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Unpacking policy processes for addressing systemic problems in technological innovation systems: The case of offshore wind in Germany

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ABSTRACT

While empirical studies on technological innovation systems (TIS) usually focus on policy instruments and their suitability for curing identified weaknesses of such emerging systems, the underlying policy processes and their effects have been largely disregarded. We address this gap by exploring the style of two crucial policy-making processes and how it influences the functioning and performance of a TIS, taking the case of offshore wind in Germany. Our findings indicate important positive and negative impacts of the policy style on the TIS. For example, the muddling through character apparent in one of the policy processes negatively influenced entrepreneurial activities, knowledge development and finally technology diffusion, whereas the participatory nature of both processes had a positive impact both on TIS functioning and performance. Based on our findings we derive implications on how to improve policy making so as to foster the development of an emerging TIS.

1. Introduction

Analyses of technological innovation systems (TIS) focus on emerging technologies often in early phases of development (e.g. [32]). Typical for these early stages is the existence of a number of failures hindering the development and diffusion of the young technologies, so that it is particularly hard for them to compete with established technologies [10]. For overcoming these failures and allowing the technologies to become market-ready, government intervention is needed [38,8].

Against this background, the goal of TIS studies is to identify such failures or systemic problems and, based on this, suggest concrete tools for policy intervention, so as to purposefully foster the technology [33]. There exists a considerable number of studies having completed exactly such analyses. One of the first studies of this kind is Negro et al. [46] that analyzes the functional patterns of the biomass TIS in the Netherlands identifying corresponding system failures and suggesting policy measures for addressing them. Further studies that examine systemic problems via a functional analysis of TIS and identify areas for policy intervention include, for example, Jacobsson and Karltorp [34], van Alphen et al. [62], and Jacobsson [31]. While the analytical framework applied in these studies has helped policy makers by analyzing where policy intervention is needed and has suggested policy instruments, studies have focused much less on associated policy processes.

In this regard, recent studies identified a need for a better conceptual understanding of institutions in TIS, including the regulatory frame [61] and tools for the selection of policies that address system failures [13]. Related to that, the literature called for a more detailed understanding of the dynamics of policy intervention processes that result from addressing systemic problems [28]. These studies hint at the importance of more thoroughly examining policies in TIS, particularly policy processes. It is therefore the goal of this paper to address this gap by analyzing policy-making processes that respond to systemic problems and exploring how these processes influence TIS functioning and TIS performance in terms of technology use and diffusion [26,4]. In particular, we focus on the style of these policy-making processes – or policy style in short – as the policy style has been argued to be an important determinant for eco-innovation [35], and analyze the role of this style for the TIS. This focus on the role of the policy style allows for revealing vital information about the nature and impact of such policy processes, which in turn enables us to

Abbreviations: BMF, Federal Finance Ministry; BMU, Federal Environment Ministry; BMWi, Federal Economics Ministry; BNetzA, Federal Network Agency; CDU, Christian Democratic Union; DOTI, German Offshore Test Field and Infrastructure Society; EEG, Renewable Energy Act; EnWG, Energy Economy Law; FIT, feed-in tariff; InfrStrPlBeschlG, Infrastructure Planning Acceleration Act; OW, offshore wind; SPD, Social Democratic Party; TIS, technological innovation system; TSO, transmission system operator; VDMA, German Engineering Association

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derive concrete policy recommendations for how to improve policy making so as to foster the development of an emerging TIS.

For our analysis we frame policy processes as part of a comprehensive policy mix concept [53]. It is these processes that shape the elements of the policy mix – that is the policy strategy and various instruments. Thereby the processes can have an indirect impact on innovation. However, it has been argued that policy processes may also directly influence innovation, yet with few empirical studies investigating this link.

We address this gap in the literature by examining the role of policy processes for technological innovation systems, taking the case of offshore wind in Germany. The main reason for choosing this case is that the German offshore wind TIS has experienced several systemic problems that were addressed by policy makers, ultimately contributing to the evolution of a complex policy mix as well as to some positive developments in terms of TIS functioning and performance [50,51]. Methodologically, we combine expert interviews and desktop research to analyze the policy-making processes in which two crucial systemic problems were addressed. These problems posed the greatest barriers in the TIS in recent years and were thus decisive for the further direction of the TIS. In doing so, we shed light on the direct and indirect mechanisms by which the style of these processes impacted TIS functioning and TIS performance.

In the following we will first review the literature on technological innovation systems and policy processes, with a focus on policy-making processes and their relevance for TIS functioning and performance (Section 2). We then provide a brief overview of the research case (Section 3), and a delineation of our methodological approach (Section 4). Subsequently we describe the policy-making processes as well as the associated policy-making style and analyze the effects on the TIS (Section 5). Finally, Section 6 concludes.

2. Technological innovation systems and policy processes

The technological innovation systems (TIS) approach has been widely applied to the analysis of emerging technologies, among others in the field of energy technologies [3,33,61]. The major goal of these studies is to detect system strengths and weaknesses by analyzing the structure and functions of the TIS. While structural analyses of TIS focus on describing its actors, networks and institutions and thus constitute static inquiries [15], functional analyses map a range of different activities taking place in the TIS. For doing so a number of key functions are applied ([26], see Table 1). This functional analysis serves as prerequisite for explaining the performance of TIS in terms of the development and diffusion of innovations [26,4]. Based on the identified system strengths and problems, concrete recommendations for government intervention are given so as to improve system functioning. In doing so, studies often suggest which policy instruments might best be suited to remove the systemic problems [46,65].

In terms of policy, TIS studies have so far focused on policy instruments and their role for innovation systems. That is, some studies show how policy instruments impact innovation systems [37,44], while other studies state which policy instruments may be effective in improving TIS performance [45,62]. Another aspect TIS studies consider with regard to policies is system building, such as how actors shape the build up of innovation systems and their institutions, including policies [39,40].

However, policy processes have as yet been largely neglected in TIS studies [13,27], although their importance for innovation has recently been stressed, e.g. in the policy mix literature. For instance, Flanagan et al. [24] in their call for a reconceptualization of the policy mix for innovation point out that policy processes should be an integral part of policy analyses. Rogge and Reichardt [53] acknowledge the importance of policy processes in their policy mix concept, based on their potential influence on policy mix effectiveness, for instance regarding innovation.

The study by Chung [12] on technology and innovation policies in Taiwan is one of the first and very few ones to focus on the analysis of policy processes in an innovation system context. It analyzes the link between the innovation policy-making process, the design of innovation policy instruments and the development of the innovation system, finding vital dependencies between these factors. However, what is still lacking is an analysis of the direct impact of policy processes on the innovation system.

In order to address this gap an important starting point is to clarify what is meant by policy processes, given the multitude of definitions that have been used [29]. Due to our focus on policy in the context of innovation we rely on Rogge and Reichardt [53, p. 1625] who, in their policy mix concept for innovation, define them as “political problem-solving process among constrained social actors in the search for solutions to societal problems”. Besides the crucial role of actors, this definition stresses an important aspect for this study, namely the fact that policy processes aim at solving (societal) problems.

Policy processes with their plethora of diverse actors with hetero-

Table 1
Key functions of technological innovation systems.
Source: adapted from [66].

Function (function number)	Description
Experimentation and production by entrepreneurs (F1)	Entrepreneurs are essential for a well-functioning innovation system. Their role is to turn the potential of new knowledge, networks, and markets into concrete actions to generate – and take advantage of – new business opportunities.
Knowledge development (F2)	Mechanisms of learning are at the heart of any innovation process, where knowledge is a fundamental resource. Therefore, knowledge development is a crucial part of innovation systems.
Knowledge exchange (F3)	The exchange of relevant knowledge between actors in the system is essential to foster learning-processes.
Guidance of the search (F4)	The processes that lead to a clear development goal for the new technology based on technological expectations, articulated user demand and societal discourse enable selection, which guides the distribution of resources.
Market formation (F5)	This function refers to the creation of a market for the new technology. In early phases of developments this can be a small niche market but later on a larger market is required to facilitate cost reductions and incentives for entrepreneurs to move in.
Resource mobilization (F6)	The financial, human and physical resources are necessary basic inputs for all activities in the innovation system. Without these resources, other processes are hampered.
Creation of legitimacy (F7)	Innovation is by definition uncertain. A certain level of legitimacy is required for actors to commit to the new technology and execute investments, take adoption decisions etc.