Research Policy xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

Incumbents' diversification and cross-sectorial energy industry dynamics

Markus Steen[a,b,*], Tyson Weaver[c]

[a] Department of Industrial Management, SINTEF Technology and Society, P.O. Box 4760, 7031 Trondheim, Norway
[b] Department of Geography, Norwegian University of Science and Technology, 7491 Trondheim, Norway
[c] Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, 7491 Trondheim, Norway

ARTICLE INFO

Keywords:
Incumbent
Diversification
Sustainability transition
Multi-level perspective
Selection pressure
Strategy

ABSTRACT

Within the sustainability transitions literature, established, mature or incumbent firms have been stereotyped as 'locked-in' to socio-technical regimes. However, we believe regimes have been black-boxed, and few studies have explored incumbents' responses to transition processes. This article aims to achieve an improved understanding of incumbents in established energy sectors and their extent of involvement in other (niche) energy sectors. To this avail, we analyze data from a first-of-its-kind survey of 133 incumbent firms in Norway's two main energy sectors, namely oil/gas and hydropower. Providing inter-temporal dimensions, our data covers incumbents' diversification activities beyond their primary sector both in the past (cancelled activities), present (ongoing activity in secondary sectors) and future (ambitions of diversification), and also distinguishes between producers and product/service suppliers. By incorporating insights on firm diversification, our analysis sheds new light on the complex transformation processes associated with sustainability transitions. Empirical results show considerable heterogeneity in incumbents' responses to changing selection pressures, which can be explained by recognition that windows of opportunity are opening and some incumbents see potential to leverage their resources and capabilities to capture value in new niche energy sectors in both domestic and international markets.

1. Introduction

Within the sustainability transitions (ST) literature, and the multi-level perspective (MLP) in particular, established, mature or incumbent firms have tended to be stereotyped as 'locked-in' to socio-technical regimes, i.e. supporting established technological trajectories (Geels et al., 2016). Firms that introduce innovations are important conveyors of change, and in this respect many researchers have contributed to the understanding of firm level roles and strategies amongst new entrants and niche actors (e.g. Konrad et al., 2012). However, regimes have been black-boxed, and few studies have explored incumbents' responses to transition processes (Hansen and Coenen, 2015; Karltorp and Sandén, 2012). Farla et al. (2012, p. 996) stress that if "*we understand the struggles of actors with competing interests (…) we will better be able to assess the conditions for sustainability transitions to materialize.*" Following this research call, this article seeks to complement other existing case based studies of incumbents in established sectors by investigating variation of incumbents in terms of diversification activities as they respond to changing selection pressures on their core activities as well opportunities associated with novel technologies and emerging industries.

Our point of departure is that a too narrow perspective on established firms and their innovation processes comes with the risk of relegating incumbents' innovative capacity and potentially positive role in the much-needed transformation of current unsustainable energy systems. Incumbents within their given sector possess the resources to steer future directions in their industry and influence regulatory matters in political decision making through lobbying, but are also capable of creating substantial changes beyond their industry through re-allocation of human and financial resources to develop or deploy new technologies (Geels and Schot, 2007). Incumbents that diversify into other (emerging) sectors may contribute with enhanced credibility of novel technologies, technological variety and innovation, important knowledge and resource transfer (Erlinghagen and Markard, 2012), the latter being of particular importance in terms of scaling up renewable energy technologies (Karltorp, 2014).

Most studies of incumbents in the ST literature have focused on 'lead firms' such as utilities, (major) car manufacturers and fossil fuel producers. These industries, however, encompass a broad range of firms such as suppliers of specialized and intermediate products and services. In the energy sectors, lead firms such as utilities or oil and gas producers are most often technology *deployers* or users, rather than technology *developers*, suggesting that considerable technological de-

* Corresponding author at: Department of Industrial Management, SINTEF Technology and Society, P.O. Box 4760, 7031 Trondheim, Norway.
E-mail addresses: markus.steen@sintef.no (M. Steen), tyson.weaver@ntnu.no (T. Weaver).

http://dx.doi.org/10.1016/j.respol.2017.04.001
Received 5 October 2015; Received in revised form 18 March 2017; Accepted 1 April 2017

velopment and innovation (new products and services) occurs amongst suppliers, many of which must also be regarded as incumbents. We suggest that insufficient attention has been given to these 'non-lead' firms (various product/service suppliers/providers) that develop new solutions (often in collaboration with users) and provide a range of necessary inputs and complementary assets to lead firms. A more comprehensive view of understanding different types of incumbents (i.e. in different value chain positions) may provide valuable new insights into incumbents' involvement in the development of new technologies.

Against this background, this article contributes to understanding industrial transformation in energy industries through an analysis of incumbents' diversification activities within and across several energy sectors. To this avail, we analyze the results from a survey conducted in 2013 of both producers and product/service suppliers in Norwegian energy sectors, focusing on Norway's two dominant energy sectors: (large-scale) hydropower and (offshore) oil and gas (O & G). Both of these sectors have experienced forms of turbulence or stagnation (i.e. changing selection pressures) over the past two decades. In previous case studies we have studied how some firms in these industries have responded to altered business environments, and found that internationalization and diversification into emerging sectors such as offshore wind power has been an important strategy (Steen, 2016; Weaver, 2016). Our survey data allows us to expand on this previous qualitative work to explore the extent and direction of diversification into new energy technology fields by a range of incumbent firms and provide explanations for these trends. Our analysis thus has both inter-temporal (past, present and future) and cross-sectorial (multiple energy sectors) dimensions. The main research questions addressed in this paper are *what sectorial level historical, current and future diversification development patterns have been observed or are anticipated in Norwegian energy industries*, and *how can these development patterns be explained?*

Following several calls for more multidisciplinary research designs, our analytical framework seeks to contribute to the ST literature by drawing on perspectives on firm diversification and implications for industrial transformation. Our focus on diversification is (empirically) not geographically bounded within Norway, as internationalization components are incorporated into our research design. Having that said, cross-sectoral diversification rather than geographical (market) diversification is our main concern here, reflecting that our primary objective is to shed light on industrial transformation processes that may be associated with sustainability transitions. We must also note that it is beyond the scope of this article to discuss in-depth incumbents' 'non-market' responses to changes in their external business environment, such as strategies that seek to influence political, legal or social arrangements (Lauber and Sarasini, 2015).

The article proceeds as follows. In the following section we outline the theoretical framework. In Section 3 we present our research setting, design and data. Section 4 presents the empirical results, which we discuss in Section 5. We then summarize, present ideas for further research and outline policy implications in the conclusion.

2. Theoretical framework

2.1. The multi-level perspective and the roles of incumbents

Seen broadly, global energy systems are currently undergoing a shift from large-scale centralized power production based on a limited number of energy sources (coal, gas, nuclear (and in some contexts) hydropower) to much more varied systems based on or incorporating many (renewable) energy production technologies (e.g. wind, solar, bioenergy, etc.). This 'greening' process of global energy systems, with the rise of intermittent decentralized production (e.g. rooftop PV), storage challenges, and demands for infrastructure innovation (smart grids, etc.) imply that many energy industry incumbents are presently subjected to (potentially) disruptive change.

Following the terminology of the multi-level perspective (MLP) (Geels, 2002), these change processes affecting established socio-technical systems are a result of both changing 'landscape' pressure (e.g. emission reduction targets, fossil fuel resource depletion, citizen concern of climate change) and the emergence of various new and rapidly developing niche energy technologies (e.g. solar, wind). Radical change is seen to emerge in technological incubation spaces (niches), and "*are carried and developed by small networks of dedicated actors, often outsiders or fringe actors*" (Geels and Schot, 2007, p. 400). The 'socio-technical regime' concept in ST literature is based on evolutionary economists Nelson and Winter's (1982) seminal introduction of the notion of 'technological regimes', which refers to shared cognitive routines within a community of engineering practice and which explains why technological change tends to follow specific trajectories. Building further on this work, Hoogma et al. (2005, p. 211) defined a socio-technical regime as a "*whole complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, established user needs, regulatory requirements, institutions and infrastructures.*" As such, regimes form the institutional context for technological and economic practices, problem-solving and strategic decision making within an industry (Geels, 2010; Fuenfschilling and Truffer, 2014). Path dependence and the embeddedness of technology in routines, production practices, organizational structures, infrastructures, consumption patterns, cultural values and mental frameworks explains why innovation processes in regimes are mainly incremental and aimed at optimization rather than transformation. The sustainability challenge is thus aggravated by the path dependent co-evolution of institutions and technology leading to established socio-technical systems being "*locked in and stabilized on several dimensions*" (Geels, 2010, p. 495), making transitions long term processes often spanning several decades.

The MLP posits that socio-technical transitions come about due to interacting processes within and between three levels of heterogeneous configurations of increasing stability (niche, regime, landscape), whereby pressure from the landscape level destabilizes regimes and opens up windows of opportunity for niche technologies (Markard et al., 2012; Geels, 2010). Whilst seminal MLP articles (e.g. Geels, 2002) distinguished starkly between 'regimes' and 'niches', for instance in terms of actor involvement and roles, this interaction has more recently been recast as relatively porous, suggesting that regimes and niches form a continuum rather than dichotomies (Fuenfschilling and Truffer, 2014; Smith et al., 2010). This reconceptualization of regime-niche interaction also led Turnheim and Geels (2013) to argue that destabilization of regimes may result from reduction in flows of resources, decreasing legitimacy or eroding endogenous commitment, i.e. various exogenous and/or endogenous factors to a focal regime. Various 'transition pathways' or types of transitions have been identified, depending on nature and timing of selection pressures and the availability of resources (endogenous and exogenous to the regime in scope) to adapt to those pressures (Smith et al., 2005; Geels and Schot, 2007).

It is commonly inferred that incumbent firms form the backbone of regimes. Whereas regime actors also incorporate users, regulators, industry associations and so on, our focus is on the industry or production side of the regime. In so doing, we follow Karltorp and Sandén (2012), who suggest that changes in established sectors (such as hydropower or O & G) – for instance if incumbents diversify into other sectors – is indicative of regime change, or, in the words of Turnheim and Geels (2013, p. 1749)Turnheim and Geels, 2013Turnheim and Geels (2013, p. 1749) regimes losing "*their grip on firms-in-industries*". Incumbents in regimes have however been tended to be black-boxed (Hansen and Coenen, 2015), and few studies have explored incumbent firms' responses to transition processes (Geels, 2014a). Regarding incumbents, key questions of particular relevance to transition processes concerns their ability and willingness to innovate and explore niche technologies and also whether or not they contribute to creating an enabling environment for new technologies, for instance through