type of dialogue is discussed in the next section.

4.1. Responding to challenges at the regional scale: The importance of dialogue

It is relatively rare that local communities prepare themselves for the arrival of extractive industries. As a consequence they often fail to capture positive effects from resource-led economic development (Lockie et al., 2009). Some communities focus their energy on resisting the resources sector, leading to costly delays in production, however conflict alone has limited potential to improve final outcomes for regional communities (Franks et al., 2014; Schandl and Darbas, 2008). Communities which have prepared for the establishment or expansion of extractive industries have often made effective use of dialogue to derive benefits for their community.

Specifically, they have engaged in tripartite (three-way) dialogue between local governments, resource companies and state governments (Ballard and Banks, 2003; Schandl and Darbas, 2008). Table 2 presents examples of inter-connected governance roles for some of the primary, secondary and tertiary impacts raised

in Figure 2. Several principles for successfully conducting participatory tripartite dialogue have been identified (MMSD, 2002), including an inclusive approach to dialogue initiation, providing adequate timeframes to take into account different needs and capacities of participants, and ensuring that the initial intent and scope of the process is agreed by all parties. Additionally, it has been observed that the process cannot succeed if one party attempts to prematurely claim high ground in the public and policy debate, and that any financial resources contributed to the process should not affect the relationships within the process (MMSD, 2002).

The difficulties of conducting this dialogue process should not be underestimated (Lockie et al., 2009; Measham et al., 2012). When studying one such dialogue process in Australia, Measham et al. (2010) found that even despite differences in the goals of participants, each party had their own reasons for persisting with the dialogue process. From the outset, private companies valued the 'early warning system' that the dialogue presented in terms of being able to foresee and address community concerns. Local community representatives saw benefits in being able to predict local employment effects and infrastructure needs.

State government representatives saw benefits having more information on the speed of development and advance forecasting of likely future needs for service provision such as education and health. Over time, participants in the tripartite dialogue developed an understanding of how the other parties operated: their cultures and approval systems, their constraints, and above all the timeframes over which developments occurred and responses could be generated. This had the effect of helping each party manage the cyclical nature of resource development and its implications for local communities (Lockie et al., 2009).

Table 2: Examples of impacts and responses requiring coordinated, multi-level governance arrangements

	Public Policy		Market
	Local	**State/Province**	**Energy companies**
Example of primary impact: **Loss of economic opportunity through changes in land access and property rights**	Establish appropriateness and legitimacy of compensation through dialogue with stakeholders	Maintain regulatory frameworks for compensation	Listening to local perspectives of what counts as reasonable compensation. Payment of compensation.
Example secondary impact: **Local vs external labour and service providers**	Promote local sourcing of services	Set incentives and/or requirements for local contribution to labour and service provision	Seek local supply chain options. Encourage accreditation of local businesses
Example tertiary impact: **Shortage of housing, transport infrastructure and social services**	Plan and release land for housing and businesses through zoning laws Review and maintain local tax arrangements	Provision of transport and communication infrastructure and social services	Payment of taxes/royalties Provide funding for local planning capability if it is lacking.

Over time, dialogue can deliver a wide range of advantages beyond those expected at the beginning of the process, and be fundamental to communities feeling sufficiently engaged to grant 'social licences' to resource extraction projects (Dare et al., 2014). In a dialogue process in Gunnedah, Australia where

exploration for coal seam gas was occurring adjacent to farmlands and coal mines, diverse parties were able to openly discuss hypothetical propositions of how resource extraction might change in the future (Measham et al., 2010). For example, dialogue focused on whether energy production were to increase or decrease over different timeframes, and whether labour forces were to be housed locally or outside of the community. Initially each party was reluctant to discuss such issues, perhaps because of fear of inadvertently giving away confidential information or providing potential ammunition to another party. However, participants in this well-facilitated dialogue did build trust, and become able to explore these types of issues openly with a view towards improving local benefits for the region (Measham and Schandl, 2013).

Two important factors contribute substantially to the success of dialogue processes. Firstly, discussion needs to be moderated by a skilled facilitator who has no financial interest in the outcome of the dialogue. The second is that groups consider themselves as discussion or 'working groups' rather than decision-making groups, to openly explore ways of managing rural transitions rather than serving political agendas within the discussion group. In the Gunnedah example, the group only discussed the implications of existing and potential developments with a view toward how they would create shared value for all parties (Measham et al., 2010).

The 'working group' approach described above, focusing on tripartite dialogue between local communities, private companies and state authorities, depends on each party committing to generating shared value from resource extraction. For this mechanism to be effective, those parties with more power and resources (e.g. private companies) must feel that it is in their interest to collaborate with those with less power (e.g. local communities).

While compensation is a major part of negotiating acceptable terms for communities, it is also important not to rely too heavily on compensation as the only way of deriving local benefits. According to Porter and Kramer (2011), over-emphasis on compensation may create and reinforce dependency of a community on resource companies. By contrast they argue that focusing on creating shared value will help to drive new innovation and economic growth beyond the individual company involved. Shared value is developed not through subsidies but through supply chain decisions and by enabling local economic development clusters (Azapagic, 2004; Feser and Bergman, 2000). In the case of unconventional energy, it will be important for multi-stakeholder dialogue platforms to discuss how to moderate extraction projects in such a way that the by-products of the industry may be treated and made available to assist other land users where possible (Hamawand et al., 2013).

5. Conclusion

In this paper we have addressed three inter-linked objectives. The first was to review the literature on the socio-economic impacts of conventional fossil fuel extraction and present these as a framework which portrays the key effects succinctly. The framework draws attention to primary socio-economic impacts in the form of direct employment and income; secondary impacts including indirect employment growth, in-migration and strain on services; and tertiary impacts including increased housing values and costs, construction of new infrastructure, demographic changes, potential for increased conflict and changes to income distribution. The second objective was to consider this framework in relation to the emerging literature on unconventional fossil fuels and highlight the main differences in socio-economic impacts of unconventional fossil fuel extraction relative to its conventional energy sibling. In particular, the paper demonstrates that unconventional fossil fuel extraction is relatively widely dispersed over space

and time, presenting increased opportunities for more people to experience benefits and problems.

The third was to draw attention to governance arrangements for addressing these impacts, bringing together insights from case studies on the human and policy dimensions associated with energy extraction. The development of the unconventional energy sector has been surrounded by much controversy and is likely to continue to be controversial. As the industry expands, it will reach more locations with little or no previous experience of energy extraction and which may not be prepared for the social and economic changes they face. Unconventional energy extraction tends to spread out over a much wider area than its conventional energy equivalent, often encroaching on agricultural lands, with important implications for governance.

Compensation is a crucial topic, particularly in relatively densely populated rural areas with established communities where there are more people with a claim to compensation for impacts including the diminished value of land, disruption and loss of privacy. The broader socio-economic impacts of unconventional fossil fuels for regional communities will likely involve a mix of positive and negative outcomes, depending to a large extent on the governance arrangements in place. Spreading the benefits beyond direct employees through job spillovers can be improved through mechanisms to encourage local suppliers. Strain on existing services and the development of new services in response to demographic changes can be addressed through gain sharing programmes such as financial transfers and local taxation arrangements.

Much of the challenge (and opportunity) for regional communities facing the development of unconventional fossil fuels is to consider what constitutes

acceptable terms for the development of the industry and how the industry can contribute to addressing pre-existing social and economic challenges experienced by rural communities. The extent to which unconventional fossil fuel extraction can complement rather than undermine other industries will be based on the governance arrangements in place. Dialogue between local stakeholders, state/provincial governments and resource companies has been demonstrated as an important basis for designing and developing effective governance arrangements.

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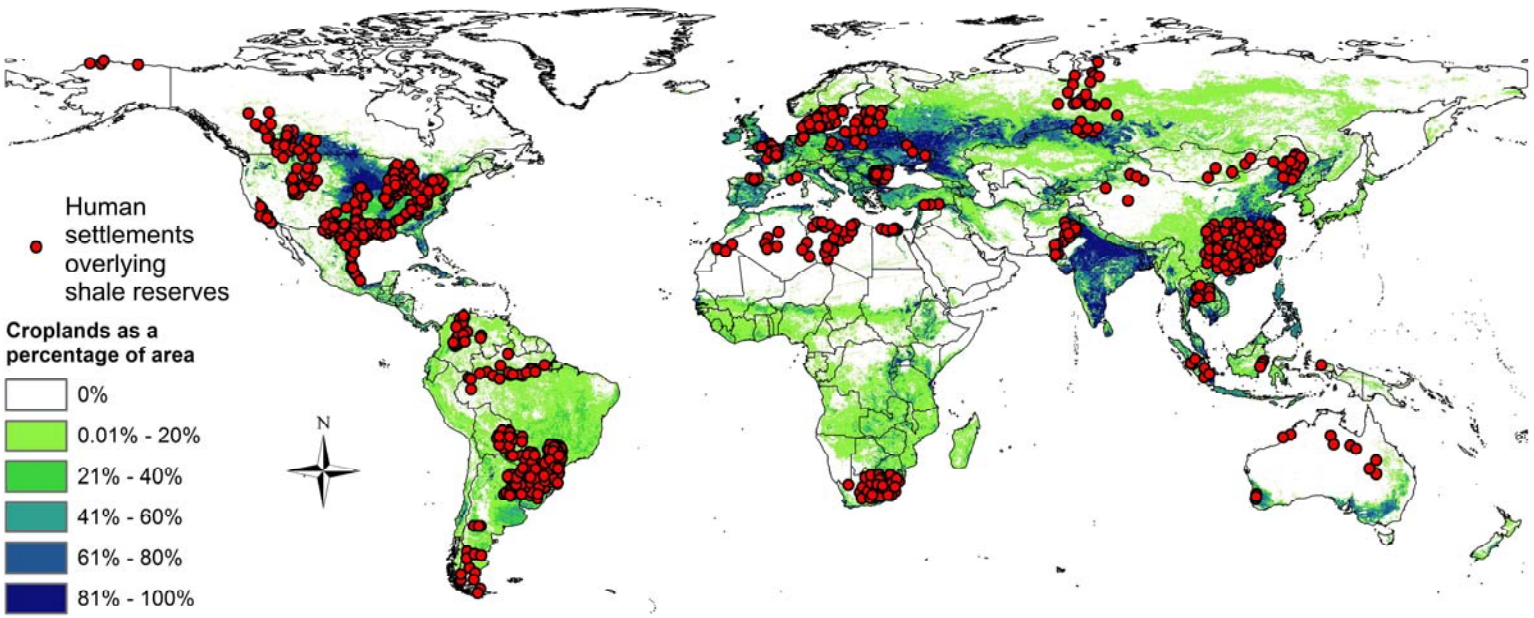

Figure 1. Human settlements and croplands overlaying assessed shale reservoirs

Notes: Human settlements overlaying economically assessed shale reserves after Measham and Fleming, 2014b. Croplands defined by Ramankutty and Foley, 1999.

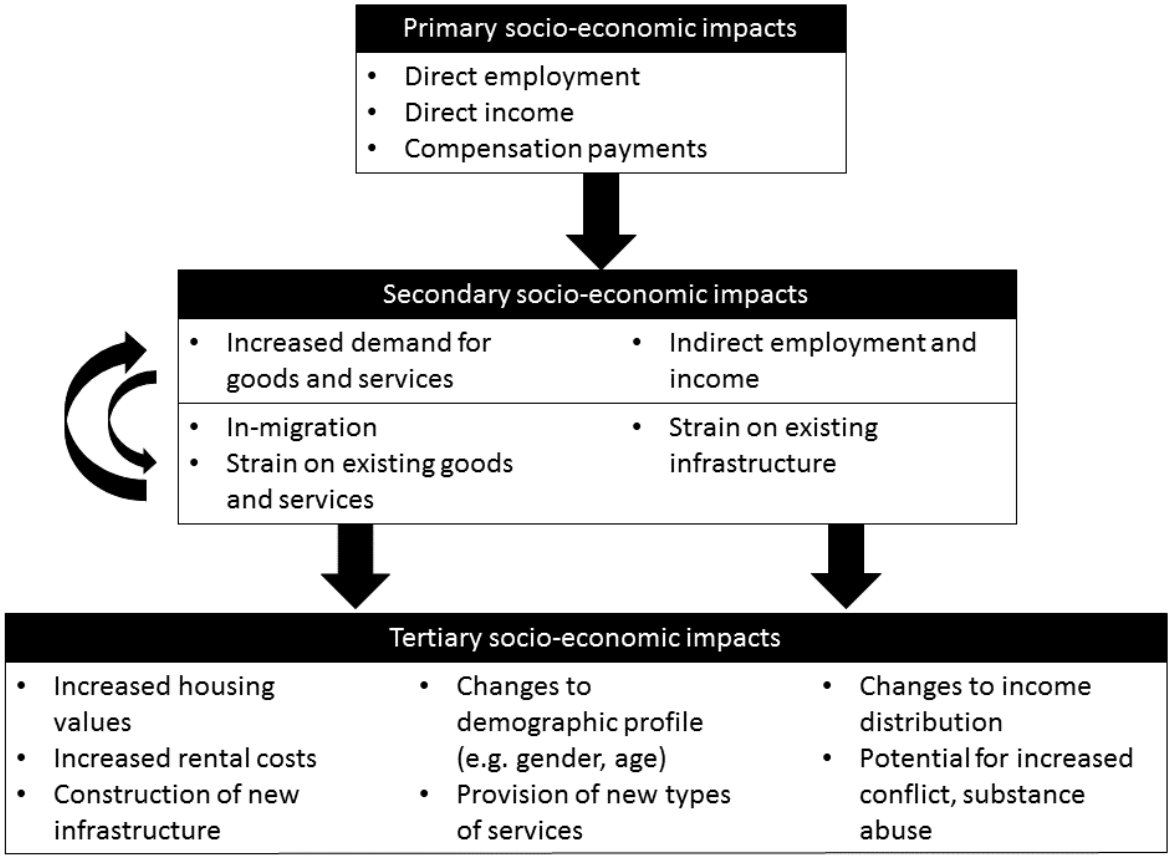

Figure 2. Primary, secondary and tertiary effects of resource development on host communities