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Universities in contentious energy debates—Science, democracy and coal seam gas in Australia

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ABSTRACT

Engaging with Australia's nascent coal seam gas (CSG) industry reveals complex responsibilities and risks faced by contemporary universities. The relationship between science and society is shifting including universities' relationships to private interests, technology and conceptualisations of knowledge as a 'public good' [28]. Understanding the material, political and economic forces that enable, shape or constrain knowledge is central to understanding contentious policy disputes. A more nuanced understanding of the economic and social conditions in which scientific knowledge is produced and absorbed, and a more careful examination of the institutional actors involved is sought [41,43,76,77]. Toward that end, this article explores the dynamics of a university-industry partnership established in the contentious research and policy arena of CSG. It draws upon the authors' experiences as participant-observers in an industry-funded research centre. These experiences have helped to characterise contradictions inherent in the demands on modern universities—private funding of research within public institutions, industry-driven research agendas, problem-solving with competing disciplinary epistemologies, and safeguarding the public interest as it relates to creation of knowledge to inform public policy decision-making. Such debates are of increasing importance as research can stimulate, or inhibit, major technological transitions in the energy arena.

1. Introduction

Science and expertise are increasingly asked to adjudicate in a growing range of environmental challenges from climate change or industrial accidents to ecosystem collapse, as governments around the world attempt to manage the delicate balance of economic growth alongside environmental protection. We are told that many of these complex challenges cannot be solved by government actors alone, instead partnerships, increasingly with private actors, will bring about solutions and action [16]. This paper investigates one such form of partnership between a university and its industry partners. In doing so we identify a number of opportunities and challenges arising in relation to the governance of science and research, the day-to-day functioning of such partnerships and their relationship to democratic representation in a contentious energy debates. One such case is in the arena that we examine—an industry-funded university research partnership focussed on one form of hydrocarbon from unconventional reservoirs, coal seam gas (CSG), and its impacts in Queensland, Australia.

The development of unconventional hydrocarbon resources around the world has generated considerable debate as communities and governments weigh up the regional socio-economic and broader environmental benefits versus the local and global socio-environmental risks posed by its extraction. Central to such debates has been the call for scientific evidence to underpin governments' policy-making and regulation. In Australia, a number of organisations responsible for the synthesis and production of scientific research and knowledge have formed to address environmental, social and technical issues relating to CSG over the past six years. The Centre for Coal Seam Gas at the University of Queensland is one such organisation.

On 7th December 2011, the then Premier of Queensland, Anna Bligh, launched a $20-million (AUD) partnership bringing together industry, government and researchers to address the knowledge needs relating to a growing CSG industry in the state. Housed at the

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University of Queensland (UQ) in its Sustainable Minerals Institute (SMI), the partnership would operate for five years as the Centre for Coal Seam Gas (UQ-CCSG). Quoted in the press release, Professor Chris Moran (then Interim Director of the Centre) said, "*the centre provided an ideal opportunity for industry, UQ and Government to work in partnership to identify and develop education and research projects which will add further value to the technical and practical operations of the CSG industry*" [39]. The launch of the Centre was welcomed by those in industry and government who sought further scientific expertise in the face of uncertainty in regard to aspects of the resource development—where to find the most gas, how to get the most out, how to limit impacts on groundwater, and how to benefit local communities. However, some media and public attention focused on the Centre's funding model and governance arrangements. These material and political conditions in which scientific knowledge is produced can be, as scholars of scientific controversies and contentious policy debates know, key sites of political debate and struggle [7,92,42,77].

This case surfaces challenges about the constellation of research questions that university investigators can gain funding – particularly industry funding – to address, the intricate dance needed to service potentially conflicting needs of government, industry and an academic's own career, and how to engage with community concerns about the social and environmental impacts of CSG. The intensification of global demand for energy and resources produces a range of environmental impacts, which science is called upon to understand so as to enable mitigation. Increasingly scholars are calling for greater reflection on the relationship between science, innovation and unsustainable industrial growth [78]. Scholars writing about late-modernity describe science, technology and innovation as key drivers of global economic growth and social change [30]. Recent writing focusses on the role of science actors in taking greater responsibility for the impacts and implications of scientific research and innovation on societies and the environment [34]. This includes the role of science and science actors including universities in bringing about sustainable futures by design, not only as mitigation strategies for continued development. Reflexive science, socially robust knowledge, responsible innovation and knowledge governance are all new areas of scholarship which seek to problematize the relationship between science and innovation and question its role in relationship to the use of finite resources and the economic paradigm of never ending industrial growth.

Contentious policy debates surrounding the extraction and development of unconventional hydrocarbon reservoirs, in particular, are by their nature political. Contentious Politics [101] defines contention as "making claims that bear on someone else's interests" (Ref. in [99]). Consequently, a key feature of such contentious debates, whereby there are a number of competing claims, is the central role that expertise and knowledge organisations, including universities, play in underpinning the legitimacy, integrity and trust in the claims of science [43,42,88,63,93]. The need to investigate the workings of institutions that produce science is receiving growing attention, particularly in light of climate debates and human health. Fuller argues, "there is an urgent need to understand the place of science in the social democratic order" (in Ref. [41]:708). The interplay of science, institutions and democracy within Australian CSG debates has become the subject of scholarly interest, but the part that UIPs play in creating the knowledge to fuel the debates has thus far been overlooked.

The role of science in relation to various aspects of CSG is employed as legitimating discourse by exponents on all sides of the debate, a process that reveals the play of power and politics. Such struggles over science are typified by a mobilisation of actors outside traditional institutional forms seeking to participate in decision-making in relation to the issue. These actors would include environmental groups and civil society organisations. Such institutional and extra-institutional engagement, what Beck refers to as 'sub-politics', make science a key site of struggle in democratic processes. As Lau states, "conflicts essentially break out at the level of knowledge around problems of definition and causal relationships. Primary resources in this struggle over risk justice are not immediately strikes, voting figures, political influence, but above all information, scientific findings, assessments, arguments" (Lau, 1991 in Ref. [8], 29). The public debates about the perceived trustworthiness and independence of research into greenhouse gas emissions from CSG in 2011, enveloped Federal and State minsters, scientists and various other actors. The research undertaken by a consultancy company Worley Parsons—a key engineering contractor was seen to be providing the basis for Queensland government policy decision-making, as the government had not commissioned their own research on the subject. Both the integrity of the research process and how the findings were used in the political process was called into question by environmental groups [68,91].

The increasing role of expertise in political life and decision-making, manifested in the rise of evidence-based policy-making and scientific advice, has also increased the visibility of the institutions that produce science, notably the university [45]. A recent UNESCO report highlights a notable shift in the institutions producing knowledge for decision-making. According to a recent state of science assessment in Australia, the university system has become the main focus and provider of government-funded research, overtaking in-house government departments. Over 70% of the value of public sector research in Australia is now performed by universities [83]. A focus on the institutions that produce science (of which universities are the pre-eminent example) along with the economic and political currents in which they are situated is called for by Sheila Jasanoff, Helga Nowotny and Brian Wynne [94,44,55], amongst others, in a special issue of *Public Understanding of Science* (2014). They request greater examination of how science is articulated and shaped through a political economy of project funding choices, national and sub-national science and innovation policies, legislation, and organisational governance, processes and accountabilities.

In response to this call, our article points to where University Industry Partnerships (UIP's), such as the UQ-CCSG, function not only within the context of contemporary Australian energy policy but also within the context of Australian innovation and science policy and a regime of shifting funding sources. We argue that such structural changes are germane to how universities – and related organisations – now must manage greater public and stakeholder awareness and interest in the production of knowledge. Australian government policies reflect the view that both science and innovation are key drivers of productivity and economic growth and are oriented to build growing numbers of university-industry partnerships and collaborations [83]. Such policy settings over consecutive decades have witnessed increasing exposure of universities to market dynamics and private sources of funding. It is clear that industry partnerships are an increasingly important component of university funding, collaboration and bring employment opportunities for researchers. How each university engages with these changes is unique, as universities are unique and complex entities with organisational goals to be attained and have defined roles—as a social actor, institution, and location for interactions among various parties [66].

In our case at the University of Queensland, CCSG's governance seems to reflect a predominant 'vision' or 'epistemology' underpinning how the research gets pursued in this UIP. Those who have different points of view appear to be marginal—not being around the table in the Centre's governing committees. While not necessarily a problem nor relevant for research that functions as industry consultancy, such governance can become problematic when research aims to inform public policy in a general or par-

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ticular sense on a contentious issue garnering high levels of public and political attention. A dominance by private parties can, in some cases, confound or at least make problematic the university's mission as performing for the 'public good', or at least pursuing a particular version on the 'public good'. Within CCSG, some would argue that a general public interest is not represented—except by government observers, who do not have votes on the governing committees. A question then is, which government departments are represented, and what are their aims—further resource development and more jobs or more affordable housing? It is important to note that environmental concerns are represented by government departments on CCSG committees. So, the case here is not black and white, but one of a delicate balance between sponsor investment and the voice accorded to those who pay the piper and how to incorporate in a practical way more marginal or excluded ones for the insight that they can bring, the concerns that they raise and the legitimacy that a broad constituency can bring. That is, how does one democratize such spaces, which seek to inform public policy, and ensure that they meet the norms expected of public entities, including transparency and accountability? While we believe that university industry partnerships are a vital part of the research ecosystem and that CCSG is a welcome source of science and research in a complex environment, the case of CSG highlights the ongoing tensions which exist between science, expertise and democracy. Our general concern is normative, about what a university should do, and our investigation explores practicalities and road blocks to achieving that ideal in a particular case.

In the document our headings include; 1. Introduction, 2. Methodology, 3.The changing university, 4. Coal seam gas in Queensland: questions of science, 5. Establishing the UQ-CCSG 6. Governance of UIP's, 7. Discussion and 8. Conclusion. We begin our argument by identifying the policy dynamics relating to science and innovation that influence what we term 'the changing university'. We describe the shift from an "ivory tower" to a social institution with multiple responsibilities, not only for increasing knowledge and increasing human capital but facilitating responses to grand social challenges and driving economic progress. This work augments the continuing examination of the 'changing university' in higher education, regional economics and innovation studies. Secondly, we introduce the context of CSG debates within Australia and the role of science and private actors within this debate. Whilst there are many incentives for private actors to fund science, the purposes and value assigned to UIPs by companies are not necessarily aligned with each other, or with other organisations participating in, or impacted by the research conducted. In the third section of the article, we turn to the case study of the Centre for Coal Seam Gas at UQ to highlight some of the challenges that arise in relation to UIPs in a contentious policy arena, such as ensuring the credibility and salience of research. While the content of the research can be agreed by the various stakeholders to be important, challenges can arise in assuring that findings are presented to the appropriate government and political representatives in a form and within a timeframe that is palatable to the policy making cycle. The fourth section of our paper, situates the UQ-CCSG within a broader literature that discusses the governance of university-industry partnerships. That is, how is it reflective of general trends, and how does it reveal new questions? We conclude with reference to current debates and suggest a future research agenda for social science. We argue that closer investigation of how industry-funded research programs are governed and positioned within public debates will illuminate how governments, university and industry are shaping energy futures. We call attention to significant questions around who is participating in decision-making.

This argument is drawn from the conceptual frameworks of Science, Technology and Society (STS) and more recent discussions within innovation literature, which highlight changing relationship between science and society [79,31,36]. The response to the changing terrain of knowledge production, science, and its politics needs to be an institutional one. Social scientists, the chief critics and, in some ways, contributors to the conceptual architecture of social institutions, have work to do in revealing potentially problematic institutional dynamics and driving change within their own academic context.

2. Methodology—participant observation/case study

This article sets out the initial observations made by the authors during their involvement as participant-observers in the UQ-CCSG and as researchers attached to a project funded by the Centre. In mid-2013, the UQ-CCSG funded a research report benchmarking best practice in research integrity and governance for UIPs for internal distribution. As reported in the minutes of a community engagement meeting facilitated by one of the UQ-CCSG member firms, "One of the first research proposals the UQ-CCSG proposed was around research governance to ensure there was no bias in the research undertaken even though it was funded by the CSG proponents."[1] The project provided two top-up scholarships for PhD students to undertake research projects relating not only to research integrity, but more broadly to research actors within the CSG policy arena from the perspective of innovation studies and STS. One activity was to present and gather materials at the 3rd World Research Integrity Conference held in Montreal in May 2013, which one of the authors attended [76]. Subsequently, the Montreal Statement on Research Integrity was endorsed by the CCSG.[2]

One of the starting points for this article was the authors' shared concern that although there was significant policy literature about UIPs, the relevant scholarly literature was scattered through various disciplines. The literature was most frequently normative and focussed on project management of UIPs within different contexts and did not clarify the various roles of the other parties involved including government and non-government organisations. That is problematic because UIPs – partnerships between private and public interests – can contribute to policy-making processes with objectives in the energy, business and higher education and innovation areas. Nader notes that all science and research has social and political implications, yet the politics of science, such as struggles over funding, design of research questions and links to national and international hierarchies of power and commerce, often remain undocumented ([100]: 9). Engaging in studies of UIPs begins to address this gap in our empirical knowledge.

In our case, the expansion of the CSG development in Queensland coincided with a series of higher education reforms (EIA, 2012). Understanding the launch of the UQ-CCSG as a result of broader organizational and societal forces presents an opportunity to explore the role and expectations of a UIP with respect to a contentious scientific and policy field [95]. By focusing at the scale of the university-industry research centre, the authors seek to reflect Webster's view of science. That is, that meso-level organisations play a significant role as the intermediary between science and society, providing opportunities for public participation in science decision-making and offering research legitimacy grounded in social and organisational norms [89]. In this case, the UQ-CCSG is a legally binding joint venture that for most purposes operates within the UQ policy and procedures framework. With goals and reporting structures that do not completely align with the historically

[1] Minutes of meeting are available at Arrow Surat Community Reference Group https://www.arrowenergy.com.au/...data/assets/pdf_file/0018/16218/20150305-ERTM-MIN-ASCRG-Minutes-26-Feb-Final.pdf.

[2] A copy of the Statement is available from http://www.researchintegrity.org/Statements/Montreal%20Statement%20English.pdf.

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embedded faculties and schools structure, the work practices in university-industry partnerships may be outside the institutional norms, for example, no teaching, more interaction with the media and "decision-gates" and requirements for ongoing reporting to industry-funders built into research programs.

While the research projects of the authors have offered a rich diversity of data, our focus in the limited space of this paper is on the events surrounding the *establishment* of the CCSG. It is here that the entanglement of diverse actors revealed a number of perspectives, expectations and concerns regarding the UIP; the competing values, divergent epistemologies, political agendas and interests associated with CSG development; and the dynamics between different actors and stakeholders. These actors have included the media, environmental advocates, farming groups, scientists, industry partners, policy-makers, administrators and members of various sectors of 'the public'. We have attempted to capture some of the events and public debates through media reports and records of internal meetings made available in the public domain.

3. The changing university

Contemporary universities are complex social institutions. They are involved not only in higher education activities but in other academic, developmental and social activities. Terms such as the "megauniversity" [24] and "multiversity" [469], 5th ed. emerged in the 1960s to define the broad array of social responsibilities that lie beyond the traditional teaching and research nexus. Like governments around the world, Australia's three levels of government shape the nature and functions of universities through a variety of direct and indirect policy levers. With an objective of safeguarding Australia's competitive advantage, Australian government policies have shifted universities from being focused on education to improve national human capital, to a key economic actor in improving the productivity and efficiency of the Australian economy through innovation and regional development [23,26].

Many factors explain why universities are changing and have become central to national public policy discussions. The transformation cannot be attributed to the national and subnational policy frameworks in which universities operate alone. It must be situated within broader institutional responses to neo-liberal economic reforms. That includes a search for additional resources from industry as government funding levelled off, or in some cases declined, and the swelling of entrepreneurial ranks within universities seeking to commercialise their research discoveries. The pursuit of knowledge for its own sake has been gradually displaced by the logic of the market in recent decades, Popp Berman argues [96]. Nowhere is the link between knowledge production and commerce more pronounced than in the contemporary university [52,10]. Here, we refer not merely to the commercial sector, such as the oil and gas industry, funding research but to the larger role of market forces and market rationale in universities.

Neo-liberal reforms in the higher education sector, as in the public service more generally, have been implemented through a number of measures. These measures include: cuts to government funding of universities coupled with drives to find what are termed "efficiency gains"; a higher intake of non-traditional students as 'paying customers' often referred to as the massification of education; and a diversification of vocational degrees [75,80]. In the past decade, the use of metrics and standards by governments for research, teaching and managerial efficiencies has become an intrinsic part of the academic landscape. The larger workforces and student bodies, expansion of sites and campuses, including some established overseas, and new forms of income have been accompanied by an "audit culture" increasing its reach in universities [12,47]. Scholars have suggested that the change in universities can partially be explained by corporatisation [64], managerialism [69], entrepreneurism [17], commercialisation [21], deregulation of higher education markets [61], and other measures to embrace neoliberal global market forces.

It is now economic orthodoxy to link national economic growth, national interest and the expansion of the "knowledge economy" to high degrees of innovation, technology, translational science, and knowledge transfer [59]. For that reason, national governments seek to drive the expansion of university-industry partnerships through a number of direct and indirect policy measures. Historically, some countries saw emergence of a single university or systems of higher education institutions with the explicit objective of collaborating with industry for teaching and research. Examples include Land Grant Universities in the US, the *Fachhochschulen* or Universities of Applied Sciences in Germany, Switzerland and Austria, and the Australian Technology Network of Universities in Australia. While some universities and industries have always had a close association, the contemporary university as a place of knowledge and technology transfer – with spin-outs, spin-offs, start-ups, incubators, patents, and other forms of "research commercialisation" – has more recent origins.

Data covering 2004–2014 from the Australian Bureau of Statistics (ABS) shows an increase in spending by both the business and higher education sectors (universities themselves) on research and development (R&D) [38]. This rise correlates with data showing an increase in applied and experimental research both within and outside universities [38]. Such data demonstrates that the Australian innovation environment is dominated by applied and experimental R&D, and expenditure is driven by business and higher education. Research, as Nowotny et al. [56] argue, is increasingly being created 'in the context of application'. The characterization of this knowledge is its growing entanglement and application with/for society, in particular its relationship to industry, markets and the economy [56]. It is the 'applied' nature of research, following Latour, that fuels controversy and uncertainty, they argue.

In the context of CSG development in Australia, industry spending on R&D or, in ABS terms, 'business resources devoted to research and experimental development' provides a telling story. Investment in R&D by the Oil and Gas sector rose quickly from $356 million in 2005–2006 to a peak in 2009–2010 of over $1.2 billion [5]. The investment by companies in R&D has been recognised as addressing a number of business concerns. Of course, greater investment in innovation and research may yield gains in costs, production and other efficiencies, for example, it may solve technical challenges, such as how to manage waste and by-products like saline water emerging from CSG wells. In addition to technical applications for some companies, investment in science and research institutions is linked in some part to a 'social licence to operate' and implementation of 'local procurement plans'. The final Queensland Curtis Liquefied Natural Gas Project (QGLNG) Social Impact Management Plan (SIMP) Report 'New Neighbours' was produced by Queensland Gas Company (QGC) in 2015, as required by the conditions of the operators' petroleum licence. The report stated that QCG provided AUD$12million of research monies to UQ and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) between 2010 and 2016, which was to contribute to "national and international knowledge of the coal seam gas industry, the effective design of major infrastructure projects and community understanding of the implications of new industrial development within rural and regional locations." It was reported that the operator had fulfilled the conditions linked to the project approval by the government in 2008, including a commitment to fund an initial research project at UQ to define meaningful indicators to measure QGC's community contribution [67]. The objectives for funding the research, how resources were managed internally

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and the ways in which research findings are absorbed back in the company sit outside the common characterisation of research and development (R&D) being raison d'être of university-industry partnerships.

4. Coal seam gas in Queensland: questions of science

Queensland is a resource rich state in the north of Australia's eastern seaboard. This abundance of natural resources, which dominate the state's economy, along with tourism, include 92% of Australia's known reserves of the unconventional hydrocarbon—known locally as Coal Seam Gas (CSG) [13]. CSG is referred to in other national contexts as coalbed methane (CBM) [13]. The transformation of CSG from a potential safety hazard associated with shallow coal mines to a viable energy commodity reflects several global trends. Notably, there is an increasing global demand for energy at a low cost mostly in the form of abundant fossil fuels. CSG benefits from being a form of natural gas, which is increasingly being transported to global markets as liquefied natural gas (LNG). Growing demand and accompanying price increases, innovation is stimulated and new extractive and transportation technologies are developed. From the late 1990s to the mid-2000s, CSG in Australia was under consideration by international and domestic firms as an exploitable resource because of commercial viability within the context of a domestic market. However, from the mid-2000s a range of factors fell into place, including the advent of rising global LNG prices and new extraction and transportation technologies were implemented which enabled the CSG industry to attract AUD$60 billion in investment. Those funds came largely from foreign companies, with CSG being framed as a potential export industry [82,48,49].

In the midst of the Global Financial Crisis (GFC) in 2008, the Queensland government announced the development of an AUD $8billion project with the Queensland Gas Company (QGC) and the British Gas Group (BG Group) to develop a gas pipeline from southern Queensland to Gladstone on the state's central coast [74]. The key frame for promoting this development was the unprecedented opportunity it presented for economic growth, jobs and development. On the 17th September 2009, the Queensland government, led by then Premier Anna Bligh, released its first Blueprint for Queensland's LNG Industry [32]. The Blueprint outlined the government's support for the industry and the eight proposed CSG-to-LNG projects. It also set out a number of key policy initiatives to manage the industry. The Blueprint would lay the groundwork for what was to become a rapid transformation of the state's resources sector and economic fortunes. Some two years later, on the 25th March 2010, Queensland government hansard reflects Anna Bligh's speech to parliament on the day after the BG Group signed a deal with the China National Offshore Oil Corporation to export 72 million tonnes of coal seam liquefied natural gas from Queenslands Surat Basin over the next 20 years. Bligh stated in her speech that,

> *"At 5pm yesterday, history was made — history for this state's workforce, history for this state's economy and its regions, history for our resources sector, and history for Queensland's significant role as a global player in the evolution of a brand-new and exciting energy industry. . . . That is history in the making and, as one commentator described this morning, it represents a seismic shift in the Queensland economy."* Premier Anna Bligh 25 March 2010 [65].

The aftershocks from this 'seismic shift' are still being felt six years later as the industry moves from its construction phase to production and 'first gas' exports. The period since the Premier 'signed the deal' and announced the development of the CSG industry in Queensland has been tumultuous, witnessing unprecedented amounts of investment in parts of the state (the development has been touted as one of the largest infrastructure projects in the Southern Hemisphere), alongside rapid social change and concerns over impacts on treasured groundwater resources in this highly agricultural area.

In the early days of the industry, the general concern from a range of stakeholders and community groups was in regard to uncertainty and a lack of scientific evidence on local conditions – e.g., groundwater levels and water quality – to employ as a basis for decision making [18]. The CSG political debate was typified by competing knowledge claims. Environmental activists and some farmers claimed that the extraction of CSG impacted upon their on-farm water sources and farming productivity [26]. Environmental groups, such as the Knitting Nannas[3] and Lock the Gate,[4] claim that the extraction of CSG causes harm to the environment and human health. Counter to these claims, the Queensland government commissioned research that found no evidence consistent with direct impacts to human health [27]. However, others have found there was insufficient evidence to rule out adverse health outcomes [90]. In addition, the Chief Scientist of the neighbouring state of New South Wales reported that, with care and best practice, environmental risks posed by CSG extraction are manageable ([26], July 2013). This view was also supported by a communiqué from the Academy of Technology Science and Engineering (ATSE) in December 2015 [2].

Stakeholders, including government departments, community groups, and farming representatives, agreed that more science and evidence regarding the potential risks of CSG were needed. Such knowledge would support rapid change and learning in the CSG policy arena as a series of State governments (from different political parties) sought to craft regulation and legislation in the face of the potential for further, rapid expansion of the industry, beyond completion of the large Queensland projects. Indeed, the requirement of science to underpin regulation was highlighted in the International Energy Agency's [40] report, *Golden Rules for a Golden Age of Gas*. The report notes, "Governments need to devise appropriate regulatory regimes, **based on sound science and high-quality data**, with sufficient compliance staff and guaranteed public access to information" [42], 9. (emphasis added).

In the context of CSG in Australia, all stakeholder groups seem to have agreed there was a need for science and evidence to underpin decision-making, inform the community and guide practice. This agreement was accompanied with concerns about the qualities needed for such information and for the science behind it. It had to be credible, independent, trusted and transparent. This sentiment was endorsed three years after the IEA report by the (ATSE) who stated,

> *It is important that **credible, impartial and trusted sources of knowledge** and expertise communicate scientific, technical and socio-economic facts, models, anticipated outcomes and uncertainties in a clear, transparent and readily accessible way to communities likely to be impacted by unconventional gas developments, and to do so within the context of community values.* (ATSE Communiqué December 2015 [2]).

Yet, as previous examples of contentious environmental debates show us, 'science' and 'evidence' can often become politicized [37,72,62].

[3] For more information about the Knitting Nannas see http://www.knittingnannas.com/.
[4] For more information about Lock the Gate see http://www.lockthegate.org.au/.

5. Establishing the UQ-CCSG: science and democracy

A number of leading water scientists in Australia were recorded in the media as stating that more research relating to CSG and water impacts was "urgently needed" [58]. Speaking on these knowledge gaps in 2011, Professor Craig Simmons from the Flinders University stated, "*We are not in a position to really put our hands on our hearts and say we know with absolute certainty what the impacts are both in local terms and cumulative terms for this industry*" [58]. The water scientists quoted came from a number of leading universities, including UQ, and all called for further investment in research. Professor Simmons noted, the "problem is that most of the data and analysis to date has been done by the companies themselves, and (it) is not independently verified by peer-reviewed science." He added, "*I think that there is a real issue around the transparency of the research*". To be clear, Simmons was speaking about data and research conducted by companies themselves in the early stages of the industry in Australia, such as that prepared for environmental impact statements. In the same story, UQ's Professor Chris Moran notes that companies cannot be held to blame for undertaking their own research, "*This is their investment. The question is: where is the Government's investment, and where has the Government's investment been?*" [58].

The industry members, encouraged by government to invest in local science and research, adopted a 'whole of industry approach' by coming together in partnership to fund Queensland-based knowledge providers, such as UQ [70]. The UQ-CCSG, consistent with the Australian government innovation policy, follows the Australian government's long running Collaborative Research Centre (CRC) model. It is a collaborative research model between universities and industry in the form of a joint venture. The UQ-CCSG was funded by industry members, who each contributed a minimum of $500,000 per year for 5 years. These funds entitled them to a seat on the Strategic Advisory Board (SAB), the centre's key decision-making and governance body. Government agencies were also invited to join the SAB, but as non-paying members, they did not secure voting rights. The founding members of the Centre included Arrow Energy contributing $500,000 pa, Santos ($500,000 pa), QGC ($2 million pa) and UQ ($1 million pa). The UQ-CCSG included most of the key players in the CSG arena in Queensland, with the exception of one joint venture—Australia Pacific LNG (APLNG).

APLNG took a different route and contributed $2 million p.a. for five years to CSIRO through a research alliance known as, the Gas Industry Social and Environmental Research Alliance (GISERA). However, APLNG in 2014 also joined UQ-CCSG, contributing $500,000 p.a. and gaining a seat on the SAB. While the membership was notionally open to other interested parties, the minimum membership cost of $500,000 could be seen to be prohibitive. Government representatives were present, but their participation was did not come with a vote on projects; rather, they represented their department's position, shared knowledge, and provided opportunities for further collaboration. The lack of a vote reflected that neither the State nor Federal government elected to provide collaborative funds to the Centre.

The Strategic Advisory Group (SAB) as a key governance mechanism would identify research "priorities, determine activities that will be resourced, and monitor and communicate all outcomes" [39]. Professor Moran, as Director of the SMI and interim Director of the UQ-CCSG, highlighted the importance of working with the industry. He stated, "*We have always worked closely with industry, and the CCSG will be no exception. . . . We greatly value the input of leading companies for the simple reason that they understand the challenges and are the ones working to address them.*" [39]. The UQ-CCSG has two other key advisory groups. One is the Development Advisory Board (DAB), which is an interface with UQ and "focuses on the coordination of UQ capability in CSG related research and education, and ensures there is a broad range of input into the formulation of CCSG's research portfolio and education program" [15]. The DAB is dominated by the UQ Professoriate, but it also includes Mr John Cotter, the Chairman of the GasFields Commission Queensland (a governmental body), offering broad oversight. The other forum is the technical advisory group (TAG), whose industry and government members evaluate the quality, value, and relevance of research proposals and preview research findings.

The SAB, as already mentioned, is the key mechanism for allocating funding resources, endorsing research projects and managing the interests of the Centre's key stakeholders. The SAB is chaired by a nominee of the UQ's Vice-Chancellor. The key members of the SAB are listed on the centre website and include: senior representatives from companies (4 individuals); and Professors representing the four research streams of the Centre Geoscience, Water, Petrochemical Engineering and Social Performance. The Australia oil and gas industry's peak body, the Australia Petroleum Production & Exploration Association (APPEA), has a representative, who is also a GasFields Commissioner. There are also representatives from the Queensland government's Department of Natural Resources and Mines, Office of Groundwater Impact Assessment, Department of Science, Information Technology, Innovation and the Arts, and Department of Environment and Heritage Protection.

The importance and impact of the UQ-CCSG as a forum for pursing the industries' objectives and meeting the government's regulatory responsibilities can be illustrated in a variety of ways. For example, QGC sought approval from the regulator – the Queensland Government's Coordinator General – to have their membership of the UQ-CCSG and GISERA be deemed sufficient to partially fulfil one of the conditions for their licence – that is, participation in CSG Industry Monitoring Groups.[5] Investment in the UQ-CCSG is also identified by QGC as meeting another requirement of the 'social impact management plan' or SIMP, for Curtis LNG Project whereby, "For the life of the Project, QGC must hold periodic community information sessions whereby landholders and community members are invited to discuss specific issues and negative social impacts of concern" [25]. In response to satisfying this criterion, QGC noted that, as part of its engagement with communities, it funds independent research organisations (CCSG & GISERA), both of which hold periodical information sessions and public seminars to discuss the research which they have been conducting in the CSG arena.[6] *New Neighbours*, the final report for Queensland Curtis Liquefied Natural Gas Project Social Impact Management Plan released by QGC in June 2015 highlights a number of research projects conducted by UQ-CCSG.[7] These studies include a project titled *Agriculture and Coexistence*, an effort to identify characteristics of successful coexistence between the CSG operations on farmland and agricultural industries. The research project, which began in 2014, established a framework to measure impacts of CSG activities on farm productivity and profitability. In the QGC SIMP final report, the CCSG-funded research project was identified as contributing to the company's social impact management plan, particularly for land use management.[8] Thus, one can see how particular projects funded by CCSG can help the CSG industry to 'tick the box' for particular provisions of government regulation. This was not a primary aim in the day-to-day pursuit of this particular project, according to our interviews and observations. Nonetheless,

[5] http://www.statedevelopment.qld.gov.au/resources/project/queensland-curtis-liquefied-natural-gas-project/qclng-change-application-6.pdf.
[6] http://www.statedevelopment.qld.gov.au/resources/project/queensland-curtis-liquefied-natural-gas-project/qclng-change-application-8.pdf.
[7] http://www.bg-group.com/assets/files/cms/QGC_Social_Impact_Management_Plan_SIMP.pdf.
[8] http://www.bg-group.com/assets/files/cms/QGC_Social_Impact_Management_Plan_SIMP.pdf.

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this opportunity for the CSG industry to gain credit in the government regulator's eyes for supporting such research appears to have been a valued outcome of this project and others.

The primary way in which research projects and proposals are formulated and solicited is through the four research streams of the Centre. Project proposals initially receive an audience through the chair of each research stream and subsequently via the Technical Advisory Group (TAG). It is the TAG that receives and oversees evaluation of project proposals, acting as gatekeepers before projects identified for future consideration are then sent to the SAB for future consideration. TAG members are responsible for marshalling feedback from technical experts in their respective organisations. The criteria against which projects are judged include technical adequacy as well as research need, as articulated by the SAB and research stream leaders [15].

As an example of how TAG processes work, the Agriculture and Coexistence project, first brought to the TAG in late 2012, did not receive approval until 80 weeks later, in 2014. Delaying the project were debates within the TAG and with the researchers about the focus of the project. For example, should it focus on farmers' long-term concerns relating to water, or was this too big a question for a study focusing on near-term agricultural productivity? Other questions included, what should the research methodology measure, and who should be invited to be a member of the Project Advisory Group (PAG). In some cases, there were good reasons for such questions to be asked. For example, there was a concurrent research project funded through CSIRO's research alliance GISERA was also investigating the nexus between agricultural practice, CSG development, and water. As such, there was a concern for duplication. However, debates regarding who should be involved on the PAG and the methodology of the qualitative and quantitative research, highlighted the challenges of divergent epistemologies. The researchers, through TAG processes and beyond, submitted the proposal to successive rounds of consultation with each of CCSG's member companies, who then passed the proposal to a range of staff members. The research team also garnered input from a number of key agricultural stakeholders, such as peak bodies, who communicated about the study with their membership. The numerous rounds of consultation demonstrated the slow pace of a participatory process but also highlighted how social science research projects in such a topical arena can be bedevilled. The end stage of the project—at the time of this writing, its delivery outputs have received a similar intensity of consultation through various levels of company staff, government, and organisations represented on the PAG.

Researchers at the UQ-CCSG are mostly employed across various schools and centres at the university and are usually not only dedicated to CSG research, making the UQ-CCSG a form of "virtual" research centre. Rather the UQ-CCSG, on the advice of the TAG and SAB, selects projects to fund and facilitates access to a network of stakeholders in the Queensland CSG industry (industry, government, other researchers, peak bodies, natural resource management groups, community consultation committees, etc.) for researchers. The membership of the UQ-CCSG played an important role in establishing a foundation for how the "supply" of research was to be framed. That is, what would the SAB agree to be appropriate topics, approaches and methodologies; what data, equipment and access to sites was able to be shared with whom; to whom and when should the results of funded research be made available to other parties and publications? The SAB provided these opinions as advice to the Centre director, who would make final decisions on behalf of UQ. Such decisions could be seen to be made in the interests of the industry, the government, and the community as well as in the interest of ensuring an ongoing harmonious relationship between the university and industry sponsors.

The close proximity of the Queensland government agencies, through attendance at the SAB meetings and ongoing information sharing communities and networks, provided crucial links for the university and companies to the State government. For example a recent (2015) federal Government report by the Office of the Chief Economist titled, *A review of the socioeconomic impacts of coal seam gas in Queensland* draws heavily upon a number of social science research projects conducted by the CCSG, as well as citing personal communication with CCSG researchers as evidence within the report.[9] One company representative noted that the UQ-CCSG provided a safe and rigorous forum for cross-industry discussions and problem solving, different from professional conferences and workshops. There were a number of issues that impacted upon the entire sector – from lack of knowledge characterising the subsurface terrain to common problems with industrial processes due to the local geology (e.g., mud causing wear on pumps). Accompanying challenges included interpreting the changing regulatory system (which was established as an "adaptive management" approach) and attending to "social licence to operate" or industry-agriculture "co-existence" issues.

Universities and UIPs become central to energy policy disputes when evidence and science-based rationality is used to inform decision-making by governments. The question of who has the credibility, authority and legitimacy to provide scientifically-grounded claims in such debates is an important one. Fuller calls for social science scrutiny of the institutions and organisations that conduct science within democracy [41,29]. Energy debates, such as those surrounding unconventional hydrocarbons, draw together themes of science, risk and politics. Scholars in this journal have argued how energy debates in particular "highlight 'patterns of power and privilege' by constituting social, technical and economic regimes", and as such, require the attention of social science to identify how power is manifest and wielded in such debates [78] Concerns have emerged in the United States, Britain and Australia, where organisations producing knowledge to inform unconventional gas policy and practice have encountered challenges to the perceived trustworthiness of the knowledge produced and disseminated. Some commentators welcomed UQ's proactive response to organise funding to undertake much needed research on socio-environmental issues involving CSG. This response can be viewed in the context of many Queensland government departments having been subjected to successive waves of rationalisation and no longer having the resources to undertake their own research.

6. Governance of university-industry partnerships in unconventional hydrocarbons

The UQ-CCSG is just one of several research centres established internationally to investigate aspects of the development of natural gas from unconventional reservoirs in various parts of the world. It is also just one of several that have attracted academic, media, and public attention [35,81]. Among these UIPs, various shortcomings have been identified—including unsuitable organisational governance structures [51], a lack of due diligence to detect conflicts of interest [19], perceived funder's bias and industry capture ("frackademia") [53], and inadequate transparency and accountability mechanisms [87]. Some research organisations have faced operational challenges, and aspects of their organisational legitimacy was called into question. These centres included the

[9] http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/coal-seam-gas/Socioeconomic-impacts-of-coal-seam-gas-in-Queensland.pdf.

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University of Texas Energy Institute[10] and similar centres at the Massachusetts Institute of Technology (MIT),[11] State University of New York Buffalo (SUNY),[12] Oxford University,[13] University of Queensland[14] and Pennsylvania State University Marcellus Shale Center for Outreach and Research.[15] The interest generated in these science actors highlights the central role which science now plays within political debates. As a result the organisations which produce scientific knowledge and research have become key political battle grounds whereby opponents highlight certain aspects of governance or funding arrangements perceived to be compromising. This provides a challenge to many UIP's who unwittingly become ensnared in political controversy not necessarily of their own making, but through an lack of understanding of the political dynamics at play and the high visibility and scrutiny they now receive. It is clear that in contentious arenas, UIP's providing applied research with industry partners generate a high degree of interest from the public and other stakeholders. As such governance processes which enhance transparency and accountability for an interested public are required. The CCSG for example has a full disclosure of their funding arrangements and governance structure on their website. Other organisations in this space such as GISERA have also provided details of their funding and Alliance contract online, along with details of project budgets. A high level of transparency, accountability and disclosure could be recognized as the 'new normal' for UIP's in contentious policy arenas.

The challenge's set out above for UIP governance echo a recent review of Australia's innovation policy platform for fostering collaboration among government, industry and universities. The review noted that a key challenge facing such collaborations is organisational governance [57,84]. The review stated, "Solving big challenges requires organisational arrangements fit for purpose" [57], xvi. As big challenges involve uncertainty, blurred boundaries and contention, organisations must have in place structures and processes to accommodate this context [57], xvi Furthermore, authors writing about Australia's CSIRO have noted that, "enthusiasm for exploring new areas of science can sometimes relegate the need for sound governance and management of those activities to a position of relative unimportance" [71], 98).

7. Discussion

Thus, UQ-CCSG can be seen to be facing a challenge in ensuring a public belief or trust that their university-created science is being deployed for its utility to policy-makers to craft legislation in the public interest and for improving industry practice and knowledge to manage social and environmental risks not to further private interests alone. Addressing such a challenge, Wynne [92,93] states, requires understanding the institutionalization and control of science. Wynne and others argue that universities, when producing and disseminating scientific knowledge in contemporary energy debates, need to carefully consider the governance mechanisms to maintain public trust in the science and how it is created. One of these challenges relates to who is represented in the senior decision making spaces of such organisations. That governance includes management structures across the levels of researcher, research group and institution, and the relationships among them.

The challenge, then, for contemporary universities is to manage a number of demands, including increasing expenses associated with research. Besides maintaining the ability to secure funding from industry whilst public funding is constrained, they need to apply knowledge to industry-related challenges; address topics deemed to be in the 'national interest' as well as the 'public good'; and provide independent, credible and trusted science and evidence to inform and underpin key policy decisions in topical arenas, including energy. This tension between private commercial and what is interpreted as the public interests requires careful consideration within universities at the macro-level – University Council and senior management teams – in terms of managing competing interests. At the micro-level, it is a tension that can create a large burden for individual researchers, who must manage differing interpretations of 'national interest', 'public good' and 'applied research' and their own career aspirations. Naomi Oreskes notes that the production of knowledge has always involved managing interests. She notes that all knowledge is set within spheres of influence; the key issue is how interests are managed or governed. She states, in regard to another case of industry funded research, that the,

> . . . critical point here is not that the fact the research was funded by industry, because all science is funded by some institution, group, or individual, and it's not clear that industrial patronage is intrinsically more problematic than support from a prince, a foundation, an armed service, or a government agency. Rather, the issue is that the research is supported by a sponsor who wants a particular result – a particular epistemic outcome – and the researchers know in advance what that outcome is, producing an explicit conflict of interest, which undermines the integrity of the research performed [62], 381.

The above quote highlights the challenge for researchers in contentious policy arenas. That is, broader forces of government, industry and markets have marked out the epistemic setting of 'development' (meaning economic development) to be underpinned by science. How alternative viewpoints, epistemologies and ideas can be included is the central challenge for science more broadly. A clearer understanding of the mechanisms that universities create to engage with external stakeholders would provide greater clarity on how universities can best engage in contentious energy debates.

University-industry partnerships are not new phenomena, and some disciplines and professionals have traditionally been closely engaged, attracting increased industry funding and relevance. Industry partners provide important funding and opportunities for research projects and collaboration and this situation can be seen as the 'new normal' in many areas of research. For public interest to be best served, this trend must be accompanied with appropriate governance arrangements and oversight to manage funders' interests, underpin integrity, and deliver what is considered to be trusted, credible and legitimate knowledge, not only for the funder, but for policy-making. The idea of fortifying the university's role as a "public space" within society to deliberate science and ideas is not new. What is more recent is addressing the evolving moral basis of the university, the nature of its social responsibilities and how to quantify such university social responsibility [22,11].

It has been identified that in the context of contentious debates where policy makers call for science to underpin political deci-

[10] UT had a failure of disclosure processes which led to the resignation of the lead researcher and the Director of the Centre—http://www.utexas.edu/news/PDF/Review-of-report.pdf.

[11] Researchers failed to disclose financial ties to industry and the credibility of research methods were questioned. See http://public-accountability.org/2013/03/industry-partner-or-industry-puppet/.

[12] There was a failure to implement disclosure policies that ultimately ended with the Research Centre being closed. For further details please see (Ref. [54]) and http://public-accountability.org/2012/11/investigation-obstructed/.

[13] There were accusations that "research money was an attempt by Shell to "buy legitimacy for its controversial activities globally." http://www.theguardian.com/environment/2013/may/09/oxford-students-alumni-protest-shell.

[14] There were complaints that there was a lack of transparency of industry funding and call for independent impact assessment and broad public debates to support "public good" research. See Cleary [98].

[15] See Ref. [54].

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sions and regulation, knowledge that is considered trustworthy, independent and credible is central to addressing community concerns and underpin decision-making [14,73,85,33]. In meeting the needs of policy-makers and industry partners, such partnerships face challenges in navigating a path between private interests and public good. One such example occurs in Queensland, in relation to one of the primary areas of CSG development is the Surat Basin, a sub-basin of the Great Artesian Basin. Throughout the basin there is groundwater (aquifers, springs and bores) with high ecological, cultural and financial value, with multiple interests including agriculture, mining, indigenous and individual landholders. A high volume of water is needed to extract CSG and this draws upon the interconnected groundwater formations in the basin. A Cumulative Management Area (CMA) was established over the Surat Basin by the Queensland Government in order to access and manage the cumulative impacts of CSG water extraction and subsequent reinjection. An independent entity established under the Water Act 2000 and funded by a levy on the companies – the Office of Groundwater Impact Assessment (OGIA) – carries out that role. A substantial research, monitoring and groundwater modelling program focussed on characterising the subsurface – coals, aquifers and the basin more broadly – and the impacts of the industrial processes – is occurring resulting in changes to the boundaries, modelling and monitoring methods. Key roles have been assumed by OGIA, the companies, UQ-CCSG and other universities, and other public research organisations [60]:115–116. This effort has been applauded, suggesting that productive inter-organisational collaboration in this domain can take root.

An 'age of expertise' and era of 'scientized decision-making', particularly in relation to energy debates, has ushered in closer scrutiny of the organization and governance of science, including its accountability and transparency. The role of the university in this space, including how it functions and reflects democratic norms and expectations, is important to consider. Changing modes of knowledge and governance underpinned by normative agendas and goals of sustainable futures include a suite of related ideas. This suite of concepts includes a new social contract for science, 'mode 2' knowledge or socially robust knowledge [56], socially responsible innovation [34], credible knowledge [14], knowledge governance for sustainability [86] and the "ecological" university [6]. We argue that these changes have produced circumstances that warrant greater attention to the governance of science and its organisational structures and processes within the changing university so as to ensure the continuing legitimacy of the science produced in universities, and the universities and scientists themselves.

8. Conclusion

The changing role of the university in the production and dissemination of knowledge for government policy making and formation of industry regulations is evident here through a case study of the establishment of the Centre for Coal Seam Gas in Queensland, Australia. Whilst the World Bank, the OECD and national governments around the world embrace policies to support innovation through increased UIP, this examination supports claims that industry-funded research centres face multiple risks and challenges, beyond the production of knowledge [50,4]. UIPs navigate the production of knowledge alongside political, financial, communication and project management objectives. This environment is one of applied research with great stakeholder interest, promised application of knowledge for policy and regulation, and university eagerness for investment by funders. That said, the organizational and institutional governance of knowledge generation indicates tensions between the commercial, scientific and political imperatives. We have outlined the complex nature of these entanglements which, rather than seeing in black and white, must be explored with nuance. We have highlighted the changing institutional landscape of the university, no longer an 'ivory tower' but very much entangled in the cut and thrust of markets, politics, contention and knowledge transfer. How independence and public trust in experts is maintained in these hybrid spaces, such as UIP's, must not be taken for granted but manged through an ongoing emphasis on local organisational governance which demonstrates accountability, transparency, representation and diversity.

Most UIPs are not visible, nor of interest, beyond the network of participants. However, this paper has shown that when research is produced amidst contentious policy debates for, and on behalf, of various stakeholders that the operations of UIPs become of interest to broader groups of stakeholders. What is not immediately obvious from the how the organisational identity of the UQ-CCSG is framed through websites and other communication materials, is to what degree, if any, the university, research centre and individual researchers are "captured" by the CSG industry. That is, moving beyond the mislaid assumption that all UIP research outputs are biased, how does industry funding shape the research agenda, inform the level of rigour and external scrutiny or what is communicated with lay audiences—all features that are germane to the legitimacy and saliency of the knowledge being produced. Similar questions are currently being asked of UIPs in the UK health sciences [1].

Our exploration of the UQ-CCSG illuminates that safeguarding the public interest, as it relates to creation of knowledge to inform public policy decision-making, has inherent tensions. The focus on the scale of the industry-funded research centre – the site of organisational contradictions and paradoxes – highlights several features. The closer investigation of these features forms the basis of a future research agenda. First, there is no organic alignment of expectations about university governance arrangements by the UIP participants and other key university stakeholders, such as students, staff and alumni. It is a challenge for UIPs and universities to devise governance arrangement explicitly to manage stakeholders' interests underpin research integrity and deliver what is considered to be trusted knowledge in situations where the research topic is of local and immediate significance. It is through further examination of UIPs in energy debates that we ascertain whether the organisational responses to the changing terrain of knowledge production, science, and its politics are adequate.

The second feature relates to the continuing role of universities, and all of the constituent organisational units including UIPs, to provide "public space" for communities to learn, disagree, co-produce knowledge, network and innovate. This 'public space' is a central tenet of the function, legitimacy and reputation of universities, and it ensures the continuing relevance of universities in social and economic development [20]. The blend of location, resources, expertise and time where researchers create knowledge, commit to ideas and produce evidence can potentially be in opposition to other opinions, including those of the state, funders and other researchers. Participation in scientific and public debates is necessary not only for the progression of scientific knowledge but for the maintenance of a modern democracy [3]. Various internal and external stakeholders become concerned when parts of the university, like UIPs, suspend the role of universities providing 'public space' when partnering with businesses. For UQ-CCSG, for example, some gatherings were closed, particularly when featuring confidential business information, while others, such as community forums, shared research findings publicly. As Stirling [78] has noted, using the dominant economic paradigms of economic development when researching particular forms of energy inhibits the potential for producing, disseminating and implementing knowledge to enact real socio-political change of the depth and scale

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imagined in alternative energy futures. Further investigation of how the 'public space' of UIPs is imagined and accomplished will show how multiple paradigms can be integrated into future energy research agendas.

The third feature of the UQ-CCSG that warrants further attention is the applicability of extant normative frameworks and standards to the governance of UIPs in contentious research and policy debates. Some European scholars suggest that universities need to enact normative aspirations of university and corporate social responsibility and the university's sustainability mission to maintain relevance Owen et al. [97]. Several normative ethical, sustainable development and social responsibility frameworks, principles and standards have been constructed to public expectations, cultivating trust in research outputs, and safeguarding research integrity (see various frameworks for this in Ref. [35]. Closer investigation of existing standards and frameworks focussed on values and ethics will surface new ways of recognizing and measuring bias, quality, value and impact of UIPs in policy-making on energy production and consumption.

The exploration of the UQ-CCSG within the context of Australian higher education and CSG-LNG sectors surfaces a range of questions about the benefits and pitfalls of industry-funded research in contested domains of the energy sector, notably expectations about university governance arrangements. Key challenges are around ensuring the accountability and transparency of privately funded research within public institutions. Our observations suggest that UQ-CCSG has in place a range of strategies for offering such accountability, but there are areas where some on the outside would suggest that greater access or transparency might be needed. Further, there are questions about the measures that other UIPs have in place. Additionally, it can be argued that any regime of accountability measures could benefit from being constantly contested and renegotiated. This status requires greater attention to the governance of science and the organisational actors, as universities are increasingly relied upon to undertake applied research to inform political decision-making. For social scientists undertaking research in regard to contentious policy arenas, the democratic accountability of knowledge is a key site for research and action.

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