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Conceptualising multi-regime interactions: The role of the agriculture sector in renewable energy transitions

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ABSTRACT

The agriculture sector plays an important role in renewable energy transitions, owing to its historical involvement in managing key resources, particularly land and biomass. We develop the multi-level perspective in relation to these emergent transition processes, conceptualising transitions towards renewable electricity production as examples of multi-regime interaction between national-level agriculture and electricity regimes. We focus particularly on the role of niche 'anchoring' into multiple regimes as the mechanism through which multi-regime interaction occurs, utilising case studies in Germany, the Czech Republic and the United Kingdom. Analysis suggests the birth of a new 'fiat' regime, oriented towards renewable electricity production. We suggest that fiat regimes, which are heavily dependent on policy supports, are often multifunctional in nature. In addition, we argue that agriculture's inherent connection to land demonstrates one of the specific characteristics of 'fiat regimes': fiat regimes are constructed largely in response to policy efforts to produce or protect public goods, such as natural resources, as opposed to 'market regimes' based on technological developments. Findings demonstrate support for the 'special case' of the agriculture sector in transition processes: high degrees of policy involvement led to 'windows of opportunity' created largely in response to national and international policy agendas, and the multiple functions of agriculture were reflected in competition between agriculture and electricity sectors over natural resource access. As renewable energy currently represents a secondary transition in the agriculture sector, we suggest that further attention needs to be paid to the impact of fiat regime policies on secondary transition processes.

1. Introduction

The European Union has set binding targets of producing at least 20% of its gross final energy consumed from renewable sources by 2020 (EREC, 2011), as part of their '20–20–20' strategy which also includes a 20% reduction in greenhouse gas emissions and 20% improvement in the EU's energy efficiency. In their National Renewable Energy Action Plans, Member States have identified their strategies for meeting these goals, which primarily focus on the energy sector: policy and regulatory frameworks, infrastructure and technology development, production price supports, and private sector investment. The plans are similar to international reports (e.g. the Stern Review of the Economics of Climate Change, 2006; Renewables 2014 Global Status Report; the IPCC Fourth Assessment Report), in that very little attention is given to role of the agriculture sector in energy production. The agriculture sector is described primarily as a problem in relation to emissions and energy consumption, and as a source of biomass. Neither are the trade-offs between food and energy production addressed to any degree. In this paper we draw attention to the role of the agriculture sector in renewable energy transition processes, further developing the conceptualisation of multi-regime interaction in the transition towards renewable electricity production.

Both the energy and agriculture sectors are high policy priorities at national and international levels, representing 'food security' and 'energy security', respectively, and are thus subject to considerable state intervention. EU renewable energy policy is typically traced back to the 1997 European Commission White Paper on Renewable Sources of Energy (EWEA, 2011), which set a goal of 12% contribution of renewable sources to the European Union's gross inland energy consumption by 2010 (EC, 1997, pp. 9). However, the European Commission had been supporting the development of renewable energy (e.g. technological research) for some decades previously. What is less recognised is that the European Union

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has also supported farm business diversification into renewable energy production since the 1980s, through the Common Agricultural Policy. A shift in agricultural policy in 1984 saw a move away from direct production subsidies and towards a more diversified rural economy (EC, 1988). In Member States, measures aimed at assisting farmers to diversify their businesses included grants for renewable energy installations. Some of the technologies currently being utilised for renewable energy production were also historically developed to address agricultural issues, such as waste management (biogas) and milling grain and pumping water (wind).

The growing literature on renewable energy transitions similarly focuses on the energy sector, occasionally including the waste and transport sectors. Analyses frequently draw on socio-technical systems thinking, emphasizing the different pathways renewable energy technologies have taken in development (e.g. Garud and Karnøe, 2003; Raven, 2007; Raven and Geels, 2010; Verbong and Geels, 2007). The literature is disconnected from social research on production of renewable energy in the agriculture sector, which identifies farm-level motivations (Huttunen, 2012; Tranter et al., 2011; Sutherland and Holstead, 2014), preferred types (Bailey et al., 2008; Tate et al., 2012; Mbzibain et al., 2013), characteristics of adopters (Villamil et al., 2008; Tranter et al., 2011; Tate et al., 2012) and the impact of policy and price supports (Clancy et al., 2012; Mola-Yudego and Pelkonen, 2008; Wilkinson, 2011). Transition processes in agriculture are also addressed utilising socio-technical systems perspectives, but these papers tend to focus on alternative farming methods and marketing strategies, such as organic farming (Belz, 2004; Smith, 2006, 2007) and local food networks (Diaz et al., 2013; Darrot et al., 2015; Lošt'ák et al., 2015). However, system transition has become a popular topic in the agro-food literature in recent years, drawing on a variety of conceptual approaches that emphasise 'sustainability transitions' (e.g. Poppe et al., 2009; Barbier and Elzen, 2012), reflecting increasing concerns over the past three decades that conventional farming practices are not socially or environmentally sustainable, and that transition is thus required.

In this paper, we analyse the interactions between the agriculture and energy sectors to form the 'renewable electricity regime', by further developing the conceptualisation of multi-regime interaction within the multi-level perspective (MLP). The MLP has been developed through a branch of transition studies which provides a conceptual framework for analysing socio-technical system-level innovations. In the MLP, 'niches' are conceptualised as sources of radical innovation, which owing to favourable 'socio-technical landscape' pressures (broad societal, technological or ecological developments), exert influence on the dominant socio-technical regime. Socio-technical regimes are considered relatively stable, 'locked-in' to particular trajectories, tending to change incrementally. The MLP focuses on radical changes or transitions. In the case of renewable energy, landscape pressures in the form of political concern regarding climate change and greenhouse gas emissions, exerted considerable pressure on the energy sector to pursue alternative production practices. These new practices – together considered 'renewable technologies' – were largely developed outside of the energy regime. For example, much of the American wind energy research was undertaken by the aerospace industry (Gipe, 1995). Biogas technologies were developed primarily in order to address waste management problems (and manure treatment) in the agriculture sector (Bruns et al., 2009). However, these technologies were not simply co-opted into the energy sector, they remain anchored in physical terms in the resources traditionally associated with other sectors, particularly agriculture. Economically successful biogas production involves both slurry and energy crop production, inherently embedded in farming systems. While onshore wind energy production requires less direct farm involvement, turbines are often located on agricultural land. It is this inter-relationship between the agricultural and energy sectors that we explore here.

The overall purpose of the paper is to assess the role of the agriculture sector in renewable energy transitions. In doing so, our objectives are:

- To further develop the multi-level perspective in relation to multi-regime interaction.
- To assess the utility of the multi-level perspective for use in understanding transitions within the agriculture sector.
- To illustrate these theoretical concepts through empirical case studies of wind and biogas from three European countries.

The paper is structured as follows. In the next section we further develop our conceptualisation of multi-regime interactions, before describing the research methods and background to the cases. We then present our analysis of the transition processes in the three study countries, organised into periods of convergence (1987–1996), consolidation (1997–2006) and contestation (2007–2013). We conclude with a discussion of the implications of the 'special case' of the agriculture regime for the study of transitions, and argue that renewable electricity production can be conceptualised as a 'fiat' regime in its own right.

2. Conceptualising agri-renewables as multi-regime interaction

The multi-level perspective (MLP) has developed an extensive literature within innovation and technology studies over the past decade (for reviews see Genus and Coles, 2008; Markard and Truffer, 2008 Smith et al., 2010). The appeal of the MLP is in the conceptual link made between micro-level innovation processes and large-scale socio-technical systems (Smith et al., 2010). The definition of the socio-technical regime is typically traced back to Rip and Kemp (1998), who widened the regime concept to include 'rules' (i.e. institutions in various forms, in which technologies are embedded). Current definitions of 'regime' emphasise three elements: actors, systems (resources, material aspects) and rules/institutions (Geels, 2011), oriented around the fulfilment of a single societal function. Analyses utilising the MLP usually follow the development of a particular technology over time, describing its evolution from innovation or 'novelty' to mainstream use (Konrad et al., 2008). Most studies using the MLP focus on historical analyses (Genus and Coles, 2008), which make it possible to define the regime in relation to the technologies under consideration (e.g. Geels and Kemp, 2007; Geels and Schot, 2010); the scale of the regime is therefore variable, depending on the technology involved. Regime-level transitions can be as minor as the technological substitution of a new means of housing pigs in The Netherlands (Elzen et al., 2011) ranging up to the replacement of horses by automobiles in North America (Geels, 2005). As a result, it can be difficult to distinguish between radical transition and the incremental changes of established regimes, depending on the scale at which the analysis is undertaken (Darnhofer et al., 2015; Genus and Coles, 2008).

In this research, we identify two regimes: agriculture and electricity, while recognising that non-agricultural waste used in biogas production is typically considered part of a waste management regime (e.g. Raven, 2007). While a regime does not necessarily equate to a sector – Geels and Kemp (2007) are clear that a regime can exist at multiple levels – for these purposes, it is necessary to consider the whole agriculture production sector a regime, because renewable energy production occurs across farming types (i.e. on dairy, livestock and arable farms). The definition of regime at the level of the agriculture sector is somewhat problematic, as the sector is widely recognised as having multiple functions (e.g. food,