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Agency and structure in a sociotechnical transition: Hydrogen fuel cells, conjunctural knowledge and structuration in Europe



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ABSTRACT

Despite each level of the multilevel perspective of sociotechnical transitions reflecting a different degree of structuration, structuration perspectives have been little used to help explain sociotechnical change and stasis. Here we show how ‘strong structuration’ can be used to theorise the role of agency in sociotechnical systems in a way that brings together psychological and sociological perspectives. Strong structuration gives weight not only to actors’ practices, but also to their experiences. Practices and structures are viewed as mutually influencing, as in Giddens’ original conception, but the role of situated, subjective experience is also explicitly acknowledged. Applying this perspective, we show how individual attitudes and beliefs in relation to a niche energy technology are influenced by experience of national economic and innovation policy environments, with in turn implications for expectations of action by self and others. The overall aim is to illustrate a framework that connects individual psychology to practice, with implications for sociotechnical structure. For this purpose we draw on case study data of European R & D stakeholder opinion of stationary hydrogen fuel cell applications for heat and power, focusing particularly on the contrasting situations of the UK, Germany and Spain.

1. Introduction

Residential-scale, fuel cell-based, combined heat and power (CHP) units are among the micro-level options for generating lower carbon heat and electricity, particularly where the energy vector is produced using renewable energy. Home fuel cells should have no harmful emissions at the point of use and have reached a commercialisation stage in several countries (e.g. Japan, South Korea and the United States) [1]. Although the technology is expected to remain comparatively expensive in the short and medium term, in the long term, home fuel cells are perceived in some quarters as having mass-market potential – though only if costs can be reduced [1]. Key among the ways to reduce those costs is production scale-up, but this will require increased demand, which will in turn requires public policy support in terms of, for example, subsidy to reduce the cost of the initial investment [1]. As for other low carbon energy technologies, where governments make a sustained, public commitment, so does the willingness of other actors to commit increase. In this respect, action follows from shared positive

expectations about the prospects for the technology and hence positive prospects for those making some form of investment in that technology. Defining expectations as beliefs about the future, we can say that beliefs, including attitudinal beliefs (beliefs that inform attitudes), both individual and collective, are important to socio-technical processes. Yet whereas beliefs, attitudes and knowledge are viewed as important influences on behaviour from psychological perspectives (e.g. [2], to date there has been little use of such accounts in the sociotechnical, sustainability transitions literature, partly for reasons that we discuss below. Here we are interested in not only describing and illustrating the interconnected role of attitudes, beliefs and knowledge in sociotechnical transitions, specifically sustainability-related transitions, but in framework-level, theoretical synthesis of psychological and sociological analyses. In principle there is the opportunity to bring together psychological accounts of individual-level processes with sociological accounts of practice-structure relationships, to give an account that connects actor psychology to sociotechnical change while drawing on the strengths of two perspectives.

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Accounts of behaviour or agency that seek to retain ontological consistency with the most well-known contemporary model of sociotechnical change in the sustainability transitions literature – the multi-level perspective [3] – need to use a sociological perspective, in the sense of deploying terms relating to inter-individual (social) processes and structures. One of the most influential and debated of such accounts is structuration theory [4], which also underpins the multi-level perspective (MLP). To briefly rehearse, the MLP, three levels of interacting phenomena are posited (the niche, regime and the landscape), representing three different degrees of structuration ([5,6]: 44–47). To some extent one could say ‘different degrees of institutionalisation’, but structuration refers more specifically to practices and their role in the maintenance and reproduction of social structures [4]. Geels’ and Schot’s [5] argument is that activities in the niche have less stabilized practices than in the regime. Niches are the protected spaces where entrepreneurs and innovators are active, where sociotechnical novelties arise and are nurtured (e.g. where new energy technologies receive various forms of subsidy); the regime is the mainstream, pre-existing system of more strongly embedded and institutionalised technologies and practices, with which niche innovations need to compete or supplement; and longer term, slower-changing background phenomena such as social values and culture, are conceptually allocated to the landscape level. The MLP framework is a heuristic intended to aid thinking about sociotechnical processes, draws on innovation studies, evolutionary economics and science and technology studies perspectives and invites supplementary accounts of process details [7].

Although (perhaps surprisingly) structuration per se has been given rather little attention in the transitions literature [8], as said, more widely it is a highly influential account of the ways in which social structures are created and maintained. Structuration focuses primarily on the role of agents or actors in these processes, in relation to their practices [4]. At the same time, Giddens’ approach has been critiqued for an unsophisticated description of agents’ *situated* motivations, reflexive monitoring and knowledgeability, through which they navigate other agents and institutionalised practices [9–11]. That is, although Giddens [4] gave a pivotal role to agents, he was not concerned with addressing their psychology in any depth: processes and constructs posited as operating within individuals, such as attitudes, beliefs and degree of knowledge, were given considerably less theoretical and empirical attention. Similarly, although cognitive aspects of regimes, including shared beliefs, are recognised as an important set of components of the regime [3], again there is little related use of individual-level (or even organisational-level) psychological literature in the sociotechnical, sustainability transitions literature.

While theoretical integration of psychological and sociological accounts is not possible and indeed contentious [12], it is possible to juxtapose such accounts within over-arching frameworks. Examples include the energy cultures framework [13] and the ISM (Individual, Social and Material) framework of behaviour change [14]. For the same purpose, but seeking tighter theoretical integration, here we use a particular extension of Giddens’ structuration approach – ‘strong structuration’ [9] – which is designed to include actor psychology in a four-fold account of how actors change structures. We show how actor perceptions of a particular technology (home fuel cells for heat and power) are conditioned by their own experience and situations – organisational, regional and national – and how these perceptions have implications for both their own actions and for the actions of others. We also highlight the extent to which actor views are focused on the anticipated actions of other actors and the way in which this mutual assessment and observation forms a significant part of what Stones [9] characterises as ‘conjunctural’ knowledge. In this context, conjunctural knowledge is knowledge of the specific causes and trends present and operating in the moment, as perceived by the individual concerned and can here be considered synonymous with situated knowledge in the sense

of being experientially-conditioned.¹ We suggest that strong structuration [9] is well-suited to the role of connecting psychological and sociotechnical accounts, through its broad scope, that extends from individual experience to system- or structure-level processes.²

Stones’ [9] perspective is thus a four-element framework developed from Giddens’ structuration theory; it is summarised in Fig. 1 in relation to the MLP and is explained further in Section 2.1. The value of the perspective when thinking about socio-technical transitions processes is that it both draws attention to the importance of individual agents’ viewpoints and provides a theoretical connection of these to transitions processes. An important feature of the approach is its allowance for methodological bracketing [9], which in turn allows for use of multiple methods, epistemologies and indeed ontologies, as a phenomenon is studied in complementary ways in order to gain a fuller account. This clearly raises many issues relating to paradigmatic commensurability, but here we follow Feyerabend [15], taking the view that the extent of commensurability between theories (and hence implicitly methods and disciplinary perspectives) is ultimately a matter of interpretation, leaving much to be gained from a multi-paradigmatic research approach (e.g. [16,17], particularly where one is working within a multi-level framing of interacting processes (such as the MLP) that benefit from different forms and levels of analysis.

In terms of further definitions, socio-technical systems are understood as ‘the linkages between elements necessary to fulfil societal functions (e.g. transport, communication, nutrition)’ (Geels, [52]: 900). Such elements consist of resources such as technologies, artefacts, knowledge, capital, labour, cultural meaning, etc. Agency plays a pivotal role in socio-technical processes and is acknowledged as such in research agendas on socio-technical transitions 1STRN, 2010. While agents themselves are viewed as critical in the socio-technical transitions literature (e.g. [18,7,19,20] and their structuring practices as likewise [5], there has been little work explicitly emphasising the sequence of connections between agents’ locally situated perceptions of their contexts – their lived experience (e.g. [21] of technologies – and of sociotechnical processes. The application of a strong structuration perspective builds on the limited sub-literature on the structuration of sociotechnical systems to date [8,22], but more explicitly connects the micro-level of individual experience to the structuration processes relevant to sociotechnical change and stasis at the niche, regime and landscape levels.

In terms of the structure of the paper, we first provide an overview of strong structuration, outlining the approach, its rationale and its relevance to understanding sociotechnical transitions processes, for which purpose we refer to Geels’ [3] multilevel perspective. We then refer to the case study with which we illustrate the value of a strong structuration approach, as a way of connecting the situated experiences and hence perceptions of agents to the broader structures in which they operate. We draw from illustrative opinions elicited in interviews with European R&D actors on hydrogen fuel cell (HFC) systems, focusing here on HFCs for the provision of heat and/or electric power in stationary contexts. We aim to illustrate a way of conceptually connecting the psychological, sociological and technical aspects of system change,

¹ The term ‘conjuncture’ and its derivatives originate in the political science philosophy of Marx and others (e.g. Gramsci). A conjuncture is thus the coming-together of several pre-existing trends at a specific point in time, giving rise to a new situation in a way that is not pre-determined, but the origins of which can nonetheless be observed post-hoc. For political actors, understanding the nature of any given conjuncture is important for successful intervention [30]. It is not difficult to see the relevance of this to the overall project of sustainability transitions, particularly in terms of understanding how socio-technical systems inter-relate with political processes.

² We use the terms system and structure loosely, to denote sociotechnical regularities of a ‘demi-reg’ nature, i.e. regularities that are ‘sometimes but not always’ [31]: “Demi-reg are event regularities, but not deterministic or stochastic, event regularities “(): This represents a particular view of the nature of social life, or, more simply, of people. It follows that people are sometimes, but not always, predictable. Agency is defined broadly, as: “the human capacity for reflective action and choice” ().

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