Out of the Comfort Zone!

Governing the Exnovation of Unsustainable Technologies and Practices

Innovations are important for sustainability transformations, yet often prove insufficient for replacing established unsustainable structures. The promotion of renewable energy, for example, has been insufficient for pushing coal out of the energy market. The prevalent "innovation bias" should be overcome by complementing innovation politics and research with a stronger occupation with the purposive termination of unsustainable technologies, products and practices. This article therefore introduces the concept of "exnovation" and discusses the need of, as well as different approaches for, the governance of exnovation processes.

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In 2015, the world's leaders adopted two remarkable agreements: the *Paris Agreement* to the *United Nations Framework Convention on Climate Change (UNFCCC)* and the *2030 Agenda for Sustainable Development* including the 17 *Sustainable Development Goals (SDGs)*. Together the two agendas provide a legal framework and a strong normative call to finally start governing the transformation to low-carbon and resource-light societies and do so in a just way (Hermwille 2016a, 2017).

The transformation of power, transport or food systems across the globe towards sustainability requires massive technological and social innovation. A lot of research and political support has addressed technological innovations, as can be seen in the fields of renewable energy or electric mobility. Focusing on new options and opportunities is convenient. Yet, it is now due time to get out of this comfort zone since it is increasingly obvious, as argued below, that promoting innovation alone is not sufficient to achieve the required transformation, at least not fast enough.

Echoing the normative framework mentioned above, this article calls for counterbalancing the "innovation bias" (David et al. 2016) with increased considerations of "exnovation" and its governance. Originating from the organizational management literature (Kimberly 1981), the term "exnovation" has started to take hold in the German debate on sustainability (e. g., Arnold et al. 2015, David et al. 2016, Hermwille 2017, Heyen 2017, Wehnert 2017). In its original form, Kimberly defined exnovation as "the removal of an innovation from an organization. Exnovation occurs when an organization divests itself of an innovation in which it had previously invested" (Kimberly 1981, p. 91).

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Exnovation and Sustainability Transformations

Expanding on Kimberly's definition, we understand exnovation as the purposive termination of existing (infra)structures, technologies, products and practices. It can be driven by different actors (the innovator but also other actors), for different (economic, ecological, ideological, or other) reasons, and it may occur in the short term or over a longer term and step by step ("phase-out").[1]

In the context of sustainability transformations, a particular interest lies in exnovation cases where technologies are not just abandoned in the economic self-interest of business actors but for reasons of socio-ecological sustainability and through "exnovation governance". Governance here denotes the coordination of actions and steering of behaviour towards an explicitly public goal (Roger et al. 2017, p. 5 f.). Governance can consist of different modes (mainly hierarchy, market, network, and negotiations) and can be exerted by all kinds of state and non-state actors (Benz and Dose 2010). However, governments are of particular interest for the cases discussed below.[2]

This article aims to provide a conceptual frame as well as a practical impulse for discussions on how to govern exnovations, especially the phase-out of fossil fuels and associated technologies. It builds on recent publications by the authors (Hermwille 2017,

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Heyen 2016, 2017, Wehnert 2017), where practical examples (such as the nuclear phase-out process in Germany) and literature (especially on socio-technical change as well as policy change and policy termination)[3] have already been assessed. Now we take things further by providing a more systematic classification and discussion of different challenges and approaches for exnovation governance.

Examining the Concept of Exnovation and Its Value

Existing socio-technical structures are generally stable and advantageous compared to new ones. This can be attributed to different kinds of path dependencies (Unruh 2000). As a result, innovations remain in niches or simply supplement existing structures. Such parallel structures of "old" and "new" might even be especially harmful to the environment. For example, while the German *Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG)* has led to a significant increase in the production of renewable energy, electricity generated by lignite and hard coal has remained relatively constant in Germany, where cheap coal prices make its production and export economically attractive.

One could argue that the replacement of old technologies by new ones is just a matter of time and no governance of exnovation is necessary. With reference to Schumpeterian economics, this approach could be labelled "exnovation by creative destruction". But the abovementioned agendas and in particular the 1.5 °C goal in the *Paris Agreement* imply that time is the critical factor for keeping the world in balance. With regard to climate change, industrialized countries need to phase out greenhouse gas (GHG) emissions in the power sector by 2050 at the latest and in other sectors soon thereafter.

Despite the often limited effectiveness of sustainability innovations alone, they are what research has concentrated on thus far. In particular the transition literature on socio-technical system change (see Markard et al. 2012 for an overview) has clearly focused on early transition phases, niche development and the early diffusion of innovations (Stegmaier et al. 2014). In contrast, the more advanced phase of "breakthrough" and a corresponding destabilization of the existing system have received much less attention or, as in the work by Turnheim and Geels (2012), have been studied in cases where exnovation occurred through technical advances and shifted demand but was not intentionally governed (Kern and Rogge 2016). Rare exceptions looking at what we call exnovation governance include Stegmaier et al. (2014; "discontinuation governance") and Kivimaa and Kern (2016; "motors of creative destruction").

Mersmann and Wehnert (2014) suggest that different types of governance mechanisms may be necessary for the different transition phases. The focus on destabilization and exnovation governance is probably particularly fruitful in the breakthrough phase when niche innovations increasingly challenge what Unruh (2000) has termed the "techno-institutional complex". Exnovation and exnovation governance can serve as intuitive terms and as a fruitful umbrella concept for a much deeper scientific discourse on dynamics, challenges and (successful) governance approaches in such processes.

A regulated phase-out can offer legal as well as planning certainty for business, workers, consumers and infrastructure planning.

Governance of Exnovation – A Classification

Given the complex adaptive nature of the very socio-technical systems that ought to be transformed, the possibilities of "steering" are necessarily limited: path dependencies must be resolved and systemic change resistance overcome (Harich 2010). Resistance usually emerges when material and ideological interests related to the status quo are threatened (Bauer et al. 2012, Geels 2014, Hess 2014). Policy termination literature refers here to an "anti-termination coalition" (Bardach 1976, DeLeon 1978). In addition to actors who are directly affected, suppliers of products or expertise as well as politicians and bureaucrats feeling responsible for the >

1 Although one could translate exnovation as "ousting the new" or see it as an oxymoron, the Latin verb "novare" does not only mean "making new", but also "change", "transform", "break", "overthrow" (cf., *https://de.pons.com/%C3%BCbersetzung/latein-deutsch/novare*). In contrast to alternatives likes "exantiquation" or "exvetation", the term "exnovation" has an immediate and intuitive appeal to almost everybody we have introduced it to and is quickly understood, since it connotes strongly to be the flipside of, or a complement to, innovation. It is also easier to use in different languages than the term "discontinuation" introduced by Stegmaier et al. (2014). Moreover, the latter sounds misleadingly like a rather simple task of just ceasing to do something. By exnovation processes, however, we mean purposive acts and complex processes – similar to innovation (as the establishment of inventions).

2 In the international discourse on a phase-out of oil and coal, the term "managed decline" is increasingly used (see, e. g., the *Lofoten Declaration*, see *www.lofotendeclaration.org*). However, we regard "decline" as a politically unattractive term and "governance" as a more suitable term than "management".

3 While the literature on policy termination/dismantling (see Bauer et al. 2012 for a state of the art) looks at the termination or at least reduction *of* policies (mostly for economic reasons), our focus is on governance and policies *for* termination of socio-technical artefacts (mainly for ecological reasons) (see also Stegmaier et al. 2014 for this clarification). However, as challenges are similar (dealing with resistance), there is a lot to learn from the policy termination literature.

sector in question can be part of such a coalition, sharing the same problem perception and values (Geels 2014, Unruh 2000). Fearing losses, vested interests are especially motivated, and also especially strong as they are already well organised and have usually spent years building up relationships and resources (e. g., Pal and Weaver 2003, Sterk 2013). Geels (2014) refers here to "instrumental, discursive, material and institutional forms of power and resistance". Discursive methods include, for example, casting doubt regarding the necessity, feasibility and/or utility of a transformation (Oreskes and Conway 2010).

Given these challenges and increased legitimacy demands, exnovation governance needs to include more than just policy instruments for termination. This is also why we speak of phase-out and exnovation processes. Therefore, the following section on governance does not only look at political instruments (policy dimension) but also on actors and processes (politics dimension). To indicate the spectrum of different governance approaches, it presents a classification and discussion along four categories:

- actor interaction,
- policy instruments for termination,
- policy instruments for socioeconomic adjustments, and
- time horizon.

In each category, different possible characteristics are presented which can be combined for different governance approaches.

Actor Interaction:
Coalitions, Coercion or Consensus?

Exnovation might be pursued by a wide range of actors – not only from politics. Greenpeace has, for example, driven a campaign for the exnovation of Chlorofluorocarbons (CFC) in refrigerators and of paper bleaching with chlorine, and was even involved in the development of environmental-friendly alternatives, together with frontrunner companies.[4]

Promising approaches are usually broad coalitions of government parties, environmental groups and innovators of sustainable alternatives. Actors with motives and goals beyond environmental and climate protection can also broaden the coalition. While supported by environmental actors, the final decision to phase out black coal mining subsidies in Germany was primarily instigated by finance policy-makers from centre-right parties (Heyen 2011).

It is safe to say, however, that there is no transformation without conflict. This is particularly true in cases of politically driven exnovation where incumbent actors are affected economically. The question is how a government deals with such conflicts. A coercive approach by government and parliament would constitute unilaterally deciding on exnovation, allowing them to implement their preferences but with the disadvantage of a profound conflict with the affected actors, not only risking support and votes but also a legal dispute, for example, on expropriation matters.

Alternatively, they can opt for a consensual approach negotiating the terms of exnovation with the stakeholders – as was done in Germany in the cases of the first nuclear phase-out decision in 2001 ("atomic consensus") as well as the termination of black coal mining subsidies (Heyen 2011, 2017). Such negotiated compromises will not be fitting or feasible in all exnovation cases. Rather, this approach appears to be most suitable when substantial legal barriers or serious structural change looms.

Instruments for Termination:
Incentives, Bans or Standards

An early and basic step towards exnovation can be the withdrawal of environmentally harmful subsidies and public investment, for example, in the area of fossil fuels. Moreover, additional price-based instruments such as emission trading or taxation to curb GHG emissions from the power and other sectors are hotly debated. For example, the *European Emission Trading System* gives price signals for utility decision-makers. Such approaches can speed up the economically-driven process of creative destruction. In practice, however, implementing these instruments in an ecologically ambitious way proves to be an extremely difficult political task (Gawel et al. 2014, Hermwille et al. 2016).

While these economic instruments usually cannot give certainty about the "if" and "when" of (complete) exnovation, regulation often does. Regulatory bans or the withdrawal of (operating) permits for existing facilities constitute direct exnovation instruments. Examples are the bans on production and use of asbestos, CFC, DDT, or leaded fuel in many countries.

More indirect exnovation laws than explicit bans can be based on ambitious standards, like efficiency requirements or pollution limits. An example of this approach is the step-by-step withdrawal of inefficient light bulbs from the EU market. In its *Ecodesign Directive*[5], the European Commission adopted continuously increasing efficiency requirements for lighting at levels that made it impossible for more and more segments of classical light bulbs to fulfil them (cf., Stegmaier et al. 2014).

It should be noted that there is no silver bullet instrument for exnovation. But regulation seems to offer more legal as well as planning certainty for business – but also for workers, consumers, infrastructure planning, and the educational system.[6]

Instruments for Socioeconomic Adjustments:
Support for Companies, Employees and Communities

Exnovation can have potentially serious socioeconomic effects on companies, their employees or even entire regions. Even if exnovation has positive net effects on the national economy, important distributive issues may arise in cases in which technologies are to be phased out, and stranded assets linked to them are concentrated in specific regions or sectors – like in the case of coal mining (see figure 1). When pushing for exnovation, governments have

4 A more current example for a civil society strategy is the divestment movement, trying to convince investors to sell their shares in fossil fuel companies.

5 *http://ec.europa.eu/growth/industry/sustainability/ecodesign_de*

6 For example, the question of whether to continue a university class on coal mining engineering would be assessed differently once a clear termination intention of domestic mining activities has been decided upon.

to decide whether and how to lessen social and economic hardships and to support the change towards new business models.

Direct financial compensation of companies can be problematic since it could cause a chain reaction of compensation claims, windfall profits and false incentives. For example, a company might let a plant, which was going to be shut down anyway, run until it receives compensation through a government-imposed phase-out. Furthermore, such a buy-out would violate the widely appreciated "polluter pays" principle and hence may be ethically and politically unacceptable. In some cases, however, compensation might be appropriate or even constitutionally required, such as when a quick phase-out is demanded. In these cases, compensation payments can be linked to the switch to new sustainable technologies. Programmes for employees could also be offered to help with new career opportunities and re-education. In exnovation cases where the economic prosperity and public budgets of an entire region are threatened, support from higher political levels for structural change in these regions can be provided. In addition to general infrastructural aid, funding could be specifically directed towards sustainable industries, taking into account regional characteristics, potentials and visions.

Time Horizon:
Short- or Long-Term, Fixed or Flexible End Date

Short-termed exnovation processes, such as a ban within weeks, may be possible in cases in which goods involve only minimal investment (like patio heaters), where alternatives are easily available and/or if a long transition period is not ecologically acceptable (as in the case of the short-termed ban on the agricultural use of DDT in several countries in the 1970s). However, when a quick exnovation process threatens to cause strong socioeconomic friction, companies and employees could be given more time to adjust to the socioeconomic change. Extended transition periods are also helpful or in some cases even essential for reducing resistance (Bardach 1976, DeLeon 1978, Pal and Weaver 2003, Polanyi 1944).

A downside to long transition periods is the potential for revision of the decision. The interim revision of Germany's first nuclear phase-out law from 2001 by a centre-right government in 2010 demonstrates this risk (Heyen 2011, 2017). It is neither possible nor desirable to fully prevent such revision decisions in democratic constitutional systems: a preclusion of reversal would violate the principle of discontinuity after elections and hinder a >

FIGURE 1: Exnovation, that is, the purposive termination of existing infrastructures or technologies, can drive sustainability transformations. Researchers discuss how to govern exnovations, especially the phase-out of fossil fuels and associated technologies. When dealing with exnovation processes, it appears to be advantageous to allow for transition periods – at the brown coal mining site Garzweiler, Germany, wind turbines stand close to the site (in the background).

new majority's ability to rule. The approval of an exnovation decision with broad political support, including from current opposition parties, appears to be the most effective approach for reducing the likelihood of revision. This was done in the second and expedited nuclear phase-out decision in Germany after the Fukushima nuclear disaster in 2011.

Finally, policy instruments for termination, especially regulatory bans, may entail a fixed end date for the sake of high planning certainty. Alternatively, instruments may have some degree of flexibility here, as is usually the case with economic instruments – but not exclusively: in the case of the first German nuclear phase-out decision, a residual quantity of electricity corresponding to an average reactor life span of 32 years was determined. It was left up to the operators how to use the remaining capacity. As a result, there was originally no fixed date by which nuclear power had to be completely phased out.

Conclusion

The focus by researchers and political actors on innovation should be complemented by a stronger occupation with exnovation and its governance. When dealing with substantial exnovation processes such as a coal phase-out, it appears to be politically, legally and socioeconomically advantageous to allow for transition periods but also to start the transition process early and to be clear on exnovation intentions and time horizons (Heyen 2017, Setton and Helgenberger 2016). This allows not only for planning and investment certainty for business, particularly in branches with long investment cycles, but also for workers, consumers, infrastructure planning and the educational system. It also means that action should be taken now, if the last coal plants are to be shut down and no new fossil-fuelled vehicles are to be sold by 2030 or 2035 as discussed in research and politics.

While innovation needs to be accompanied by exnovation, the same is true vice versa. Even the most amenable windows of opportunity for exnovation decisions, such as a crisis or catastrophe, can only be utilised if alternative solutions have already sufficiently matured (Kingdon 1995, Turnheim and Geels 2012). The decisions to phase out nuclear power in Germany would, for example, not have been possible without the years of research and development in the field of renewable energy and the existence of alternative visions and narratives (Grießhammer and Brohmann 2015, Hermwille 2016b). Exnovation decisions can also free up innovation capacities and speed up the development and further maturing of alternative solutions (Kern et al. 2017).

We didn't dig deeper into upcoming exnovation cases such as coal mining and internal combustion engines – but it seems evident that there is a lot to learn from theoretical and historical comparative perspectives. This applies to the dynamics of exnovation as well as its governance and the corresponding socioeconomic adjustments. The detailed study of past and upcoming cases should help to hone the concepts developed and to address the many questions this brief article cannot resolve: are there additional categories and characteristics relevant for exnovation governance? Can they be linked to different ideal-type governance approaches (suitable for different exnovation contexts and challenges)? And what are the limits to exnovation governance?

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