

Beyond opposition and acceptance: Examining public perceptions of the environmental and health impacts of unconventional oil and gas extraction

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Abstract

This review of public perceptions of unconventional oil and gas (UOG) exploration identifies four main types of study. First, UOG is analysed in terms of specific environmental and public health impacts. Second, by examining socio-economic impacts (namely the development of energy boom-towns). Third, in terms of the relationship between prior knowledge of UOG technology and public attitudes of support or opposition. Fourth, in terms of framing and discursive analysis of UOG by stakeholder groups including the print media. We identify a specific knowledge gap for environmental health professionals: that research is needed into how public and environmental health messages can be best communicated to diverse communities potentially affected by fracking, in order to directly improve public health outcomes.

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Introduction

The rapid development of unconventional oil and gas (hereafter UOG) resources, from tight sands, shales and coal seams using horizontal drilling and hydraulic fracturing techniques, is a growing international energy policy concern. The potential profitability of UOG, as revealed in the shale boom occurring in the USA, has popularised so-called *fracking* globally. Aside from the USA, countries such as China, Argentina, Algeria, Canada, Mexico, Australia, South Africa, Russia and

Brazil (in descending order of resource magnitude) have all embarked upon shale development programmes [1], whilst smaller reserves in Europe (e.g. Denmark, the UK and Poland) have estimated net profitability and political support for extraction activities. Political support for UOG is motivated by energy security of supply, rural economic regeneration and taxation revenue concerns. UOG development is, however, banned in some countries (e.g. Scotland, Ireland and Germany), and within some regional/sub-federal administrations (e.g. New York, Maryland in the USA, or Victoria in Australia). Others have moratoria in place (e.g. New South Wales in Australia) in light of documented environmental and health impacts. Government-level action to block UOG development is often motivated by lack of trust in oil and gas industry actions to protect local communities from harm [2], and this, in turn, is influenced by public perceptions of the economic, social, environmental and health implications of the technology at local, national and international scales.

Primary environmental impacts

The health impacts of UOG are now well documented. As a fossil fuel, UOG elevates the long-term global environmental health impacts associated with climate change (through fugitive methane emissions, and contributions to the total carbon budget) [3]. Natural gas, however, has a lower carbon footprint to coal, produces lower NO_x, SO₂, black carbon, CO, mercury and particulates than coal at a mass per energy base and so is often framed as a transition fuel for short-term decarbonisation of fossil-fuel based energy systems [4]. Yet despite its environmental performance relative to coal, there remain a number of environmental health impacts from UOG that are both local and immediate. These include exposure to hazardous materials: air pollutants, ground and surface water contamination with hydraulic fracturing fluids [5], naturally occurring radioactive materials (NORM) in waste-water returns [6], risks to communities and workers from seismic events [7], vehicle traffic-associated risks (including collisions [8] and air quality impacts [9]), accidents and malfunctions, and light and noise pollution [10] primarily from drilling rig construction and operation. Air and water impacts, particularly from exposure to fracking additives, have documented negative health effects including nervous system, respiratory and gastrointestinal health risks, cancer risks [11] and increased incidence of infant mortality [12]. This collective public

and environmental health research has identified the key point and non-point source pollutants and their potential metabolic effects. However, as Adgate et al. note [13], there are persistent uncertainties about various factors and metrics. These include the frequency and duration of human exposure to chemical contaminants, the heterogeneous pollution monitoring, control and mitigation strategies in place, and a paucity of baseline environmental health data against which to measure community impact. Therefore, there is a need for integrated studies of public health, environmental and socio-economic impact data [14], and both Cooper et al.'s [15**] comprehensive review of UOG sustainability and Meng's [16**] total environment assessment are useful in further defining this knowledge gap.

Secondary socio-economic and health impacts

Aside from directly measurable impacts, there are also associated social impacts that have secondary effects upon community health. The concept of the energy "boomtown" has been subject to sustained sociological inquiry since the 1970s. Boomtowns emerge following rapid exploitation of a new resource, leading to an influx of non-local labour and new infrastructure and investment models to a rural community. Though positive economic benefits are strongly attributed to new extractive developments, there are numerous negative impacts. These include aesthetic and amenity value loss, loss of access to the outdoors and wildlife habitats, housing and infrastructural shortages leading to price increases and housing poverty, environmental injustice and heightened crimes rates, in turn leading to elevated incidence of psychosocial stress [17], substance abuse and depression [18,19]. Sociological research on the boomtown concept has specific attribution to case studies of UOG development [20–23]. However, Jacquet's [24**] review notes that the social scientific focus upon whether boomtown conditions exist in UOG communities leaves a research gap on repeated, longitudinal, data collection and analysis on social impacts to better understand the long-term effects. Moreover, although there is strong evidence on the primary and secondary community health impacts of UOG development (alongside other community resource extraction and energy project cases), until recently, less attention has been given to the subjective interpretations of such energy developments [25], and the impact that public perceptions have upon UOG development decisions and outcomes.

Discussion – public perceptions of unconventional oil and gas

Within the public health literature there is an important need to understand not just the biophysical impacts of UOG-related risks, but also the socio-cultural and psychological dimensions of risk perception and the effect that these have upon resource development. As Werner et al. [26*] note, there is a clear gap in

scientific knowledge with regards to public health perceptions and concerns, a need for research comparing public perceptions on health risks with epidemiological risk data, and a need for improved risk communication with affected communities. This is important because public opinion has substantial effects upon policy decisions, even when such opinions run counter to the activities of political organisations and industry elites [27]. For these reasons, we must better understand the differentiated reasoning for support or opposition to UOG, the underlying mechanisms that drive such differentiated support, and the effect that this has upon natural resource extraction and energy policy choice.

When considering specific environmental risks, water withdrawal, contamination and quality have been primary concerns since the start of the shale boom, particularly in the USA [28]. Thomas et al. [29**] note that water impacts are among the most commonly cited and important environmental risks, with air pollution, damage to the land and landscape, and associated impacts on wildlife as common secondary concerns. However, rather than focus on specific environmental impacts, much work on UOG perceptions examines top-level, framing or discursive construction of shale gas risks (whereby certain aspects are emphasised and others minimised in scientific and political communication and how this influences public opinion and the range of policy choices available). In European studies of shale gas perceptions, social science researchers have commonly employed qualitative and/or documentary methods of discourse analysis, media and stakeholder interviewing. These studies examine issues of how key industry and policy communicators socially construct UOG technology, for example, by comparing it with coal in order to frame it as a "clean" or "transition" fuel [30]. Numerous studies have shown that certain industry framings lead to a lack of trust within local communities, and how such lack of trust in policy authority, industry and regulatory messages (and their messengers) undermines local support (sometimes referred to as *social license to operate*) [2,31–34]. Recent research using both deliberative methods and survey data has shown how local support is influenced by perceptions of UOG as being beneficial to climate change (or vice versa) [35*], as being based in both place-based (local) experiences as well as national energy and environmental policy contexts [36,37], and how issues such as media framing at the national level [38], or even the use of 'fracking' terminology (with its lewd connotations), skews public perception [39].

When looking at support and opposition-influencing framing effects, there is considerable variation between and within countries. For example, greater pro-UOG messages are emerging within media and government messages in countries such as Poland [38], at local state levels in regions with higher levels of current or historic

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