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Moving beyond the heuristic of creative destruction: Targeting exnovation with policy mixes for energy transitions

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ABSTRACT

Scholars looking at policy mixes for the energy transition and seeking to facilitate a move away from fossil-based structures are increasingly addressing the opposite side of innovation. To describe this, the article introduces the concept of exnovation, referring to attempts to end fossil-based technological trajectories in a deliberate fashion. It applies a framework that encompasses innovation and exnovation alike in order to investigate the policy mix of the German energy transition. Beside finding that energy transition policy mixes need to emphasize regulatory instruments more in order to bring about decarbonization, the article also describes some general aspects of the policy mix design required to govern the innovation-exnovation nexus.

1. Introduction

With a focus on technology policy regimes [1], policy mixes for energy transitions aim to bring about sociotechnical change toward sustainable energy production systems by introducing, changing, or terminating instruments that (de-)regulate industries, (re-)direct efforts, and set (dis-)incentives. Scholarship on sociotechnical transitions refers to the heuristic of creative destruction as a quasi-evolutionary process [2] set in motion by innovations that subsequently destabilize sociotechnical regimes [3–6]. The energy transition literature understands innovation as the cornerstone of change, and hence, it has assessed various policy mix conceptions and their principles in great detail with a view to promoting renewable energy innovations (e.g., [7–11]). The idea of creative destruction, first introduced by Schumpeter [12], has been associated with competition that is driven by entrepreneurial incentives and market selection [13] and that thus destroys pre-existing states of market equilibria [14–16]. A substantial body of literature on niche management has therefore underscored the need to better promote renewable energies by developing innovation-supporting policies in order to bring about desired change and replace carbon-intensive technologies (e.g., [6–8,17]).

However, the utility of creative destruction should be reconsidered for a couple of reasons. As Schumpeter [12: 82] notes, “capitalism, then, is by nature a form or method of economic change and not only never is but never can be stationary.” The implication is that processes of creative destruction are mostly uncertain in their outcome [15], thus contradicting the very notion of niche management, which implies having control over outcome and endeavor. Further, transition scholarship has underscored that innovative niches might face resistance from actors representing the current government and vested interests, which is one reason why innovations may fail to destabilize the system of concern [10,8,7,4]. Most importantly, however, radically innovative technologies can coexist in markets with unsustainable, status quo technologies [18,19]. This seems to be an especially pressing problem for energy transitions that aim to replace climate-unfriendly technologies with immediate innovation. A good example of this dilemma is that of the German energy transition: Whereas the share of gross renewable electricity production has grown considerably over the years, an increasing share of electricity based on coal and lignite is being exported [20].[1] This is related to indecisiveness on the part of the government and to the lack of regulation (e.g., [20–22,11]). Consequently, incentives seem an unlikely means of achieving decarbonization; tougher regulations enforced by governments will also be necessary.

While the topic of innovation has been studied extensively in the policy mix literature on energy transitions, little attention has been paid to what could be called the diametric opposite of innovation: exnovation. Exnovation is a process in which a given technology is currently no longer used because its physical infrastructure has been deliberately removed; this distinguishes exnovation from concepts of discontinued use [23,24]. Originally, the term came up in macro-organizational innovation studies [23,25] and sectoral innovation studies [26,27] but it has recently gained traction in the literature on sociotechnical transitions (e.g., [28–30]).

The reasons for exnovating technologies – for instance, for removing the technologies supporting fossil-based energy producing systems – are

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[1] In 2015, about 10% of supposedly coal- and lignite-generated electricity was exported [98].

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that such technologies are societally framed as obsolete and undesirable, particularly in regard to their environmental externalities [30]. This is not just true for physical infrastructure like producing units, utilities, or grids; it also includes practices that are part of complex sociotechnical energy-producing systems [29]. Therefore, as Gross and Mautz [30: 146] correctly point out, "in order to eliminate existing unsustainable modes of energy utilization and technology development, a gradual process of exnovation will inevitably be required that is almost certain to herald the end – sooner or later – of the fossil fuel phase and perhaps also the nuclear phase." As noted at the COP 21 in Paris, perhaps the most pressing goal for energy-producing systems is decarbonization in the face of climate change [31]. From this perspective, exnovation is a desirable goal for energy transitions in their aim to move toward fossil-free energy futures.

It is, however, unclear how scholars should conceptualize a policy mix aiming not only to introduce renewables but also to exnovate fossil-based energy technologies, especially if we do not rely on the principle of creative destruction. This not only relates to the selected instruments and their aims, but also to their relation to each other and to pre-existing policy mixes governing electricity production. While the guiding principles for conceptualizing policy mixes that promote energy-market innovation have been well-researched [8,9,17], it is unclear whether these guiding principles can facilitate the design of policy mixes that address both innovation and exnovation sufficiently well to achieve decarbonization in the face of climate change.

The task of this article is, therefore, to address this gap. It looks at the potential of a policy mix to encompass exnovation, which is an important element of energy transitions that target decarbonization and aim to completely remove fossil-based electricity production technologies. This complements research on the destabilization of industrial (electricity) regimes. Looking at the "coupling" of innovation and exnovation [26] and drawing on the case of the German energy transition, the analysis categorizes the instruments of the policy mix that seek to promote innovation and exnovation and thus decarbonize electricity production in accordance with the Kyoto climate targets. Further, the analysis strives to comprehend the temporal dimension of the emergence of this policy mix so that it can better analyze the relation between innovation and exnovation. This contributes to the scholarly understanding of exnovation of fossil-based electricity production systems in situations where renewable replacements are within reach and alternative, more efficient fossil-based electricity production technologies are no longer a politically acceptable option, as is currently the case in Germany. Whereas nuclear energy is about to be exnovated via amendment [6], it is also rather unlikely that coal and lignite will be replaced by natural gas for two reasons. One reason is the merit order effect, which makes natural gas-based electricity production expensive in Germany (e.g., [32]), and the second reason is the maintenance of German energy security policies aiming at the reduction of its high dependence from Russia's natural gas imports [33,34].

The general question addressed here in this article is therefore not only what a potential policy mix addressing both innovation and exnovation would look like, but also what design principles such policy mixes could be based upon. The remainder of this article is structured as follows. Drawing on the concept of exnovation and on the policy mix literature, Section 2 conceptualizes a framework that introduces the theoretical foundation of this analysis. This will help the article to assess the policy mix targeting the innovation-exnovation nexus that governs energy transitions. Section 3 introduces the general method used to apply the proposed framework to the case study, which is developed in Section 4. I choose to draw on the German energy transition since this case is highly informative regarding the relation between innovation and exnovation. After a discussion in Section 5, which is structured according to this framework, Section 6 contains concluding remarks.

2. Framework

2.1. Addressing exnovation by acknowledging the innovation-exnovation nexus

There are two strands of the sustainability transition literature that generally deal with the deliberate termination of technologies. The first strand of literature relates to deliberate termination due to policy actions. Such literature looks at organizational termination (e.g., [35]), or policy termination (or dismantling) (e.g., [36]) and identifies supporting factors, such as changes in administration or periods of political turbulence, as windows of opportunity for change [37,38]. A good example is the case study by Turnhout [39] on the change of instruments in the policy mix for environmentally friendly land-use management in the Netherlands. Yet this work is not linked to the termination of specific technologies or specific technological regimes; it merely focuses on the termination of the policies themselves or of specific elements of a given system, such as organizations. The holistic perspective of exnovation differs from such concepts because it extends this perspective to encompass an entire given system.

The second strand of literature, which has already been mentioned above, relates to, for instance, industrial discontinuities and industrrial liefe cycles (e.g., [40]), product elimination (e.g., [41]), technological innovation systems (TIS) [42], or regime destabilization (e.g., [10,5]). This work bases its quasi-evolutionary understanding of change – in which innovations push products, technologies, or entire industries out of (generally liberal and unregulated) markets – on the heuristic of creative destruction. One example of the recent literature on the energy transition policy mix is a study by Kivimaa and Kern [17]. The study, which expands work on TIS by examining regime destabilization, rightly points out that this destabilization can enhance innovation pathways, a topic insufficiently addressed by policy mix literature. Unfortunately, the study compares policy instruments that relate to regime groups such as "mobility, heating in buildings and electricity" [17: 211], thus obscuring a focus on specific innovation-destruction/destabilization interactions that could lead to the removal (and not just the destabilization) of the given technology. It therefore remains unclear to what degree regime destabilization and disruptive innovation leads to the complete removal of a given technology. To address these gaps, the framework proposed here looks at what could be termed exnovation policy instruments by taking into account their relation to renewable energy innovation policy instruments in the context of the German energy transition policy mix.

Electricity provision is a public service, and the welfare of modern states depends on it; governments thus show great interest in supporting this service [43]. The reasons to exnovate depend on why a previous innovation (in this case carbon-based electricity production) was introduced [23]. For instance, an innovation might have undesirable effects and could be evaluated on those grounds, which is true in the case of energy-producing technologies that have arbitrary environmental effects. It would therefore be desirable to change the existing policy mix in order to move away from such technologies. It is clear that if old energy-providing structures become exnovated, new alternatives must be waiting in the wings in order to prevent blackouts [44]. An energy-transition-oriented policy mix that includes exnovation as a policy goal should hence also look at innovation and its functional relation to exnovation—the innovation-exnovation nexus.

This article aims to extend the literature that sees innovation as a mere driver of technological discontinuity by also acknowledging exnovation as a driver of the unfolding innovation potential [24]. Further, to enhance exnovation, more decisive government action should be given more importance. Kimberly [23: 92] points out that "changing executive priorities and changing patterns of adoption behavior" might lead to exnovation. It is noted that "particularly in public-sector organizations, termination of governmental support for a particular technology may force exnovation" [23: 92]. In reference to this, Clark and