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Institutional change from the margins of natural resource use: The emergence of small-scale bioenergy production within industrial forestry in Finland

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ABSTRACT

There exists a growing interest in understanding the mechanisms of innovations in the forestry sector. This article contributes to that goal by presenting a detailed study of the emergence of small-scale wood energy production practices in Finland. Given the distinctive and institutionally strong orientation of Finnish forestry towards raw material production for the pulp and paper industry, such innovative ways of using forest resources seem somewhat improbable and surprising. Despite this, we argue that the development of these new production practices can be understood as a process of institutional renewal that combines elements of continuity and novelty. In our empirical analysis, we follow the emergence of a new forest management category of "young forest" and explore how its naturalization as part of various institutional rules, identities and practices enabled the birth of local wood energy production within the forestry sector. In order to elucidate this multidimensional change, we analyze the new forest category as a boundary object, a socio-technical category with multiple functions and identities, within the large technological system of forestry. These analytical concepts help us illuminate how various material and discursive practices—both in the forestry and energy sectors and at the local and national levels—were able to interact for innovation and institutional change.

1. Introduction

This article explores the possibilities of economic renewal in a strongly institutionalized economic sector, namely, the Finnish forestry sector. The Finnish forestry sector is a good example of an economic success story that has for decades been subject to incremental changes to improve its performance. Structural changes of global markets have recently, however, put the forestry sector under a heavy pressure to renew. Research on innovation and institutional renewal has well identified the importance of deliberate efforts on research and development, as well as the functioning of and conditions provided by innovation systems. At the same time, the possibilities and mechanisms of less coordinated and totally unforeseen innovations that emerge from the margins of existing systems have remained less understood. By presenting a detailed case of a complex bottom-up bioenergy innovation within the Finnish forest sector, we will suggest that such marginal developments may be significant sources of renewal, even for large and institutionalized sectors.

In Finland, the path-dependent nature of economic development in the forestry sector has been strengthened by the exceptional intertwining of national economic and business interests. The export-oriented forest industry connected the previously peripheral economy of Finland to the world economic system in the late 19th century (Kuisma, 1993), and even the later modernization of the Finnish economy was mainly linked to innovations in the pulp and paper industry (Lehtinen et al., 2004). The production strategies were backed by national forest policy. Forest resource use statistics show that 66% of the total consumption of timber (nearly 81 million m^3) is used by pulp and paper industry while only 26% of timber is used by woodworking industry in the mid 2000s (Ylitalo, 2005). Only some 17%, of which the majority is industrial waste wood, is used for energy production.

The Finnish forest industry's strategy of focusing on high quality printing papers for the European market has recently proven to be an extremely uncertain strategy in the globalizing markets, resulting in the closing down of paper mills and thousands being unemployed (Niskanen et al., 2008). The challenge of the economic renewal of the forestry sector has been discussed in terms of enhancing the productivity and developing new sources of income through innovation and entrepreneurship (e.g. Rametsteiner et al., 2006). The Finnish forest industry has been blamed for the lack of innovations, with its low research and development (R & D) intensity being identified as one of the obstacles for renewal. Only 0.5–0.7% of

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annual forest industry turnovers have been invested in developing new products and processes (Palmberg, 2001). Moreover, the funding has been channeled into pulp and paper related innovations (Häyrynen et al., 2007). The Finnish forest industry's input into the development of new timber products has been modest despite it being a major player in the woodworking industry. It has also been estimated that the sector is dominated by large companies with relatively few SME's.

In line with more general academic literature on economic transition, obstacles and possibilities for innovations should be studied in the context of innovation systems, rather than singular firms or products. The need to analyze system-level changes has particularly been acknowledged in literature dealing with global environmental concerns: for example, responding to the EU climate policy targets to increase the share of bioenergy up to 20% requires radical improvements to production and consumption systems, as opposed to singular product innovations (Seyfang and Smith, 2007). Innovation systems involve the interaction between various organizations: market actors, companies, states or regional governments, universities and other research organizations. The approach has been used in comparing and evaluating the ability of regions and countries to produce innovations, but lately it has also triggered deeper understanding of the social dynamics behind innovations (Geels, 2004). For instance, system-level pressures to established technological regimes, such as changing policies or increasing costs, and capacities to adapt to these pressures, such as new competencies and funding systems, have been analyzed (Smith et al., 2005).

Above all, such analyses help to understand innovations as socially and institutionally embedded, that is, as a result of complex interactions between science, policy, enterprises and the rest of the society. At the same time, they recognize the challenge that path-dependency poses to renewal in established sectors. For example, a recent analysis of the Finnish forestry sector points to the large-scale nature of existing industrial production as forming an important structural condition for its change (Niskanen et al., 2008). Large-scale pulp and paper production is dependent on its ability to control the economies of scale, e.g. raw material flow and energy costs. Therefore, companies avoid investing in production technologies that would increase competition for strategic resources, although on a rhetorical level, the Finnish forest industry has committed itself to R & D on new products (Finnish Forest Industries Federation, 2006).

How, then, can the sluggishness be overcome and something novel be born within highly homogeneous economic fields? We suggest that more attention be paid to points of friction in the margins of large socio-technical systems, such as the forestry sector. The actual seeds of innovation are not necessarily located within identified business challenges or purposeful programs of existing institutions. Instead, shifting the focus from the core of a system to boundary elements that try to cope with its normal modus operandi may reveal surprising developments of innovation and change. Paradoxically, therefore, the strongly institutionalized and path-dependent forestry sector, with unified goals and the tendency to ignore other options, has offered us, social scientists interested in institutional change, a good opportunity to study the mechanisms of change.

Our case is a successful bottom-up innovation, small-scale production of bioenergy, that grew out of the interplay, and mismatch, between the institutionalized, national forest management system and the everyday problem-solving and livelihood practices of forest owners. Presenting a stark contrast to large-scale industrial production, small-scale bioenergy innovations enable us to examine and discuss the role of minor, even marginal changes as triggers of technological transitions.

Our analysis is a synthesis based on an extensive study on wood energy production in Finland (Åkerman, 2005; Åkerman et al., 2005; Åkerman and Jänis, 2005; Peltola, 2007). Study data were compiled from three sources. Firstly, 443 newspaper articles were culled from the Finnish newspaper, *Metsälehti* between the years 1985 and 2001, a period during which wood energy use increased significantly. *Metsälehti* is a professional magazine directed at forest owners and forestry professionals, and it is widely read among the target group. Secondly, 22 thematic interviews were conducted with local heat producers between the years 2003 and 2004, focusing on the history and development of small heating businesses. Thirdly, an in-depth case study was performed of the Tuupovaara heating cooperative in the North Karelia region in the eastern part of the country, exploring the intertwining of local and broader conditions for small-scale heating activities.

2. Theoretical starting points: institutional change of large technological systems

We take advantage of several theoretical concepts developed to understand the nature of change in production systems. We start with an introduction to the transformation of forest into a *socio-technical category* during the history of modern forestry (Section 3). This development illustrates the process of institutionalization of forestry as a *large technological system* enabling the large scale utilization of natural resources. The theoretical framework of large technological systems, originating as an historical approach to technology (Hughes, 1989), seeks to explain stability and change of systems, such as those pertaining to energy, communication or transport. The systems have grown around a radical socio-technical innovation, e.g. the lighting bulb, and coevolved with the rest of the society. They are thus not just collections of artifacts and machines but form a web of interconnected, heterogeneous socio-technical elements.

Closing off options and alternatives is typical for large technological systems, which tend to gain institutional weight or *momentum* through all the physical investments, interests, knowledge, skills, rules, and other structures that form their core relations (Hughes, 1995). The technological momentum of large technological systems captures both the inertia of the system and its ability to push development in a particular direction. The effect is built on a selection process: orientation towards particular technical and social problem settings, paradigms and strategies. The legitimacy of visions and knowledge is thus an important element of stability in large technological systems.

We will indicate that the key trigger for small-scale bioenergy production was the rise of a new management problem, the dilemma of "unmanaged forests", in Finnish forestry discourse and policy at the end of the 1980s (Section 4). This dilemma was an outcome of the implementation of the rotation-based forest management system since the 1950s. The increasing use of forest biomass in energy production since the mid 1990s, and especially its small-scale segment, the organization of farmer-forest owners to become energy producers, is a sign of internal tensions regarding the production strategies of forestry and the discrepancy between the needs of the forest industry and the livelihood of private forest owners.

The attempts to solve the forest management problem produced a new administrative category, "young forest growth", in the Finnish forest administration. Thus, the role of forestry categories is the focal point of our analysis. Following Geoffrey Bowker, we see the socio-technical categorization of forests as a technique of controlling forest use (Bowker, 2000), and as such an integral element of the socio-technical relations of forestry. Therefore, the change of forest categorizations is also crucial. By following the origin and different uses of the new category, we suggest that although it was initially developed to solve the problems of the institutionalized forest management system, its appearance also resulted in unanticipated ways of forest use, small-scale wood energy production, which, in the end, partly questioned the goals of forestry (Section 5).

To illustrate how the new category started to function as an institutional catalyst we employ the concept of *boundary object* (Star and Griesemer, 1989), which originates and is best known in the social studies of science and technology. Boundary objects, by definition,