

Emerging Dimensions of Networked Energy Citizenship: the case of Coal Seam Gas mobilisation in Australia

*Declan Kuch, University of New South Wales
Asha Titus, Australian National University¹*

Abstract

Coal Seam Gas (CSG) activities have mobilised new political coalitions across the traditional left/right political divide in the eastern Australian states. Through the charting of these activities we propose the concept of ‘networked energy citizenship’ to capture the tensions between fossil fuel capital and the rural and urban alliances that form in response to a range of concerns and unexpected connections. These include bubbling rivers, pipelines routes and new duties thrust upon landholders. We emphasise the advantages of analysing online data around energy issues as part of traditional qualitative data gathering. This article reports empirical findings from a custom database of tweets around CSG issues and theorises the politics of knowledge at stake in this challenge to state-appointed expertise. We apply the Economic Sociology concepts of ‘bridging’ and ‘brokering’, to analyse the distinctive structure of the online issue networks around CSG; however, we remain wary of claims of predictive power which tend to gloss the material conditions and political character of these networks. For this reason, online expressions of concern around unconventional gas should be understood as ‘events’ implicated in a wider set of economic, political and techno-scientific processes.

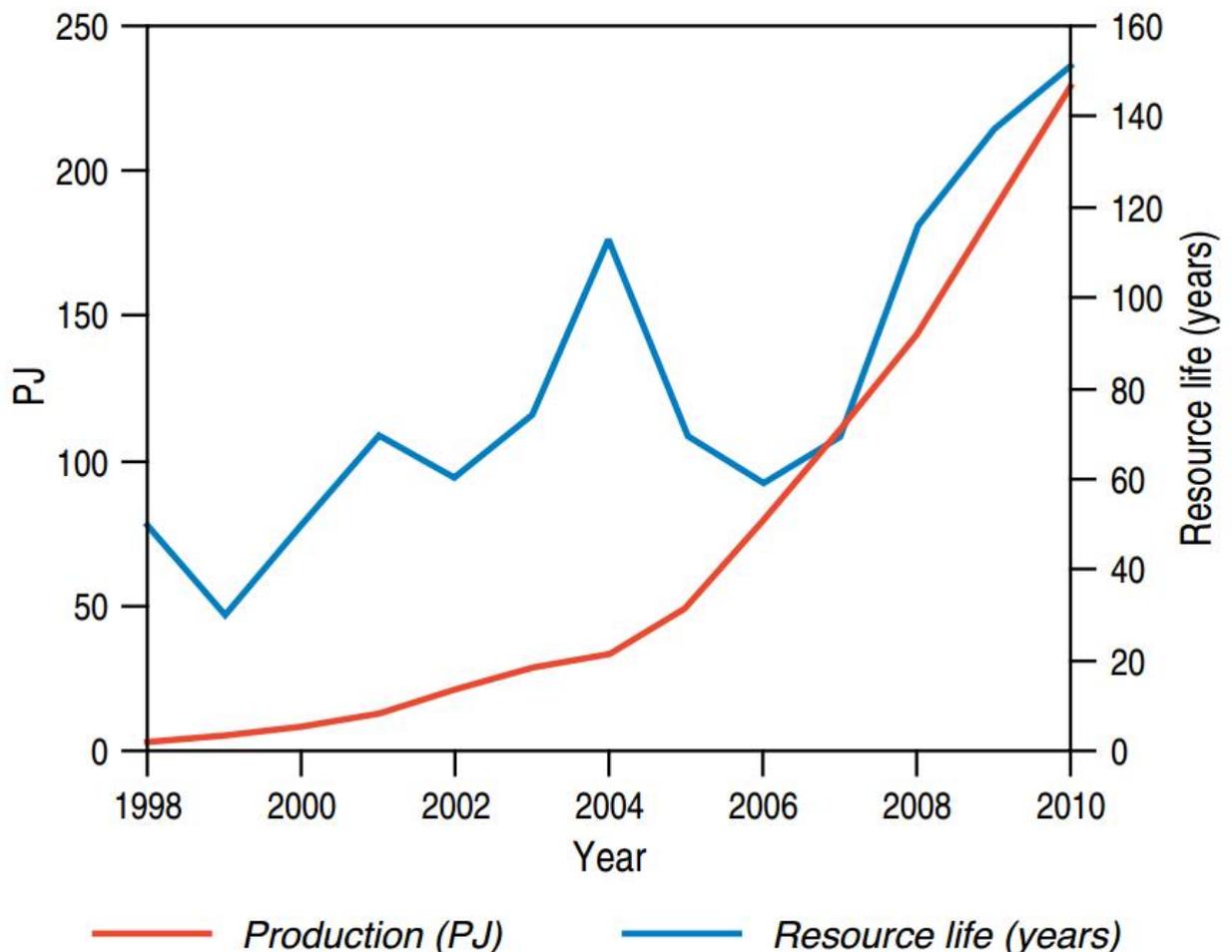
Keywords: Coal Seam Gas, Office of Coal Seam Gas, NSW Chief Scientist, Issue Network Analysis, Social Network Analysis, Protest, networked energy citizenship, unconventional gas, carbon democracy, hydraulic fracture stimulation, fracking, protest, Twitter, Web 2.0

Introduction

The ‘gas rush’ – the rapid expansion of shale, coal seam and other unconventional gas production – has presented the United States, Australia and other countries with a number of pressing questions about science, energy and citizenship. The flow of cheap gas represents an epochal shift in politics and economies, marginalising concerns about peak oil (Klare 2013; Mitchell 2013). Gas powered bus fleets have been commissioned and rolled out as a result of falling gas prices and fertiliser plants are being built in the United States rather than Asia where gas prices are higher². However, a number of concerns have arisen about the environmental and social effects of this new energy boom (Cleary 2012; Manning 2012). These include the fugitive emissions from the ‘fracking’ process and associated health effects of living near gas fields. In addition, the potential for aquifer contamination and conflicts over

the use of water have mobilised protests spanning traditional left/right divides between environmentalists and agricultural groups. The economic justification for the gas rush was founded upon a demarcation between expert and non-expert knowledge of water use, aquifer interference and other issues that these new protest movements have sought to challenge, thereby turning matters of economic fact into matters of concern (c.f. Latour 2005). Therefore, the stakes for regional communities are high, especially with the rapid growth of unconventional gas production. Where shale gas dominates the US energy landscape, the much shallower Coal Seam Gas (CSG) has come to dominate Australia's gas markets, accelerating from negligible volumes in the mid-1990s to over 200 Petajoules³ in 2010 (see Figure 1).

Figure 1: Gross Production of Coal Seam Gas in Australia (red) and total estimate of resource life in years (blue). (source: Geoscience Australia, Australian Gas Resource Assessment 2012 page 18)



Decades of testing and trialling gas extraction technologies have resulted in today's gas rush⁴. Low combustion emissions from these trials have led many government policy-makers to controversially estimate emissions and classify gas as a fuel with a lower greenhouse gas footprint than coal. These estimates have included only a small margin of error for well failure and a limited range of other accidents and leakages (c.f. Hou 2012). The CSIRO has been commissioned to undertake lifecycle analysis of emissions through a partnership with the industry, but this has proven controversial both in terms of its potential validity and timing⁵. Nevertheless, proponents have pitched unconventional gas as ostensibly fitting a niche between growing demands for

energy security from nation-states and a burgeoning international climate change mitigation regime. Measurement controversies signal wider discord in so far as security and ‘low emissions’ rationales for the technology have not translated into public acceptance – quite the contrary. There has been a democratic deficit in planning and consultation, captured by terms such as ‘adaptive management’ whereby regulatory rationales have shifted from protecting existing environmental and social interests to the needs of the industry to negotiate its pipeline routes and drill holes. The industry’s expansion onto agricultural lands, in particular, has prompted the creation of new collectives who challenge scientific claims of safety as well as economic claims of efficiency⁶.

This article presents social media data from New South Wales public protest mobilisations around the gas industry planning and regulation. The slower growth and smaller scale of industry progression in New South Wales suggests that these protests have been successful. Neighbouring Queensland has more successfully depoliticised the industry’s growth through economic narratives (Mercer *et al* 2014). We outline how new social protest organisations have emerged, providing information brokerage opportunities between clusters of concerned social movement actors. In addition, the central role of journalists and environmental bloggers in brokering information about gas industry developments, is linked to the term ‘networked energy citizenship’ to describe the contested knowledge politics of gas exploration and production, and their associated socio-economic and planning regimes.

The intersection of energy and citizenship through networks conjured here is deliberately both provocative and playful; energised populations, affected by unexpected new connections between human and nonhuman participants: farmers host environmental activists on their properties swapping knowledge about fertilisers for lessons in Twitter use; videos of methane bubbling rivers near gas drilling sites circulated among concerned groups. Citizenship, as we seek to develop it here, invokes new understandings of duties and rights regarding land in the ‘third carbon age’ (Klare 2013). The extractive capital shunned from choking urban life in the Nineteenth century and built upon now depleted, distant fossil fuel reserves descends upon rural and other non-urban settings.

Mobilisations around gas issues in this context are at once epistemological, political and socio-economic in so far as they challenge domains of expertise that dominate gas exploration and extraction and ask such questions as: are the assessments of gas reserves a scientific issue for the eyes of state-appointed geologists only? Which governing body licenses and gives authority to companies to explore reserves and on what grounds? At stake in these questions are judgements about the suitable planning and use for valleys, plains and forests in which gas-fields are planned.

We examine the ways network relationships, built on protest against gas industry actions, are always actively curated by social movement participants, rather than passively working within existing social clusters. Such dynamism might be intuitively viewed as a general feature of social movements, so we additionally contend that the material character of unconventional gas production and supply chains, particularly the uncertainties surrounding the transformation of prospective gas reserves into viable production, have significant effects on the structure of network relations in so far as a variety of landholders and other actors are enrolled. The purpose of this article is not to analyse the techno-scientific controversies around water allocation, aquifer contamination risk, fugitive emissions and so forth in detail, but rather to show how social movement mobilisation techniques have been adapted to the context of unconventional gas contestation and land-use planning policy in Australia,

converging on coordinated protests at State and Federal Parliaments. Thus our concept of ‘networked energy citizenship’ is not reducible to contests in the domain of science alone, but rather draws attention to science as a site where broader contests over the suitability of energy technologies for a socio-economic community are disputed. That is, the necessity for onshore gas producers to access a web of drilling sites across agricultural and environmentally sensitive lands in New South Wales is important for understanding the political forms that have emerged through the public contestation of gas production in that area specifically, and in Australia in general.

From ‘Networks-as-Structures’ to ‘Networks-as-Events’

Energy issues around the ‘gas rush’ provide a novel site for assessing the relationship between individuals, whether as citizen or consumer, and the material conditions of their relationship to others. The relationship between individual and social structure among Social Network Analysts has largely developed without consideration of the material context of those relations. The first generation of Social Network Analysis research emphasised how network properties like density, structural equivalence/position, centrality and between-ness predict individual and collective behaviour. Having developed in the 1960s in direct opposition to Parsonian structural functionalism, this influential line of scholarship in contemporary American sociological scholarship steered clear of the excessive emphasis on internalised norms, values, ‘attributes and attitudes’ of structural functionalism. Combined with an overwhelming preference for formal models and technical methodological innovation, this meant that the cultural and socio-psychological meanings of ties were largely bypassed and the focus was predominantly on interpreting patterns among types of ties (White *et al* 1976, p. 245, Santoro 2008). The idea of ‘diffusion’ (e.g. Earl 2009) shares this conceit by looking only at structural comparisons of growing networks – materiality is absent.

Recent proliferation of computational work in disciplines as diverse as social physics, computer science and epidemiology contributed to the idea that network position constitutes actors’ identities and roles. Such simplicity is also the basis of claims to the predictive power of network analysis. Networks, in these disciplines, have been seen to serve as channels for attitudes, ideas and innovations which flow from one node to the next in such a way that ‘the nodes and ties have an existence that is independent of the cultural object, attitude, or practice that travels across them’ (Mische 2011, p.82). The social tie and its content were seen as being able to causally impact each other but were ultimately deemed separate. In this way, a science of ‘the social’ can chart network ties regardless of the reasons for their formation or material conditions of contestation.

Later work (especially from the social movement literature where organisational network boundaries are difficult to definitively chart) started to push the boundaries of structuralist network tradition by reformulating social relations and systems of meaning as co-constitutive and mutually evolving. In a programmatic exposition of what has now come to be called ‘relational sociology’⁷, networks were conceptualised as “composed of culturally constituted processes of communicative interactions” (Mische 2003, p. 258). Using new analytical methods, Mische (2003) and others synthesized the epistemological with the political by analysing the structural embeddedness of social movement actions.

We develop these concepts to compare and analyse social movement efficacy⁸ in two ways in this paper: Firstly, the largely successful twitter campaign against coal seam gas expansion we analyse is less concerned with meaning-making than

communicating a shared sense of threat and peril. Therefore we shift from meaning-making of groups already constituted to the events and issues that underpin a shared sense of perplexity and threat compelling new organisation. We term this a methodological shift towards ‘networks-as-events’ to denote the study of the ways social movements mobilise around techno-scientific issues. The shift from structure to event helps draw attention to the political character of issue-networks through both the process communicating affect and the role of particular objects of contestation. Secondly, we follow Timothy Mitchell’s related argument that techno-scientific structures of energy production have their own vulnerabilities, and therefore, are shaped by technical and nonhuman domains.

Social Movements of Scientific Citizenship

The relationship between media platforms and social movements was complicated long before the arrival of social media platforms such as Twitter. This relationship has often been conceptualized as one of a struggle for wider public attention. Mainstream media outlets have had a monopoly on public attention because they have had the means of channelling information through broadcast and print media. These outlets operate in existing political hegemonic frames which means that “certain actors [are] given standing more readily than others, but certain ideas and language are given a more generous welcome” (Gamson & Wolfsfeld 1993, p. 119).

A pertinent point of reflection is Latour *et al*’s (2012) suggestion that the new study of networks has enormously increased the visibility of the material dimension of networks. That is, protests and campaigning require databases, lists, computers and servers to coordinate messages; they also require tents, tools and other protest devices to assert influence over project sites. Several studies have examined the relationship between the online and offline worlds of protest. For example, Pilny and Shumate (2011) argue that online and offline networks among NGOs share many of the same fundamental characteristics, especially social aims, financial ties and mainstream media visibility. Gillan’s (2009) study of Anti-War coalitions shows the ways online campaigning tools were integrated into a well-established set of protest tools by activists. We seek to overcome the slacktivist-activist distinction, which relies on a conceptualization of separate “real” and “virtual” worlds in a digital dualist framework. In this way, we seek to build on the work of those such as Gillan (2009) and others in seeking to examine how online and offline networks operate in concert to understand why network forms become visible in online environments such as hyperlink and new social media networks. The integration of new network analysis into social movement campaigning has seen protest become less virtual⁹ and the more material, the more digital it has become, to paraphrase Latour (2012). Latour *et al* (2012) do not seek to dismiss the ideas of society or network but rather to capture the configuration of many heterogeneous elements into ‘collectives.’ Thus, materiality denotes the practical means of mobilising a collective. Indeed, for Latour, the concept of networks – and indeed societies – represents a methodological quirk developed because of a deficiency of data-gathering techniques. Latour and his colleagues overcome this deficiency by making apparent the ‘collective self’ engendered by digital networking. Moving from the comparison of existent social structures to ‘networks-as-events’ helps to overcome this deficiency by showing the ways social formations cluster around techno-scientific controversies and issues.

Many contemporary controversies around which new political networks form are not solved by (more) science, but rather are a result of its practices. From

environmental controversies such those around due process for a Coal Seam Gas industry to AIDS activism¹⁰, social movements are engaged not only in the ‘sociology of the social’ but are contesting new associations of humans and nonhumans (Latour 2009). Sociological studies of risk and trust have challenged traditional divides between nature and culture which underpinned ‘deficit’ models of citizen engagement with science. The shift in emphasis from scientific practice as concerned with the mastery of nature to cleaning up the side effects, such as spills, ‘monsters’, and externalities of modern calculus and technological innovation that Beck (1992) calls ‘reflexive risks’. These are risks which render science simultaneously indispensable, devoid of its imagined original validity and politically reflexive. The utility of the nature/social divide is diminished by this development as the difference between the source of the risks and their likely manifestations becomes decreasingly clear (Beck 1992). This ambivalent character of science in both risk assessment and management means that threats existing in the real world and those imagined by humans cannot easily be differentiated. This is because knowledge of them is entirely mediated through the ‘sensory organs’ of science – experiments, theory, peer review and technologies (Paladino and Simonelli 2013).

Such ambivalence is exemplified in the final report of the NSW Chief Scientist, which warns that where “detailed hydrogeology is not yet fully characterised, there could be unexpected events, learnings, or even accidents” (O’Kane 2014, p. iv). ‘Full characterisation’ is not defined in the report, which later refers to ‘adequate’ characterisation of hydrogeology, which would be derived through expert judgement of seismic, drill core and other partial technical scientific ‘organs’ (see also Manning 2012). The ambivalent relationship between citizens and science mediated through such warnings of accidents means that the structure of the hyperlink and other communication networks is instructive in illuminating how information flows around new authority figures.

The rise of networked media, then, makes possible and visible knowledge flows that can challenge incumbent and state-sanctioned frames of economic worth and amplify unexpected events that show gaps in existing knowledge. Much of this contestation occurs through the rhetoric of ‘facts.’ For industry proponents and their media acolytes, ‘the scientific facts’ are the coal seam gas sectors’ ‘winning hand’ in the battle for public opinion¹¹. In this way, networked scientific citizenship overlaps with existing Sociological accounts of ‘citizen science’ typically directed towards the ‘Canonical’ (Shapin 1990) or ‘Traditional’ (Michael 2002) accounts of Public Understanding of Science (PUS). Traditional PUS implies that it does not make sense for society to be given the opportunity to speak back to science, except through the representative channels provided by the State (Bertilsson & Elam 2003, p. 238). No longer can the lines of communication between science and society be one-way from state to citizenry. Sociologists have criticised the ‘realist ideology’ that polices modern dualisms of fact and value by emphasising that

knowledge and its material embodiments are at once products of social work and constitutive forms of social life; society cannot function without knowledge any more than knowledge cannot exist without appropriate social supports. Scientific reality ... embeds and is embedded in social practices, norms, conventions, discourses, instruments and institutions ... the building blocks of what we term the social (Jasanoff 2004b, pp. 2-3)

The assumption that there exists a measurable distinction between lay (irrational) and

scientific (rational) knowledge means Traditional PUS performs a particular model of citizenship – one challenged by new networked modes of engagement and protest, precisely because counter-expertise can challenge and amplify uncertainties along newly formed concerns. The networks of farmers and environmentalists we observed online and offline exemplify such relations.

Carbon Democracy: Citizenship in an Age of Gas

The idea that techno-scientific reality ‘embeds and is embedded in ... the building blocks of the social’ has been inventively pursued by Timothy Mitchell in his recent work on ‘Carbon Democracy’ (Mitchell 2009, 2013). Two aspects of this argument are particularly relevant here. Firstly, he argues that the specific properties of hydrocarbon production chains relate to the kinds of political opportunities available to social movement actors. Through the concept ‘Carbon Democracy’ he explores the intersecting histories of coal, oil and democracy in the twentieth century. He closely follows the methods of production, distribution and conversion of fossil fuels into other forms of socio-technical organisation, financial circulation and political power and turns to these in order to trace the ways in which the concentration and flows of energy could open up democratic possibilities or close them down. He argues that, “ignoring the properties of oil itself reflects an underlying conception of democracy” (2009, p. 400). Mitchell’s target of criticism here is a view of democracy as fundamentally the same, as possessing an essence and a universal character able to be decoupled from the conditions of its inception and transplanted extraneously. This universal concept of democracy criticized by Mitchell equally applies to Social Network Analysis concepts of ‘networks’ in the sense that social ties are compared and analysed without regard to the material conditions of their production. Rather, it is only represented as a relationship between participants. A second area of relevance is Mitchell’s suggestion the recent ‘Arab Spring’ was largely a ‘Facebook revolution’¹². Rather than embodying a universalist conception of digital, networked citizenship, he points out years of concerted campaigning that culminated in what has become popularly known as ‘the Arab Spring’. Decreasing oil prices and subsequent food price spike fed into disruption through labour strikes and protests that were years in the planning. These all culminated in a government decision to cut off the internet – the regime “hacked itself” (Meister & Mitchell, 2012, p. 13)

On the other hand, for Mitchell, oil required an entirely different skill-set to extract and very different political power structures. The locus of political power shifted from miners to engineers working on the surface because it is they who assess reserves, assemble drills and pipe crude oil to ships and refineries. Where coal requires matching with particular power stations from its source, crude oil reaches its market potential from the refining process. Thus crude oil-laden ships can set off without knowing their final destination and receive instructions en-route once prices are settled.

However, oil and gas share key components of their production chains. They are both global industries of enormous technical complexity, incorporating satellites and sophisticated sensory imagery to isolate subsurface targets for extraction (Willow 2014). Both require practical surface engineering skills to translate prospective reserve data ascertained from possible or ‘contingent’ reserves to a demonstrated, economically feasible resource¹³. Such capacities of translation incorporate proprietary knowledge, practical skills and scientific literacies often presented as a key property of the success, vitality and competitiveness of contemporary economies and technological societies (c.f. Barry 2005). Thus, the techno-science of the oil and

gas industry, which includes multi-million dollar University research affiliations, cannot be disentangled from economic discourses that exclude and marginalise other land uses (Mercer *et al* 2014; Willow & Wylie 2014). This entanglement of the economic and technical means that a key capacity of oil and gas expertise is its flexibility in translating previously uneconomic reserves of unconventional gas into production according to prevailing global prices – a key political component to Mitchell's *Carbon Democracy* thesis. Such moves are experienced as a form of precarity and exclusion, as Wylie argues albeit in a US context:

Surface owners and residents of resource extraction zones are often the last to know about the shale reserves beneath their feet. In many instances, the industry is able to secure leases and access target resources before residents are able to mobilise resistance. It is therefore vital to examine the oil and gas industry systematically and structurally in order to understand how and why the isolation of surface owners is produced. Oil and gas extraction is typically marked by an enclaving process, through the establishment of what Andrew Barry (2005) calls "technological zones," to which only certain people have access and in which space and time are marked differently... Access to technological zones is limited to employees, and their distinction from the surrounding landscape is further emphasised by particular spatial and temporal arrangements (Willow & Wylie 2014, pp. 227-8).

The contingent scale and temporalities of knowledge oil and gas production is an event, in the sense that it requires a diverse array of socio-material processes to coincide: broad scale estimates of reserves must be demonstrated to investors who will risk capital on wells producing significant gas resources. Crucially, Mitchell's thesis does not depend upon an absolute decline of coal and rise of gas¹⁴; but rather on the presence of new patterns of fuel production that challenge existing economic production based upon oil and coal. Indeed, Mitchell's thesis leads us to think topologically – across human and nonhuman domains and temporalities – in considering energy citizenship. By topological thinking we broadly mean the shift from thinking of fixed points in space to a relational understanding of processes such as resource assessments and drilling practices. Such thinking also compels a broad understanding of how the territorial boundaries of states – often thought to be fixed – are bound up with the disputed techno-scientific processes of assessing and producing energy resources.

Thus, the import of Mitchell's thesis for the present discussion is the speculative movement from resource assessment to production through contested land holdings. In the state of New South Wales, farmers and other landholders have effectively become enrolled in *in vivo* economic experiments to extract the most promising gas resources. For these reasons, new social media platforms – primarily Twitter and Facebook – have been pivotal in the mobilisation of protest and contestations about the place of coal seam gas in Australia's Energy Policy mix. The speculative nature of Coal Seam Gas exploration and production means that much of the resource for the Eastern Australian Gas Market has been identified in the Gunnedah Basin (Bradshaw 2012) bordering on the same highly productive 'black soil' agricultural lands in New South Wales that saw the same exclusions and exemptions from gas extraction which were won in Queensland (de Rijke 2013). Beginning with land use concerns raised by effected farmers, to contestations of industry expertise and technologies such as hydraulic fracturing or fracking, the economic viability of the onshore gas industry

has grown into a full blown public controversy with refutations and media campaigns by the petroleum and gas industry association. Traditional forms of civic protest gained momentum, with online signature campaigns, calls to direct action, extensive online discussion and mobilisation of the participative dynamics of Web 2.0 for diffusing links to counter expertise and ‘citizen science’.

Methodology of data gathering

Examining the extent to which the properties of oil and gas matter to the structure of public mobilisations requires as sophisticated sensory data and resources as the industry itself. However, public interest research lacks such resources (Mercer *et al* 2014). A growing body of anthropological literature documents the *experience* of living in gas fields in the United States through more traditional methods (Paladino and Simonelli, 2013; Poole and Hudgins, 2014) and experiments in remote digital data collection such as the WellWatch.org project (Wylie & Albright 2014; Wylie *et al* 2014). This work has effectively documented the ‘tumultuous social and physical transformations resulting from, and produced by, an unfolding frontier of energy production that unsettles social, economic, and ecological landscapes’ (Willow 2014). Thus the concept of energy citizenship moves ‘upstream’ from this site of contact by examining the social structures that redistribute other knowledge of policies beyond that sanctioned by industry and government to new audiences of policy-makers in Australia. We interviewed several key participants (defined by the centrality measures outlined below) as well as undertook regular reviews of mainstream media publications on the topic. Our twitter database grounded these investigations.

The manner in which the online controversy around coal seam gas unfolded provides rare insight into the exogenous limitations placed on social movement actors with respect to their access to elite alliances, institutional patronage and ability to effect enduring policy changes. We created a comprehensive dataset of scraped tweets and digital content in order to trace the trajectory of this issue from June 2011 to May 2012 and in turn answer questions about variations in levels of participation, conditions of crystallisation of emergent protest and subsequent movement success. Our custom-built database captured a total of 54,479 tweets, 42,407 embedded hyperlinks and 24,143 retweets along with platform dependent, already formatted geotags and timestamps. We ran descriptive analyses for an overview of overall trends and then coded and performed careful content analysis of a random sample of every 10th tweet data.

Gathering a database of rapidly produced online data, such as tweets about unconventional gas issues, is not a simple task. Application Programming Interfaces (APIs) change within platforms, meaning coding invariably involves much trial and error. Initial trials were carried out using the Twitter Archiving Google Spreadsheet (TAGS) v3.1 that harvests and stores tweets onto a spreadsheet. Given that this open-source software is built to handle keyword searches to capture twitter output from conferences and other such small events, we experienced serious limitations in data gathering. This related to the number of tweets that could be archived, reliability off/from the online server and the inability of Google spreadsheets to handle the volume of tweets as well as issues with initial keywords like ‘coalseamgas’ pulled in. In the first month this was 18,000 unique tweets that included from and to user fields, tweet text, geolocation and time stamp.

To overcome these limitations and to archive tweets in a systematic manner we secured a dedicated server. We used a customised database software called yourtwapperkeeper (<https://github.com/jobrieniii/yourTwapperKeeper>) to scrape and

archive the twitter dataset. Customization was necessary for a number of reasons. One of the major downfalls of this software was that it had to be manually started by a user if the server it was running on crashed. Therefore, our developer built a script that would be triggered on the reboot of the server that would restart the script. During the outage, if longer than 5-10 minutes, a gap in data would occur as Twitter has a time-limit on how far back data can be searched through. Once this script was implemented, the software ran without major interruption for a number of months. Parsing live twitter streams for the keywords #fracking, #CSG, #lockthegate, #gasland, #wewantCSG and other emerging trending topics, we gathered publically available data on:

- `text` - the actual tweet text
- `user_id_str` - unique id of the user that sent the tweet
- `in_reply_user_id` - if the tweet is reply to a user, id of user
- `created_at` - time of tweet
- `user_timezone` - timezone of user
- `user_location` - location of user, this is user defined
- `user_geo_enabled` - if user has enabled geo information
- Number of followers
- Number of people following
- Their chosen language

This information was available via Twitter's Streaming API (<https://dev.twitter.com/docs/streaming-apis>). This method of data collection provided higher quality data than other scraping options along with a reduced risk of a gap in data. The downside of this implementation was that it was built from scratch by the developer, and as result no Graphical User Interface was available. All requests to review/slice data were done through the developer.

The script was written in PHP and the scraped data stored in a secure MySQL database. The requests to slice data included splitting by keyword and only providing data where users' language was set to English. A number of the keywords were common phrases in other languages such as Spanish. As a result, the database required cleaning to ensure unrelated tweets were excluded. This assessment also influenced our selection of hashtags. During high-traffic periods as many as 250 tweets were collected per minute. Another key challenge we grappled with was how to filter by geo-location in order to exclude non-Australian tweets as only 1-2% of users actually add GPS-based location data to their tweets. This made it difficult to filter a Twitter stream for tweets from a specific area only. However, the content of much tweeted media suggested that physical drill rigs were a significant site of concern.

Energy Citizenship in the Gas Rush

‘Energy Citizenship’ has recently been used to represent a range of actions and subjectivities¹⁵. For our purposes, the new and unexpected connections that have animated the anti-CSG movement speak to the schism between usages of the term ‘citizen’ before and after industrialisation (c.f. Mitchell 2009). Contemporary usage gravitates towards an increasingly globalised subject of a variety of rights, such as freedom of expression, fair trial etc. (eg. Ryan *et al* 2014). However, prior to industrialisation, ‘citizen’ denoted a peculiar class and urban status: “an ordinary (city- or town-dwelling) person as opposed to a member of the landed nobility or gentry on one hand or an artisan, labourer, etc. on the other”¹⁶. The former definition is most often deployed as a critique of state coercion and repression while the latter implicated in nation-building through the construction of new duties upon rulers (Moyn 2010). For the purposes of the present discussion, we simply note the importance of a material and socio-spatial dimension to citizenship that is absent from terms such as ‘netizen’ that generally express the former definition. Thus we wish to avoid theorising the subject of energy citizenship a necessarily universal one, but rather situated in concerns of place.

Our research found new alliances of ordinary people and landholders both expressing concern and seeking to impose new duties and obligations on gas companies. The alliance ‘Lock the Gate’ emerged in both our dataset and broader media analysis as both the most prominent and politically diverse network. The alliance comprises some ninety community groups including resident action, conservation, and church-based groups together with traditional environmental protest groups and Rural Greens¹⁷. The concept of ‘Locking the Gate’ seeks not only to prevent gas companies from entering land, but to prevent companies fulfilling the requirement of their Petroleum Exploration Licences to undertake active drilling to assess resource potential.

‘Lock the Gate’ has conducted several demonstrations, blockades (resulting in arrests) and online campaigns staffed full-time to coordinate messages and counter industry information. They also offer advice for landowners who wish to ‘Lock the Gate’ against mining companies seeking to prove up the gas resources under their land on their premises. Our dataset shows that tweets frequency are a proxy for coordinated protest events culminating in more traditional forms of activism, such as demonstrations at Parliament House.

Figure 2: Coal Seam Gas Hashtags by frequency of public tweets over time

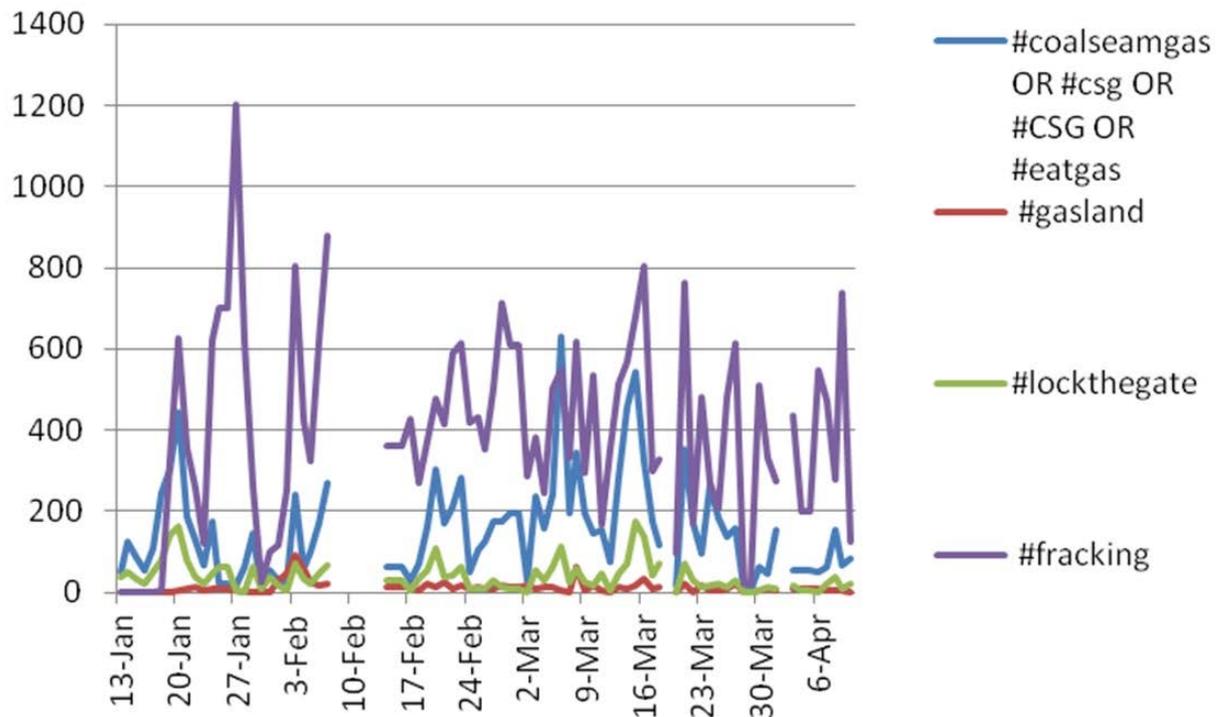
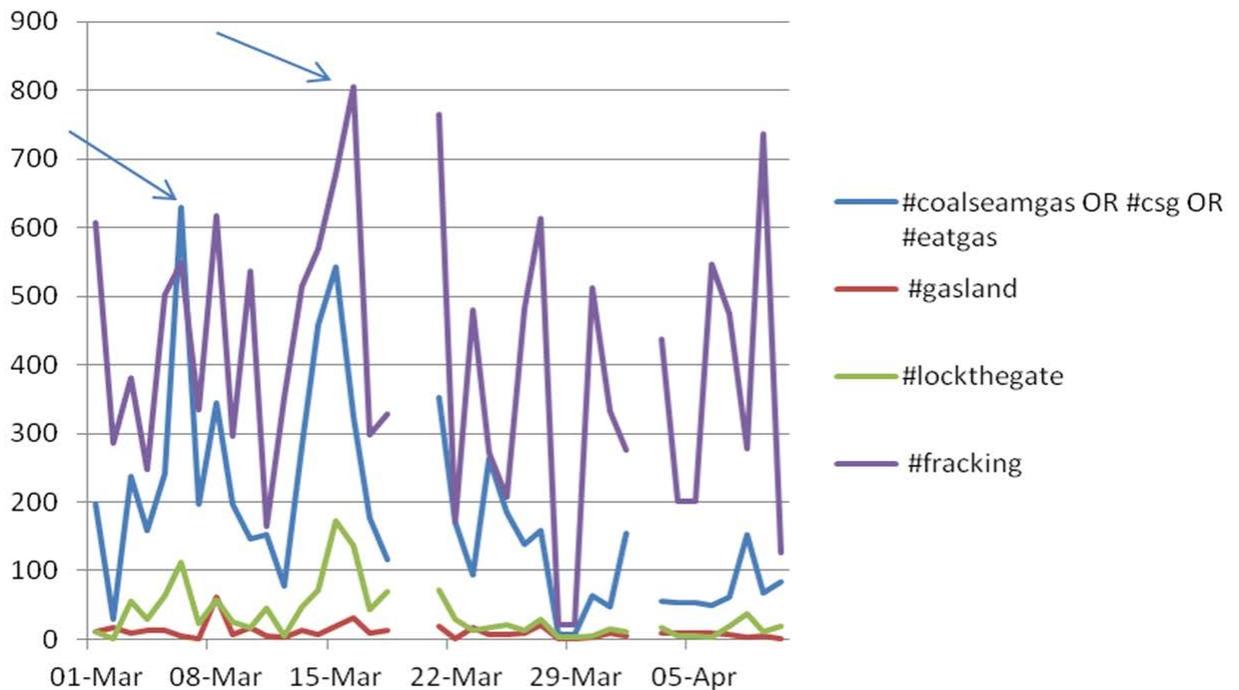


Figure 3: Notable events in mobilisation around various hashtags during March 2012. Note: First arrow refers to peak on 6 March; Second arrow highlights 15 March 2012 protests



Events around March 2012 corresponded with Queensland elections (that had initially raised the possibility of CSG becoming a pivotal matter of dispute and concern) as well as key peaks in the volume of CSG hashtags which for the first time exceeded #fracking, owing partly to the reactions to the release of three key policy frameworks including the NSW Strategic Regional Land Use policy, NSW Draft Aquifer

interference policy, NSW Draft Code of Practice for Coal Seam Gas Exploration.

The gas industry position, however, has been provided by Australian Petroleum Exploration Association industry twitter handles like @RWilkinsonAPPEA, and subsequently the @YES_CSGAlliance. Rick Wilkinson's now moribund account became relatively less active since the hotly discussed media campaigns under the banner of 'We Want CSG' crystallised into a broader counter-campaign under the hashtag #wewantcsg. Supporters like @Unlockthegates and @Fracking4future emerged to put forward the position of Coal Seam Gas as a key to achieving future energy security, as well as dismissing opponents as 'unemployed', 'NIMBY' and unrepresentative of wider public opinion.

Coal Seam Gas issues are given international reach, in so far as they are discussed by clusters of concerned but not directly affected 'retweeters' creating hashtag communities and 'ad hoc' issue publics. This is because, as Marres and Rogers (2008) suggest, "'Global' not as 'level' or institutional arrangement, but effect of network practices that circulate information, people and things, in order to articulate objects of knowledge, and of politics NGOs operating trans-nationally." Research thus far suggests that 'retweets' tend not to crystallise into more persistent direct action interventions. Rather, they create a frame to manage content between multiple audiences. That is, publics are cultivated around issues, rather than absorbing information about science in ways the Traditional PUS model expects (c.f. Marres 2007). This suggests that networked energy citizenship is not so much a specific characteristic of individuals but an event determined by the relevance of issues to landholders and other political actors whose values challenge those of gas proponents and their allies in government (c.f. Mercer *et al* 2014). Two sets of concepts stand out in understanding the diversity of the social movements around unconventional gas and also speak to its limitations: the concepts of bridging and brokering and active 'audiencing'.

1. Bridging and Brokering

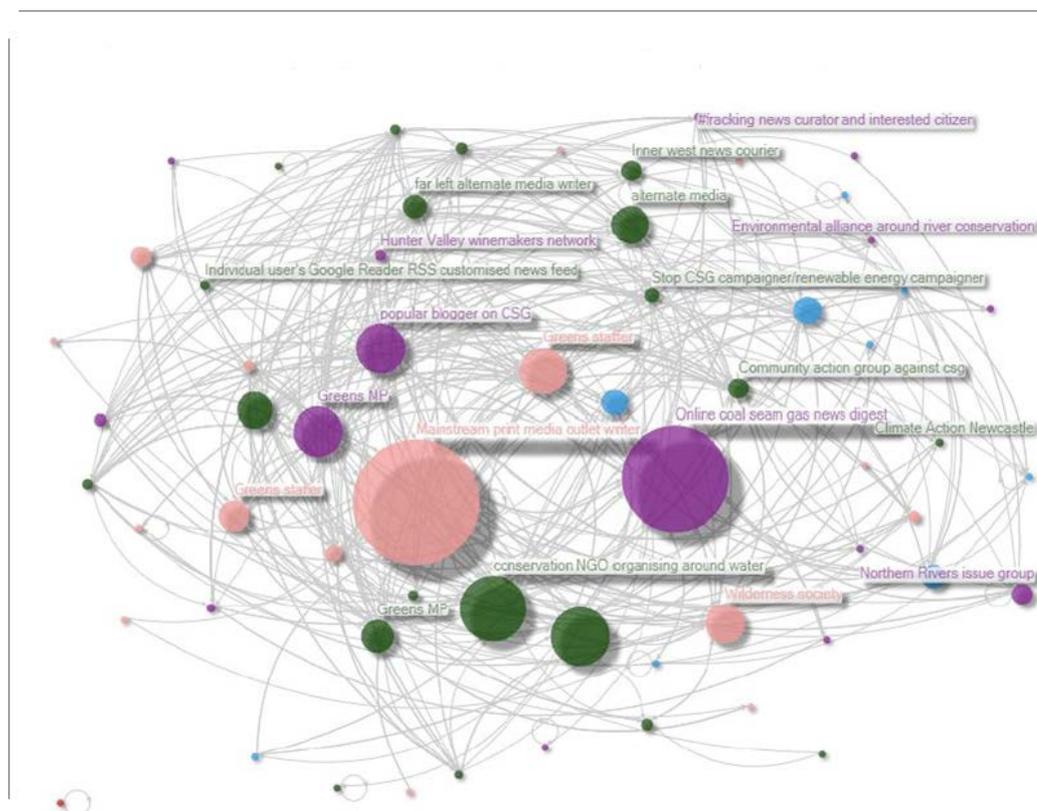
One prominent Social Network Analysis understanding of multiple audiences envisages bridging as the movement between existent clusters of social networks. This is commonly understood as a description of the power of 'Lock the Gate': an alliance of farmers on one hand and environmentalists on the other. This emphasis on mapping clustering patterns and bridging ties in Network theory draws from the work of Granovetter and the proposition that a node's position within large scale networks is important because network outcomes are spatially distributed in a manner that cannot be merely explained by one's socioeconomic or geographic attributes. Granovetter in his classic studies (Granovetter 1973, 1983) formulated that a defining feature of social relationships is the formation of bounded groups and dense clusters of strongly connected agents linked by 'weak ties' or 'local bridges'¹⁸. Granovetter's (1973) concept of Bridging and Brokering has inspired a model for information diffusion in a 'social movement society' (Meyer & Tarrow 1998). Given such a structure, he claimed that the set of contacts one's close friends had access to are likely to be the same as those you know yourself. Therefore, novel information has to reach you from another friend cluster, requiring a bridge between the two clusters which in most cases is a weak tie. It is from here that he builds his central thesis of the 'strength' of weak ties in information diffusion in the way weak ties link otherwise unconnected segments of the network and broker access to diverse information. For example, information would likely travel between farmers on one hand, and environmentalists on the other, with special individual brokers needed to transfer information.¹⁹

This theory of information transmission partially explains how conversations around major demonstration events are structured, with diverse actors entangled with the issue of CSG. Figure 4 charts the diversity of this coalition, connected through several key brokers. We saw mounting contestations about energy policy and its implications for sectors with competing claims to land use such as the agricultural, viticultural and other primary industrial sectors. A range of advocacy organisations from traditional conservation based groups to direct action groups that have been created with the explicit purpose of opposing Coal Seam Gas are active in the conversations around this issue (Cleary 2012). Each group – from viticulture to forest conversation – gives voice to a marginalised set of concerns put at risk by the potential overflows of the industry’s expansion. Our site visit to one blockade found it well-resourced and coordinated. Several participants wore t-shirts expressing opposition to CSG (eg. No CSG) and ‘Lock The Gate’ signs were plentiful. There was a social media bench where photos and information about the events were immediately uploaded to twitter with hashtags carefully selected to cultivate audiences for photos of gatherings and confrontations with police and other officials. The choice of hashtags beyond simply those relevant for existent networks suggests an active process of ‘audiencing’ material from protests. Thus, whilst the concept of brokerage assumes multiple audiences, new distinctions between the inside and outside of social clusters were always being remade around new sites of assessments for gas drilling, assessment or production.

2. Curation as ‘Audiencing’

The other concept illustrating the diversity of social movements is active audiencing. The distinction between ‘curation’ and ‘aggregation’ provides a useful point of departure. Aggregation refers to the gathering of all data around, for example, a hashtag; however, curation refers to the cultivation of useful information about a topic. The concepts of curation and ‘audiencing’ speak to studies of how good ideas are developed at hubs of otherwise unconnected segments (Burt 2003). They emerge from the synthesis of disconnected pools of information especially if the tie is the only link between otherwise unconnected clusters, such as those between church groups, farmers and environmentalists. Tufekci’s (2013) concept of micro-celebrity²⁰ partially helps to explain this dynamic: our data showed a mainstream media journalist and Parliamentary party members in prominent positions disseminating information and amplifying certain issues and messages. Audiences for and participants in CSG protest thereby coalesced with mainstream media readers and party members.

Figure 4: Parliamentary protest Conversation Network Snapshot



On the top right of Figure 4²¹ is a twitter user who has created a #fracking news tag and curates, forwards and circulates everything pertaining to Coal Seam Gas to their followee lists. A few sample tweets from a subsequent protest event are:

..the people who attended the rally are accidental activists, elderly people, farmers..." said @NoCSGGurley.
#polaw <http://www.morechampion.com.au/story/188703/protestors-hit-sydney/>

Hunter Valley vineyards threatened by mining encroachment (The Oz)
| <http://www.theaustralian.com.au/executive-living/food-drink/mining-has-become-threat-to-vineyards/story-fn845mx8-1226345055188> | #nswpol
#agchatoz #POLAW

We see that the user who placed the #nswpol tag next to the tweet about mining encroachment is consciously pushing that status message on to high circulation. This hashtag is a high volume Australian political hashtag where developments in State politics are raised²² (Bruns & Burgess 2012). The hashtag #agchatoz stands for Agricultural Chat Australia, a regular chat forum style hashtag used by farmers, and #polaw for Protect Our Land and Water, created by the NSW Farmers' Association and later adopted by 'Lock the Gate' alliance members as a slogan for their Land Use Policy campaign. Thus, an important method for politicization is to generate multiple audiences for articles and hyperlinks.

By deploying these hashtags for such diverse content as photos of drill rigs, videos of bubbling rivers, documents about drilling, as well as sites of protest and blockade, we see active politicisation and mainstreaming of CSG issues using the participatory features of Web 2.0. These participatory features are powerful because individuals

interpret their own relative position on the network in relation to influential nodes. This is a clear case where users are actively building network relationships to ‘audience’ their content and thereby cultivating publics around concerns about Coal Seam Gas.

Each different component of the network is well connected and overlaps. This stands in direct opposition to red-blue polarised US blogosphere maps created through Social Network Analysis (Adamic & Glance 2005). In our case, the use of network clustering algorithms does not produce a network that correlates with profession or political affiliation. A follow up interview with the central actor found that their motivation was to promote the ‘newsworthiness’ of the event. This produced a high centrality measure, but did not mean their ‘bridging and brokering’ role was related to their ambitions as a social movement actor, but rather intriguingly points to the embeddedness of twitter in journalistic practice and public engagement with issues. Therefore, high centrality measures do not necessarily correlate with bridging and brokering roles as some have argued (eg. Han 2009).

Our case study found that bridging and brokering were still important for self-identified social movement actors. Brokering information and curating audiences allow diverse social groups to mobilise against Coal Seam Gas issues. Gas shares many of the same technical features identified by Mitchell (2009) in his *Carbon Democracy* thesis: its extraction is governed by surface engineering, and its markets are not qualified in the same ways he suggests coal mining is (mined coal must be matched to use, gas is substitutable). However, ‘Lock the Gate’ has attempted to exploit the susceptibility of gas extraction that echoes Mitchell’s analysis of coal. By bridging diverse audiences and supporting blockades of exploration drilling, wider demands of energy regulators can be made and the economies of gas exploration have been disrupted in NSW²³. The point here is less whether the industry can be stopped, than how diverse participants can be brought to bear on the issues of its extraction and thereby provide new forms of scrutiny outside the incumbent government expert regulatory mechanisms.

From Scientific Citizenship to Networked Energy Citizenship

Onshore unconventional gas production has brought new collectives into politics that defy traditional left/right axes of current Parliamentary politics. These collectives have contested the knowledge claims of gas companies and their regulators. Using the case study of Coal Seam Gas in New South Wales, this article has introduced the concepts of ‘bridging and brokering’ as well as active ‘audiencing’ to theorise how new political movements have gained salience both online and offline around concerns about aquifer safety, fugitive emissions and land access. We have suggested that the redrawing of the demarcations of expert and non-expert in the overseeing of Coal Seam Gas indicates that a new kind of citizenship – a networked citizenship – has emerged to challenge Coal Seam Gas. This citizenship is networked because the audience for specific political demands are cultivated through online social networks as well as existing social networks of farmers and environmentalists.

The endurance of traditional protest forms such as marches on Parliament also suggests that research concerns of social movement studies about worthiness, unity, commitment and numbers of participants continue to be as relevant as ever. For example, the backing of high profile journalists in mainstream media – leading to committed coverage in Fairfax press – appears to have had a decisive influence on policy. Future comparisons with other sites of industry expansion such as Queensland (Mercer *et al* 2014) who do not achieve such backing could be a useful comparative

site of analysis to test our concept of networked citizenship. The idea that new social movement networks should be understood to be more material and less virtual does not mean a rejection of the key insights from Social Network Analysis²⁴. Information flowing across different groups and audiences is a general feature of contemporary politics, made more visible with new network analytical tools. How then, does the structure of energy systems and their opponents matter in the analysis we have presented? Concepts of brokerage and ‘audiencing’ are key features of contemporary social networks that are rendered visible through network visualisation tools such as those we have presented here. Yet the topological thinking about energy citizenship we implore requires consideration of both the material scale of the gas industry and its speculative capacities – that is, its ability to render land economically viable for gas production according to prevailing global gas market conditions. For these reasons, the network analysis we present should, therefore, not be confused with predictive models that are now gaining in popularity, as prediction overstates the links between the nodes in the network at the cost of illuminating the issues that bring those nodes into contact in the first instance.

Our concept of energy citizenship is therefore intended to convey why network brokers are powerful and how structures form around matters of concern such as drill rigs, measurements of methane emissions and other artefacts. Attending to the material character of gas exploration – especially its encroachment onto farmlands – and the use of social media devices such as hashtags to build alliances adds a new dimension to studies that focus on such abstractions as rights and monetary resources. Our research suggests that protests ‘audienced’ through online networks are not simply directed at ‘falsifying’ scientific findings but rather at cultivating publics, that is, creating communities that target and elucidate matters of concern. These matters include policy documents and other nominal ‘political’ objects but also encompass techno-scientific objects such as photographs of drill rigs, videos of bubbling rivers and other concerning developments. In these ways, networked citizenship is defined not just by the bridging of social networks, but the cultivation of audiences that focus on objects of gas exploration, production and extraction, and the conflicted science surrounding these.

The unexpected nature of these connections and threats also relates to an important political dimension of their use on twitter generally. Twitter’s timeline is not algorithmically filtered, unlike Facebook’s. Many noted that news of recent race riots in Ferguson, Missouri were absent from their Facebook newsfeeds, whilst prominent in their twitter feeds (Tufekci 2014). This results from certain key words such as ‘congratulations’ being valued more highly in the Facebook feed algorithm, whilst other terms – in this case, associated with concerns about race relations – assigned with lower value. As Tufekci states,

I have witnessed Twitter network’s ability to surface unexpected content again and again, from matters small to large. It’s true, Twitter can be rife with rumors, some false, especially at times of protests, disaster or other crises. But the speed with which the correct information is also surfaced is even more impressive and only possible because the network quickly surfaces it, with each node filtering news through judgment and experience (2014).

This filtration through judgement and experience is not reducible to science in the sense that judgements about the economic worth of the gas industry are also intrinsic to the decision to spread information. Indeed, protest movements in the Northern

Rivers of NSW have disputed the attempt by the industry to frame debate about the safety and suitability of gas production as conclusively resolvable by reference to science. The recent strategic decision to change their name from ‘CSG-free’ to ‘Gasfield-free’ incorporates the planning politics implied by wider contestation. For these reasons, traditional Enlightenment models of PUS poorly describe how these publics are mobilised because these models expect a continuum of knowledge from lay to expert.

Nevertheless, networked energy citizenship as we have characterised it, redraws this boundary by engaging with the overflows of energy production in novel ways that still render assessments by State scientific bodies useful. The recent review of the science of aquifer interference by the Chief Scientist of NSW in response to online and offline campaigning exemplifies this. Further research could examine how scientific findings are circulated online, both through endorsement and contestation. Our concepts of ‘audiencing’ and ‘bridging and brokering’ suggest such dissemination will not be a linear movement from science to society but rather be assessed by key, trusted individuals who will likely have institutional affiliations as do journalists or through political parties. The emerging dimensions of gas industry mobilisation we have documented suggest networked campaigning is now an important aspect of the redrawing of central principles of contemporary scientific citizenship; namely who is qualified to define energy futures and what constitutes adequate oversight of those energy technologies.

References

- Adamic, L. & Glance, N. (2005) 'The Political Blogosphere and the 2004 US Election: Divided They Blog', *Proceedings of the 3rd International Workshop on Link discovery*, ACM, 36-43.
- Beck, U. (1992) *Risk Society: Towards a new modernity*, Sage Publications, London.
- Bradshaw, M, *et al* (2012) *Australian Gas Resource Assessment*, Geoscience Australia, Canberra.
- Bruns, A. & Burgess, J. (2012). 'Researching news discussion on Twitter', *Journalism Studies*, vol. 13, no. 5 - 6, pp. 801-814
- Bruns, A., & Highfield, T. (2013). 'Political networks on twitter: tweeting the Queensland state election', *Information, Communication & Society*, vol. 16 no. 5, pp. 667-691.
- Bruns, A., & Stieglitz, S. (2012). 'Quantitative approaches to comparing communication patterns on Twitter', *Journal of Technology in Human Services*, vol. 30 no. 3-4, pp. 160-185.
- Burt, R.S. (2004), 'Structural holes and good ideas', *American Journal of Sociology*, vol. 110, no. 2, pp. 349-399.
- Cleary, P. (2012) *Mine-Field: The Dark Side of Australia's Resource Rush*, Black Incorporated, Melbourne.
- Rijke, K. (2013). The Agri-Gas Fields of Australia: Black Soil, Food, and Unconventional Gas. *Culture, Agriculture, Food and Environment*, 35(1), 41-53.
- Earl, J. (2010) 'The dynamics of protest-related diffusion on the web', *Information, Communication & Society*, vol. 13, no.2, pp. 209-225.
- Elam, M. & Bertilsson, M. (2003) 'Consuming, Engaging and Confronting Science The Emerging Dimensions of Scientific Citizenship'. *European Journal of Social Theory*, vol. 6, no. 2, pp. 233-251.
- Gamson, W. A., & Wolfsfeld, G. (1993) Movements and media as interacting systems. *The Annals of the American Academy of Political and Social Science*, 114-125.
- Giddens, A. (1998) Risk society: the context of British politics in *The Politics of Risk Society*, pp. 23-34.
- Gillian, K. (2009) The UK anti-war movement online. *Information, Communication & Society*, no. 12, pp. 25-43.
- Granovetter, M. (1983), 'The strength of weak ties: A network theory revisited', *Sociological Theory*, vol. 1, no. 1, pp. 201-233.
- Granovetter, M. (1973), 'The strength of weak ties', *The American Journal of Sociology*, vol. 78, no. 6, pp. 1360-1380.
- Han, S. K. (2009) 'The Other Ride of Paul Revere: The Brokerage Role in the Making of the American Revolution', *Mobilisation: An International Quarterly*, vol. 14, no. 2, pp.143-162.
- Hou, D., Luo, J., Al-Tabbaa. (2012) Shale gas can be a double-edged sword for climate change. *Nature Climate Change*, vol. 2, no. 6, pp.385-387
- Jasanoff, S. (2004a) Science and citizenship: a new synergy. *Science and Public*

- Policy*, vol. 31, no. 2, pp. 90-94.
- Jasanoff, S. (2004b) *The Idiom of Co-Production*. In Jasanoff, S. (Ed.) *States of Knowledge : The Co-Production of Science and Social Order*. Routledge, New York.
- Klare, M. T. (2013) "The Third Carbon Age." *The Nation*, 8 Aug.
- Latour, Bruno, *et al.* (2012) "'The whole is always smaller than its parts'—a digital test of Gabriel Tarde's monads." *The British Journal of Sociology*, vol. 63 no.4: 590-615.
- Latour, B. (2005). *Reassembling the social: An introduction to social life*. Oxford University Press, Oxford
- Mackenzie, D. (2009) *Material Markets*. Oxford University Press, Oxford
- Mahdavi, H. (1970) The patterns and problems of economic development in rentier states: The case of Iran. *Life*, no. 1000, p.1.
- Manning, P. (2012) *What the Frack?: Everything You Need to Know about Coal Seam Gas*, NewSouth Publishing, Sydney.
- Marres, N. (2007) The Issues Deserve More Credit Pragmatist Contributions to the Study of Public Involvement in Controversy. *Social Studies of Science*, 37(5), 759-780.
- Marres, N., & Rogers, R. (2008) Subsuming the ground: how local realities of the Fergana Valley, the Narmada Dams and the BTC pipeline are put to use on the Web. *Economy and Society*, 37(2), 251-281.
- Meister R., & Mitchell, T. (2012) Do We Have the Nerve to Know Finance as Class War? An exchange between Robert Meister and Timothy Mitchell edited by Peter Dimock. *Rethinking Capitalism* Issue 03. April.
- Mercer, A., de Rijke, K, and Dressler, W. (2014) Silence in the midst of the boom: coal seam gas, neoliberalizing discourse, and the future of regional Australia. *Journal of Political Ecology* vol 21, pp. 279-302
- Meyer, D. & Tarrow, S. (1998), A Movement Society: Contentious Politics for a New Century. In D. S. Meyer & Tarrow S. (Eds.) *The Social Movement Society: Contentious Politics for a New Century* (pp. 1–28), Rowman & Littlefield, Lanham, MD.
- Michael, M. (2002) Comprehension, apprehension, prehension: Heterogeneity and the public understanding of science. *Science, Technology & Human Values*, 27, 357-378.
- Mirowski, P. (2011) *Science-mart*, Harvard University Press, Harvard MA.
- Mische, A. (2003) 'Cross-talk in movements: Reconceiving the culture-network link' in *Social movements and networks: Relational approaches to collective action*, Oxford University Press, USA, pp. 258-80.
- Mische, A. (2011), Relational sociology, culture, and agency. In J. Scott, and P. J. Carrington, (Eds.) *The Sage Handbook of Social Network Analysis* (pp. 80-97), Sage Publications, London
- Mitchell, T. (2009) Carbon Democracy. *Economy and Society*, vol. 38, no.2, 399-432.
- Mitchell, T. (2013). *Carbon Democracy: Political power in the age of oil*. Verso. London.

- Moyn, S. (2010). *The Last Utopia*. Harvard University Press, Harvard, MA.
- Nowotny, H., Scott, P. & Gibbons, M. (2003) Mode 2 revisited: The new production of knowledge. *Minerva*, vol. 41, pp. 179-194.
- O’Kane, M. (2014) Coal Seam Gas Review: Final Report. *Office of the NSW Chief Scientist and Engineer*. <http://www.chiefscientist.nsw.gov.au/coal-seam-gas-review/final-report-september-2014> (Accessed 7 October, 2014)
- Paladino, S, Simonelli, J. "Hazards So Grave: Anthropology and Energy." *Culture, Agriculture, Food and Environment* 35.1 (2013): 1-3.
- Pilny, A. & Shumate, M. (2012) Hyperlinks as extensions of offline instrumental collective action. *Information, Communication & Society*, 15, 260-286.
- Poole, A., & Hudgins, A. (2014). “I care more about this place, because I fought for it”: exploring the political ecology of fracking in an ethnographic field school. *Journal of Environmental Studies and Sciences*, 4(1), 37-46
- Ryan, S. E., Hebdon, C., & Dafoe, J. (2014). Energy research and the contributions of the social sciences: A contemporary examination. *Energy Research & Social Science*. In Press.
- Santoro, M. (2008). ‘Framing Notes. An Introduction to "Catnets"’, *Sociologica*, 2
- Shapin, S. (1990) Science and the Public. *Companion to the History of Modern Science*, ed. RC Olby, GN Cantor, JRR Christie, and MJS Hodge, pp. 990-1007.
- Shellenberger, M., Jenkins, J., Nordhaus, T., Trembath, A. (2012) ‘Where the Shale Gas Revolution Came From: Government’s Role in the Development of Hydraulic Fracturing in Shale.’ *The Breakthrough Institute*, Washington D.C. <http://thebreakthrough.org/index.php/programs/energy-and-climate/where-the-shale-gas-revolution-came-from/> (viewed 1 December, 2012)
- Tufekci, Z. (2013). “Not This One” Social Movements, the Attention Economy, and Microcelebrity Networked Activism. *American Behavioral Scientist*, 57(7), 848-870.
- Tufekci, Z. (2014) ‘Why Twitter Should Not Algorithmically Curate the Timeline It’s the Human Judgment of the Flock, Not the Lone Bird, That Powers It’. *Medium* <https://medium.com/message/the-algorithm-giveth-but-it-also-taketh-b7efad92bc1f> (viewed 12 September, 2014)
- White, H.C., Boorman, S.A. & Breiger, R.L. (1976), ‘Social structure from multiple networks. I. Block-models of roles and positions’, *The American Journal of Sociology*, vol. 81 no. 4, pp. 730-780.
- Willow, A. (2014). The new politics of environmental degradation: un/expected landscapes of disempowerment and vulnerability. *Journal of Political Ecology*, 21, 237-257.
- Willow, A., Wylie, S. (2014) Politics, ecology, and the new anthropology of energy: exploring the emerging frontiers of hydraulic fracking. *Political Ecology*,
- Wylie, S., & Albright, L. (2014). WellWatch: reflections on designing digital media for multi-sited para-ethnography. *Journal of Political Ecology*, 21, 321.
- Wylie, S. A., Jalbert, K., Dosemagen, S., & Ratto, M. (2014). Institutions for civic technoscience: How critical making is transforming environmental research. *The Information Society*, 30(2), 116-126.

¹ The authors would like to thank Fleur Johns, Faye Bussau and two anonymous reviewers for their helpful comments. This research was funded by the New South Wales Department of Industry and Investment for the project *Managing Low Emissions Coal Technologies project risk: The role of public awareness*.

² See for example NY Times (2012) In a Nature Gas Glut, Big Winners and Losers <http://www.nytimes.com/2012/10/21/business/energy-environment/in-a-natural-gas-glut-big-winners-and-losers.html?pagewanted=all> (viewed 12 November, 2012).

³ This figure covers gas for both domestic and export use. Domestic use of natural gas for cooking and heating in the 2010-11 financial year was 148.8 PJ <http://www.bree.gov.au/publications/aes-2012.html> (viewed 27 November, 2012).

⁴ The main technological advances were made possible by technological innovations resulting from a sustained partnership between the gas industry and the American federal government. For example, Massive Hydraulic Fracturing, the technology responsible for large scale shale gas drilling in the United States, was first developed by industry in conjunction with the Department of Energy in 1977. Government support for unconventional gas dates back to Bureau of Mines' support for pulling natural gas from coal mines to reduce the risk of explosion in coal mines, resulting in the rise of coal-bed methane, a major source of natural gas. (Shellenberger et al, 2012)

⁵ For a succinct overview of recent issues with measurement of CSG emissions in Australia see Manning (2014) "Fugitive CSG emissions are no big deal, right? Wrong." Crikey, Private Media, Melbourne. 12 August 2014: <http://www.crikey.com.au/2014/08/12/fugitive-csg-emissions-are-no-big-deal-right-wrong/>

⁶ 'Flawed process claims spark rocky 24 hours for CSG', <http://www.abc.net.au/news/2013-04-02/gas-companies-respond-to-approval-process-allegations/4605044>; Rickson, K. (2012) "Coming apart at the seams? Social impact assessment and the coal seam gas controversy in Queensland, Australia http://www98.griffith.edu.au/dspace/bitstream/handle/10072/48904/82432_1.pdf?sequence=1 (viewed 2 June 2013).

⁷ Harrison White and colleagues like Charles Tilly, Ann Mische, Jeff Goodwin and Mustafa Emirbayer combined Erving Goffman's work on interactions in public spaces with theories about cultural framing processes that give rise to social movement organizations.

⁸ See for example the analysis of Social Movements' worthiness, unity, commitments and numbers in Tilly, Charles (1993) "Social movements as historically specific clusters of political performances." *Berkeley Journal of Sociology* 38 (1993): 1-30.

⁹ As Alex Reid suggests, Latour uses the term virtual in two very different ways. One is more critical and refers to the virtual as an ideal realm in a very different manner to Deleuze. The other is more interesting "objects have now

become things again: the disputed topic of a virtual assembly.” Such assembly requires "concatenations of mediators" with "actualized virtualities." We take Latour's opposition between virtual and material in the context in the first definition, whereby the material denotes the means to organize collective assembly. As Latour states, "it does not require much effort to see that a virtual and always present entity is exactly the opposite of that is needed for the collective to be assembled: if it's already there, the practical means to compose it are no longer traceable; if it's total, the practical means to totalized it are no longer visible; if it's virtual, the practical means to realize, visualize and collect it have disappeared from view... To put it even more bluntly: either there is society or there is sociology" (Latour, 2005:163)

¹⁰ Although predating the Web 2.0 era, other notable examples include gay activism in the United States from trials for the HIV drug AZT. Activists challenged the ways the technical knowledge of assessing the risk of HIV to the general populace were also moral judgements about who was entitled to accept risk. AIDS activists examined, challenged and altered the incumbent norms of timing, selection procedures and other scientific practices by engaging with the scientists who effectively neglected sufferers by pursuing “pure” science. See Epstein, Steven (1996). *Impure science: AIDS, activism, and the politics of knowledge*. University of California Press.

¹¹ Tasker, S.J. (2013) Coal Seam Gas empires fight back against their critics. The Australian 22 July, 2013.
<http://www.theaustralian.com.au/business/companies/coal-seam-gas-empires-fight-back-against-their-critics/story-fn91v9q3-1226682799003> (viewed 14 August 2013)

¹² See for example Tufekci, Z. (2012) New media and the People Powered Uprisings. *Technology Review*
<http://www.technologyreview.com/view/425280/new-media-and-the-people-powered-uprisings/?p1=A3> (viewed 1 December, 2012)¹³ For an explanation of the resource classification system used in Australia see Appendix C in Bradshaw, M, *et al* (2012) *Australian Gas Resource Assessment*, Geoscience Australia, Canberra.¹⁴ The latest EIA medium term assessment predicts moderate global growth in coal demand over the coming five years
<http://www.iea.org/publications/medium-termreports/> (viewed 29 August 2014)

¹⁵ For example Ryan *et al*'s (2014) review of social scientific contributions to energy research uses the term ‘citizen’ to cover contingent valuation preferences in economic studies; the global population as a whole (“aggregated actions of billions of citizens”); owners of cooperative enterprises; protestors of energy systems following disasters.

¹⁶ OED <http://www.oed.com/view/Entry/33521#eid9255453> (viewed 16 Sept 2014)

¹⁷ See <http://www.lockthegate.org.au/about> (viewed 10 Sept 2013)

¹⁸ In his study of the exchange of information regarding job vacancies among acquaintances, Granovetter (1973) postulated that time commitments, similarity

and cognitive balance requires that if A and B are friends and C is a friend of B, then there is bound to be a tie between A and C. The strength of this ‘weak tie’ depends on the strength of the tie between A and B. From this empirical standpoint he suggests that the stronger the tie between A and B, the larger the proportion of individuals who have a relationship with either or both of them, to be tied to ‘both of them by a weak or strong tie. This overlap in their friendship circles is predicted to be least when their tie is absent, most when it is strong, and intermediate when it is weak.’

¹⁹ Previous social movement research confirms the critical role of brokers and even argues that leadership and influence can be understood as a function of network position and the capacity to bridge otherwise disjointed clusters. In a study of alliance and collaboration patterns, Diani demonstrates that removing a few key nodes in a network of NGOs in the Italian environmental movement (in the mid-1980s) would have destroyed the possibility for communication and coordination between subgroups rendering the movement incohesive and ineffectual. See Diani, M. (2003). *Leaders or Brokers? Positions and Influence in Social Movement Networks*” in *Social Movements and Networks. Relational Approaches to Collective Action* ed. Mario Diani and Doug McAdam.

²⁰ Micro-celebrity refers to “... politically motivated non-institutional actors who use affordances of social media to engage in presentation of their political and personal selves to garner public attention to their cause, usually through a combination of testimony, advocacy, and citizen journalism. The phrase should thus be understood on conceptual grounds rather than as either a judgment or an evaluation of worthiness or of privilege—which, in any case, is expressed through the privilege of attention and status whereas the activist himself or herself often remains in considerable danger from repression.” (Tufekci, 2013:850)

²¹ In Figure 4, the node sizes in the graph depend on a network measure for influence called ‘betweenness centrality’ which is an indicator of not of how many followers one has but of one’s relational position within the network as affecting access to and brokering of information between two or more otherwise unconnected clusters. It is a measure of how many of the shortest paths between two others an actor lies on. The nodes have been carefully and systematically coded according to attributes based on self-published, public profile information.

²² While accurate figures for hashtags are hard to ascertain, Bruns and Highfield (2013) estimate that the #auspol hashtag community (a similar but more popular umbrella hashtag for the general discussion of domestic political issues) averaged over 5000 tweets per day and over one million tweets in the first half of 2012. Therefore, the many users who appended #auspol to their tweets about CSG, strategically made their content available to a pool of around 26,290 politically engaged and highly active unique users (figures from a sample gathered over 8 Feb. to 8 Dec. 2011 – Bruns and Stieglitz 2012).

²³ In response to the protests at Parliament House described above, the New South Wales Government commissioned the Chief Scientist to review CSG activities in NSW, see <http://www.chiefscientist.nsw.gov.au/coal-seam-gas-review> with the final report published in September 2014. The Land and Water Commissioner was

also created <http://www.trade.nsw.gov.au/lw-commissioner> (viewed 10 Oct 2013) to 'Provide guidance to landholders and the community in relation to applications for mineral and petroleum (including coal seam gas) exploration licences throughout the state; Oversee land access agreements; and Provide advice to government on applications for exploration or production activities.' The creation of the Office of Coal Seam Gas represents the culmination of these protests, with an information portal on groundwater monitoring and other scientific projects aimed at reassuring the community about the safety of the industry: <http://www.resourcesandenergy.nsw.gov.au/landholders-and-community/coal-seam-gas> (viewed 21 Sept, 2014)

²⁴ In this sense, we are inspired by Mackenzie's (2009) concept of Material Sociology, which sought to add, rather than compete with Economic Sociology by adding new concepts of agency to the field that enhance reflexive understanding how theories can 'perform' their objects.