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Assessing socio-technical mindsets: Public deliberations on carbon capture and storage in the context of energy sources and climate change

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HIGHLIGHT

- Energy systems are judged in the context of wider socio-technical system dimensions.
- Skepticism about climate change may affect support for CCS.
- Concerns about CCS include: CO_2 leaks, accuracy of monitoring and costs.

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ABSTRACT

The adaptation and transition to new configurations of energy systems brought on by challenges of climate change, energy security, and sustainability have encouraged more integrative approaches that bring together the social and technical dimensions of technology. The perspectives of energy systems and climate change play an important role in the development and implementation of emerging energy technologies and attendant policies on greenhouse gas reduction. This research examines citizens' views on climate change and a number of energy systems, with a specific focus on the use of carbon capture and storage (CCS) as a technology to address greenhouse gas emissions. An all-day workshop with 82 local participants was held in the city of Calgary in Alberta, Canada to explore the views of climate change, energy and CCS. Participants were provided the opportunity to ask experts questions and discuss in small groups their views of climate change policy and energy systems. Results demonstrate that participants' assessments of energy systems are influenced by social–political–institutional–economic contexts such as trust in industry and government, perception of parties benefiting from the technology, and tradeoffs between energy systems. We discuss our findings in the context of understanding social learning processes as part of socio-technical systems change.

1. Introduction

The adaptation and transition to new configurations of energy systems brought on by challenges of climate change, energy security, and sustainability have encouraged more integrative approaches that bring together the social and technical dimensions of technology. Looking at energy systems through the socio-technical lens as a *seamless web* (Hughes, 1999), with on-going interactions between science and politics, among actor networks in socio-political, technological and scientific realms, a better understanding of the dynamics between technology and society can emerge. This pattern is not unique to energy systems but applicable to a wide range of large technological systems.

That energy systems need to be understood within their social-political-institutional contexts has been increasingly a point of departure for discussions on a wide range of energy technologies (see Devine-Wright, 2010; Ekins, 2010; Walker and Cass, 2007). The role of the public in such discussions has been of special interest, given their various roles and responsibilities as users, taxpayers, voters, supporters or detractors of various technologies. Our particular interest here is to explore the engagement of publics from a particular Canadian community on the question of the use of carbon capture and storage (CCS), framed as a technology to address the challenges of climate change.

The city of Calgary in Canada was the site for an all-day workshop on climate change, energy, and more specifically, CCS

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as a technology to minimize greenhouse gas (GHG) emissions from fossil-fuel energy sources. The primary objectives of this workshop with 82 local participants included the exploration of public views on a range of energy sources and potential solutions to the climate change challenge including the deployment of CCS. This Canadian public consultation was one of several international initiatives sponsored by social scientists from the Commonwealth Scientific and Industrial Research Organization (CSIRO) of Australia as part of an international comparative study, which was in turn funded by the Global Carbon Capture and Storage Institute (GCCSI).

The paper is organized as follows: A brief discussion on CCS as part of a complex socio-technical system will provide a frame for our description and analysis of this case study. This will be followed by our description of the workshop results as a case study of upstream public engagement on this issue. We then analyze our findings in the context of the variety of socio-technical configuration elements that emerge from public deliberations on this technology and discuss the implications for policy and research.

2. Background

2.1. CCS as part of a complex socio-technical system

The planning and implementation of energy systems has recently been framed as a socio-technical systems project (see Walker and Cass, 2007; Markusson et al., 2012; Stephens and Justio, 2010). Drawing from the field of science, technology and society studies, the socio-technical systems approach can be described as the middle ground between technological determinism (technology as fixed and shaping society through its impacts) and constructivist perspectives (society shaping the technologies it desires). Hughes (1989) has maintained that "technological systems contain messy, complex, problem-solving components. They are both socially constructed and society shaping" (p. 51). It recognizes that just as artifacts can open up new possibilities for different social and cultural practices, social processes may also shape technology development and design (Rip and Kemp, 1998). Energy systems are best understood as socio-technical arrangements, with strong interconnections between technological and social networks including institutions, regulations, social practices, cultural values, beliefs and expectations. Within this framework, "users" of a given technology or technological system like energy systems may include the different roles publics assume—as consumers, taxpayers, supporters, or non-users and detractors. Users are also social constructions, imagined by others in the socio-technical system and configured into technological design and management (see Abi-Ghanem and Haggett, 2010; Walker et al., 2010). Use or consumption in socio-technical terms is more than purchasing or adopting, especially with regard to radically new technologies. The social and cultural appropriation of such technologies can extend from the development of beliefs or ideas, the efforts to fit such ideas into existing frameworks of beliefs and practices, and opportunism to the adaptation into the range of acceptable technologies or technologies in use. Such integration will involve learning, adjustments, or changes to routines, adjustments that involve cognitive, affective, and behavioral work (Geels, 2005).

The intertwining of artifacts, procedures, practices and politics as part of the seamless web allows us to consider the place of publics and opportunities for public engagement as part of the sense making processes around complex socio-technical systems and the democratic requirements for the governance of such large-scale systems (Hendricks, 2009). The feedback loop is an important component of socio-technical systems thinking, producing information about (mis)alignments between goals and performance (Hughes, 1989). How publics are conceived within this framework is part of conceptualizing this feedback process, with the dominant model in the energy systems literature primarily premised on the model of information transmission and consumer acceptance (see Cotton and Devine-Wright, 2012). From the science, technology and society perspective, on the other hand, there is a consideration for a two-way or multi-way exchange of ideas and social learning. In this context, processes of technology innovation and societal embedding incorporate iterative feedback loops (Argyris and Schön, 1978) including identification of values and beliefs, hopes and concerns among various actors involved in the course of technology development (Grin and Van de Graaf, 1996). In this context, a public deliberation such as that described in this study would be an early step in this multi-way exchange and social learning.

Both technical and social aspects are important to the development and implementation of CCS. Public views and attitudes towards CCS have been a major factor in the opposition to such projects such as those proposed for Barendrecht, The Netherlands and Greenville, Ohio (Van Norden, 2010). While there has been an increasing amount of research on public views on CCS (for example, see Ashworth et al., 2009; Bradbury et al., 2009; Itaoka et al., 2009; Oltra et. al., 2010; Reiner et al., 2006; Shackley et al., 2004), little work has been completed in Canada with the exception of earlier public opinion research by Sharp (2005). No study in Canada involving public deliberations has been conducted and the research presented here addresses this gap.

2.2. The public deliberation context: The energy picture in Alberta and Canada

An important context for this study and the sample group from Calgary that participated in this discussion on energy is a brief portrait of the national energy context as well as the provincial backdrop. Energy production plays a key role in the Canadian economy, accounting for 5.6% of national gross domestic product (GDP) in 2007 while energy export revenue contributed $90 billion Canadian dollars, or about 20% of the value of all national exports (Government of Alberta, 2011). This energy resource wealth accounts in large part for the country's lowest electricity prices in the world (National Energy Board, 2011).

Canada is also the sixth-largest user of primary energy in the world (NRTEE, 2010), a high-energy usage that can be attributed to individuals' large travel distances, a cold climate, an energy-intensive industrial base, relatively low energy prices and a high standard of living (NRTEE, 2010). These factors in turn account for the country's relatively high GHG emissions, with a contribution of about 2% of the total GHG emissions worldwide based on 0.5% of the world's population.

The foundation for Canada's energy development has always been regional and local. While the country as a whole is reliant primarily on hydro-electric power for energy production, the dominance of hydro is most evident in British Columbia, Manitoba and Quebec; Ontario is primarily reliant on nuclear energy, while Alberta and Saskatchewan use coal as their primary energy source. In the case of Alberta, the provincial context for this consultation, the majority of its electricity is produced through fossil fuels, including 44% of electricity generation from coal and almost 40% from natural gas (Government of Alberta, 2011), accounting for the largest amount of GHG emissions in the country. This considerable reliance on these fossil fuel sources may be surprising to many who might assume oil (from the