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The political economy of carbon capture and storage: An analysis of two demonstration projects

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ABSTRACT

Carbon Capture and Storage (CCS) technology is considered key to mitigating climate change by international institutions and governments around the world. The technology is considered advantageous because it may enable the continued utilization of fossil fuels while curbing carbon emissions. However, development of the technology remains slow on the ground. It is generally argued that large-scale, integrated demonstration projects are needed as a next step toward commercialization. Despite government support in several countries, few projects exist so far worldwide. This paper asks why it is so difficult to get demonstration projects off the ground. The argument is that it is not only project-specific factors that determine the feasibility of demonstration, but given the need for government support, a variety of political economy factors influence decision-making processes by policy makers and companies. The paper introduces an analytical framework developed on the basis of the political economy literature that considers six sets of factors that influence outcomes. It discusses two specific projects, Longannet in the UK and Quest in Canada, and explains why one failed and the other one is under construction. The analysis shows that although climate change has been a more important policy concern in the UK compared to Canada, the specific political economy situation of fossil fuel rich provinces like Alberta has led to the Quest project going forward.

1. Introduction

Many analysts, governments and international organizations see addressing climate change as a major challenge for science and technology policy making (Gallagher et al., 2006; Mikler and Harrison, 2011). While a number of countries have invested significant resources into developing renewable energy technologies, there is a recognition that fossil fuels will play a major role in global energy systems for years to come (IEA, 2010a). Carbon capture and storage (CCS) has therefore been hailed as a key technology for climate change mitigation by the International Energy Agency (IEA), the Intergovernmental Panel on Climate Change (IPCC) and some governments including those of the US, Canada, Norway, Australia and the UK (IPCC, 2005; HM Government, 2010; van Alphen et al., 2010; IEA, 2010b). The aim of CCS is to prevent the release to the atmosphere of carbon dioxide (CO_2) arising from large point sources by capturing and transporting it to an appropriate site for underground sequestration. It is argued that in this way CO_2 emissions for example from a coal-fired power plant could be reduced by 80–90% (Balat et al., 2009). A key argument of proponents of CCS is that having CCS as part of the climate mitigation portfolio may significantly reduce the overall costs of meeting the mitigation target compared to portfolios not using CCS (see e.g. IPCC, 2014: 41).

While there has been enthusiasm since at least 2005 when the IPCC published its special report on CCS (IPCC, 2005) and while many model runs suggest that CCS could be part of the mitigation technology portfolio (Riahi et al., 2007; Bistline and Rai, 2010; Eom et al., 2015; Iyer et al., 2015), progress on the ground in terms of large scale, integrated (from capture to storage) demonstration projects has been slow. An IEA report tracking CCS progress states that “the largest challenge for CCS deployment is the integration of component technologies into large-scale demonstration projects” (IEA, 2013: 5). Similarly, in 2013 the Global CCS Institute identified eight large scale integrated CCS projects around the world, but acknowledged that a number of other projects had been canceled due to “ongoing difficulties in assembling viable business cases” (Global CCS Institute, 2013: 3). By now (2015), the Global CCS Institute counts 14 large-scale CCS projects in operation, most of which work on natural gas processing. The first large-scale, integrated CCS project on a commercial coal-fired power plant has opened at Boundary Dam in the Canadian province of Saskatchewan in October 2014, but several US projects have been delayed. Moreover, by mid 2015 the final investment decision had not been taken to build a single large-scale, integrated demonstration project within the European Union (although there are several prominent projects such as the Rotterdam Opslag en Afvang Demonstratie project (Road), which has yet to receive

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a final investment decision by its proponents), although funds to support such activities had been set aside since 2012. In July 2014 the EU commission awarded €300m of funding to a proposed White Rose project in the UK where front-end engineering and design work is currently taking place, but no final investment decision has yet been taken.

What is a CCS 'demonstration' project and what function does demonstration serve? Technological demonstration can be understood as a process of *social learning*, involving not only the working out of scientific or technological uncertainties in the operation of the technology but also the generation of accepted facts about the technology, the promotion or 'selling' of the technology by interested parties to secure public or government support (Shapin, 1984; Rosental, 2005). CCS demonstration projects are intended not only to show that CCS physically *works*, but also that it *can work* in the context of existing social, political and economic problems, relations and interests. So while CCS is seen as an important option for reducing carbon emissions by some, progress on actually 'demonstrating' this has been slow (de Coninck et al., 2009a). This article examines why it has been so difficult to get large-scale, integrated CCS demonstration projects off the ground. It develops a political economy perspective on the complex array of factors that have influenced the enthusiasm to develop demonstration projects, and which have pushed some projects to proceed and others to stall. A political economy perspective combines the analysis of political and economic factors which – in the case of CCS – closely interact, as without policy support there is no business case to invest in CCS. This framework will be explained in more detail in Section 2.

The paper is structured as follows: In the next section, we review the relevant CCS literature, outline a political economy perspective on the challenges of technological demonstration and argue why such an approach is helpful in understanding the difficulties of CCS. The remainder of this article presents two case studies, the Scottish Power Longannet project in the UK (Section 3) and the Shell Quest project in Alberta, Canada (Section 4). Section 5 presents the analysis. Section 6 discusses the conclusions that can be drawn from the analysis.

2. A political economy perspective on challenges of CCS demonstration

Approaches to understanding technological development and deployment tend to gravitate around two poles. At the micro-level, a focus on project-level organizational and technological characteristics predominates, and the question of whether or not to proceed with a proposed technological solution to a given problem often comes down to the costs and risks of that approach in comparison to alternatives (e.g. see Bergerson and Lave, 2007; Abadie and Chamorro, 2008; Szolgayova et al., 2008). At the macro-level, on the other hand, broader structural trends predominate and the analysis focuses on large scale, socio-technological systems associated with key areas of social life such as transportation, electricity or agro-food production and how they change (Geels, 2004; Nykvist and Whitmarsh, 2008; Foxon et al., 2010; Verbong and Loorbach, 2012). A political economy perspective tries to situate itself somewhere between these two poles, examining the interplay of a range of economic, political and institutional factors in technology-related decision-making processes involving government and private sector actors.

The entry of CCS onto the global climate change agenda has led to an emerging social science literature on CCS. The majority of this work clusters around two areas: (a) the economics of CCS and the role CCS should play within different mitigation scenarios (Rubin et al., 2007; Otto and Reilly, 2008; van der Zwaan and Gerlagh, 2009); and (b) the public acceptability of CCS (van Alphen et al., 2007; de Coninck et al., 2009b; Shackley et al., 2009). While there has been recognition of the importance of political factors contributing to the uncertainties surrounding CCS (Markusson et al., 2012; Watson et al., 2014), consideration of this dimension has largely focused on their impact on the economics of the technology — highlighting, for instance, the importance of adequate policy and regulatory frameworks to address the 'financial gap' and to resolve questions about long-term liability.

The existing literature on CCS is therefore largely 'instrumental' in character, examining the various policy approaches that might stimulate CCS development and trying to find the most effective solution (Groenenberg and de Coninck, 2008; Scrase and Watson, 2009b; von Stechow et al., 2011; Backstrand et al., 2011). At this level of analysis the answer to our research question (understanding the difficulty of getting demonstration projects off the ground) is to point to the absence of policy and regulatory frameworks adequate to assuage industry uncertainty and resolve the 'financial gap'. Add to this a policy paradigm (at least in most OECD countries) that emphasizes markets and 'technological-neutrality' of policy interventions in the energy sector (Kern et al., 2014a), and one arrives at the received wisdom concerning the barriers to successful demonstration: CCS cannot currently be justified as an emissions-reducing technology at the project level in the absence of substantial public incentives, which could be supplied through economy-wide carbon pricing (with a sufficiently high carbon price) and/or direct financial subsidies.

Yet there remain unaddressed issues that are clearly relevant to why such demonstration projects are hard to get off the ground. While the financial gap and lack of carbon pricing are indeed important barriers, the factors that play into governments' decisions to do (or not to do) something about these barriers are rarely if ever considered. Nor does this speak to the role that varying access to government by energy sector interests might play in shaping policy outputs. In short, what is missing in the existing literature on CCS is a more critical analysis of the complex interplay of factors that shape policy at the intermediate state/market level. It is here that a political economy framework for understanding technological development can be most fruitful. The focus at this intermediate level – between site-specific projects and larger macro-trends – is not on what policies are most effective or efficient in deploying CCS, or on defining the place of CCS in a 'truly sustainable' energy system. Instead, it is on the factors that influence social, technological and policy choice and design over a medium-term timeframe (5 to 10 years).

Political economy is defined by its interest in the relationship between the state and the market (Gamble et al., 1996) and how the interaction between the two contributes to outcomes in either sphere. The relationship of primary concern in assessing CCS demonstration project development is that between public policy makers and private enterprises. In this context, it is worth emphasizing that the realization of a large-scale CCS demonstration project requires a substantial commitment from both government and the industrial actors that will build and operate the facilities. Precisely because it involves *demonstration* of technological systems that are not fully commercialized, we are a long way from 'business as usual' for either party. CCS projects are expensive, involving large upfront investment, and continuing costs for CO_2 capture, transport and disposal over the life of the plant. They present substantial risks to all participants including, for example, construction over-runs, technological problems (integrating CCS reliably with the normal plant operations, or unforeseen difficulties at the storage site), and reputational risks to firms, regulators and politicians should things go wrong (Markusson et al., 2012). These projects are complex, not just from an engineering perspective, but also in terms of financing and regulatory arrangements, and interactions with multiple partners and publics. Although governments could in principle build such projects themselves, in practice in OECD countries their role is primarily focused on funding and regulation, with construction and operation left to industrial actors (although in some cases these may ultimately be state-owned firms). The decision to go ahead and build such a project involves complex negotiations, and the approval of both government and the companies concerned. The lumpy character of the investment, and the risks and complexities of these projects, suggest that they are likely to be difficult to get off the ground.

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