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CONCEPTUAL ASPECTS OF DISCONTINUATION GOVERNANCE

An exploration

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4.1 Introduction: Focus and phenomenon

The fact that socio-technical regimes do not last forever, but decline, is receiving increasing attention in research on the transition of socio-technical systems and innovation dynamics. There is a great need for this attention, because for a long time these research directions have not or only marginally dealt with how existing systems and their supporting regimes (as well as parts of them) destabilise or how innovations break down before they are fully established. The *complex interrelationships* are not easy to reconstruct. Often, an obvious dimension of this gets lost in the background or is difficult to consider on top of it: the active destabilisation or promotion of destabilisation, the intended exit or termination of support for existing regimes, pursued by a wide variety of actors, alone or together, in the public and political spheres, but just as well in the private and corporate spheres.

Not even a reasonably agreed *terminology* has emerged.¹ Therefore, it must be stated here which terms are mobilised to designate what. “Discontinuation” means the rather actively pursued exit from a socio-technical regime, in contrast to “destabilisation” as rather passively developing (Turnheim 2023). The notion of “decline” itself is used as a very general term to describe the *circumstance* of progressive destabilisation or discontinuation. The term “phase-out” is employed when it is literally a matter of gradual development. Exit and abandonment are used as relatively non-specific terms to describe the opposite of maintenance, stabilisation, or continuation. Since this paper is about the political, administrative, and managed governance work on an exit from a socio-technical regime, I will mostly speak of “discontinuation” as a more or less purposeful pursuit of a goal.² “Discontinuity” then rather refers to the circumstance of a targeted or achieved end of such a regime. Finally, I choose the concept of the socio-technical regime from the multi-level perspective (Geels 2019) as a reference point for the

governance efforts: as the object-related and theoretical context of choice for the considerations.

This chapter is about the purposeful discontinuation of a socio-technical regime, no matter what stage or path of development, maturity, or age. When speaking of socio-technical regimes, I may be talking about narrower or broader domains, the immediate usage environment of a device (e.g., light bulb) as well as the associated value chain (light bulb manufacturing) or embedding in other regimes (household, power supply, lamp design, and many more). I assume that some form of concerted, purposeful action or series of actions, using means of shaping the public or private, will occur if a socio-technical system is to be ended. This can involve large-scale technology as well as small devices, entire infrastructures as well as production lines or product ranges. Discontinuation affects technology as well as the science, politics, economy, everyday practice, or law that supports it. It affects knowledge and ignorance, forgetting and preserving, strategies and routines, individual and collective action. Not everything that happens during discontinuation is induced through governance, but it is a research focus to better understand whether, in which ways, and to which extent governance plays a role. I am in fact interested in *configurations that shape the situations bearing the possibility (if recognised and used) to deliberately change/discontinue a socio-technical regime through governance*.

We still know too little about discontinuation and destabilisation to make a further-reaching exclusionary theory selection. The phenomenon itself cannot be subsumed under existing concepts, patterns, and models—existing research was too often blind to the interplay between discontinuity, socio-technical phenomena, and governance, and therefore the optics for grasping it in an adequate way need to be invented. Since we are talking about a rather new and emergent research field, I suggest, firstly, to use a *mix of perspectives* and, secondly, to understand these ways of seeing as *heuristics*—conceptual propositions to see phenomena associated with discontinuation from a governance-related viewpoint.

In the following, I will develop arguments about how existing knowledge about discontinuation can be used to argue for certain governance approaches that offer the chance to get to the bottom of discontinuation governance-in-action (section 4.2). I will then introduce a number of relevant existing concepts that can help us to become aware of discontinuation governance, if only as a precursor to case-specific and cross-case concepts that should emerge from the research (section 4.3). I conclude with a series of challenges that discontinuation governance research is currently facing.

4.2 Governance as key focus

If we want to put the “governance” of discontinuation on the agenda, we should clarify what can be meant by “governance”. Given the plethora of questions relevant to discontinuation itself, this conceptualisation cannot be exhaustive at this point. Given the newness of the research field, it would also not be appropriate to make a definitional determination. Instead, it is wise to suggest heuristic aspects

that might be relevant to consider. Ultimately, it will be a task of any research on discontinuation governance to develop an appropriate concept of governance itself or to specify alternatives such as “policy”, “politics”, “administration”, and so on that fit the respective object of research. However, it would be a pity if no effort was made to specifically shape the concept of governance or if it was only done implicitly. Then this aspect would perhaps be black boxed instead of being made fruitful.

The term governance is used to indicate that the notion of hierarchical “steering” or “government action” as the tackling of collective problems falls short of capturing political processes and situations in complex societies, political systems, and states. The questions that regularly arise are: who is doing what, what is it about, in which structures is the action embedded, which structures is it trying to meet or escape and which means and forms of action are used. A general starting point for research with a focus on governance of discontinuation is that by governance we address a process of mutual shaping a political, market, technoscientific, or any other social order. The assumption, then, is that governance-making and governance structures in some political ways have as their aim and purpose the stabilisation, maintenance/repair, and/or destabilisation of a given order. It is political when someone asserts him- or herself alone or with others and achieves a somewhat binding order that is meant to help address collective problems. The various social contexts of these socio-technical orders are also relevant.

This applies to any order that a community, an organisation, or a group establishes for itself, more or less on the basis of procedures and rules. This can happen not only by direct control, but also by influencing (or coordinating, negotiating) relationships between more or less independent actors against the background of their resources, arenas, rules, instruments, and in rather heterarchical or rather hierarchical contexts. Does governance mean a more tentative or directive approach (Kuhlmann et al. 2019)? We would want to see which relationships characterise a governance and how, which orientations and motivations are at work and/or expressed, and how (far) individual actions are coordinated. This we would need to understand also in temporal contexts, so what was before the current situation and in which direction it moves. Here it is helpful to look at the development in its patterns and manifestations as well as individual situations in the course of this development. The not-so-frequent nor well-known discontinuation governance especially must be searched for how an opportunity actually arises that discontinuation becomes central. Which failed attempts, abortions, preparations, changes of plans, power structures and discourse struggles first opened up the chance to distance oneself from something familiar, “normal” and accepted for a long time? Do stable orders break down from delegitimation, disinterest, non-action or destruction, withdrawal or redefinition of knowledge and norms, perception, or interpretations? Does a regime destabilise from dysfunctionality, erosion, exhaustion, weakness, or fragile statics, from the inability to be adapted or updated (Joly et al. 2022)? In addition to process and situation orientation, the analysis of problem orientation is also cultivated (Kohoutek et al. 2013). It examines how discontinuation

governance takes place (as process), in which constellation it asserts itself and ends a socio-technical regime (situation), and finally along which problem perceptions and agendas it finds its authoritative orientation.

It doesn't suffice only to mention many aspects that need to be looked at more closely typically, but also to point out symmetries. This means that when the focus is on governance-making, one should not ignore the structural circumstances; or, conversely, that one should not overlook the specific action of influence or triggering action in the face of all the structures and abstract developments; and that one should put events and justifications, knowledge- and value-related perceptions, explanations, and justifications in relation to each other. One can read volumes about the usual policies and governance arrangements, routines, and improvisations. But what is discontinuation—how do you do it, why, what for, what triggers it, hinders it, or ends it? How far is discontinuation presenting itself as a governance innovation?

In order to study how discontinuation is actively addressed by governance, it needs to be seen how much public and private or mixed elements are de-aligned; how much corporate (private) governance and public policy (alone or together) are defining the subject of discontinuation (e.g., of actors in a household or in public transport). It must be clarified for each individual case in which planetary, global, regional, national to local interconnections discontinuation takes place. How are specific and meta-governance frameworks related, are their developments inter-dependent or do they contradict each other? Is a meta-governance framework built up first before a specific regime is brought down?

4.2.1 *Discontinuation as a social construct*

When governance tackles something, we observe that it is typically because those involved have agreed that there is a *problem* that needs to be addressed (Colebatch 2006; Colebatch et al. 2010; Dewey 1927). The fact that there is a problem for a collective, what it is for them, how to recognise it, what it has to do with other or previous problems, how one usually reacts to it, and so on are all questions of shared perception, interpretation, and negotiation of what to do with it (Kingdon 1984; Hoppe 2010) in the light of norms and theories, patterns of consciousness and frames as our (shared) interpretations of how situations are organised. Conflicts also arise as to what one sees, whose view is correct or whether/how one usually reacts to it with governance. Normative questions also arise whether one should see something one way or another, what one should do with it, what is the right (factually appropriate) or best (politically, morally, ethically, etc.) reaction to it.³ If one considers these processes of the social production of occasions to engage in governance, it becomes clear why one would do well to explore how active or non-active discontinuation occurs, how it comes about that discontinuation governance does not always receive the same attention, although it may already be a means of choice again and again on a smaller scale. It is therefore also worthwhile to see how discontinuation governance can experience an upswing when, for

example, as is currently the case, the most diverse upheavals are being discussed and discontinuation is seen as a way to go, as in energy issues, technology development, environmental protection, or industrial policy (or for other areas, see, e.g., Sato 2002; Bauer et al. 2012; Princen et al. 2015).

If both the way of acting, which can be understood as discontinuation governance, and the occasion to do so, must be continuously produced and maintained, i.e., are not determined as innate or natural law conditions, then we can see them as social constructs. Then we can say discontinuation governance is communicatively constructed, be it at the beginning or as it is sustained during social negotiations (Eberle 2019: 265). Negotiation is thereby understood as a generic category referring to the negotiated order as a result of all kinds of interactions, not only as one form of shaping social order among others (cf. Strauss 1978, 1993: 57). Following Berger and Luckmann (1966), we can see discontinuation governance and its result, discontinuity, as the co-construction of a discontinuous reality: as objective facticity *and* subjective meaning. This means asking how it is possible that human activity should produce or discontinue a world of things and vice versa: the *co-construction of continuous or discontinuous reality* (ibid.: 27). This means that something is encountered as a social matter that cannot easily be ignored or escaped, *and* that this has meaning for an actor. For instance, in 2009, at the start of the phase-out, the incandescent light bulb (ILB) was an object that followed norms that were increasingly perceived as delegitimate, an object that industry wanted to get rid of, and the ILB users knew how to interpret this situation, e.g., by stockpiling the ILB for use beyond the end of production because users liked the light quality, or, conversely, they shared the perception that ILBs needed to be replaced for energy-saving reasons and hurried to exchange the old ones for the new ones.

At the same time, it is clear that precisely discontinuation and destabilisation entail a change and thus a partial dissolution of an existing social order (in our case better: socio-technical order) that has hitherto been preserved *grosso modo*. The *fluidity of order*, order as something mobile, plastic, turns out to be sometimes lossy while analysing and governing discontinuation and destabilisation: not everything remains forever. What just belonged can lose legitimacy or even become obsolete.

4.2.2 *The agency–structure nexus*

There are many reasons to assume that discontinuity is not purely a question of *active* governance action. Socio-technical regimes are too large and complex to always be brought down with simple actions. Where active action is taken with this aim in mind, *passive* tendencies may also come into play, intended developments may go hand in hand with unintended ones, and planned developments may go hand in hand with unplanned ones. Active attempts may fail, take a long time with an uncertain outcome, or have a partial rather than comprehensive impact. Existing destabilising tendencies may first be discovered, waited for, and eventually exploited, but not triggered completely on their own. Before active action can take effect, a great deal of preparatory work may have to be done, such as discovering

and picking up on existing trends, exploiting other processes for discontinuation, and laying a variety of foundations so that discontinuation can become conceivable, communicable, acceptable, realisable, and justifiable. Times and windows of opportunity to become active can be wrongly chosen or less sustainable than thought.

At the same time, however, one cannot claim that discontinuities occur without any *intervention or active influence, impetus, or intention*. Socio-technical regimes may be doomed to decline because they are not maintained and developed, or even neglected, or because they overlook problems that over time build up to existential threats. Complex systemic relationships can lead to discontinuation and destabilisation just as well as any other condition. Destabilisation may not lead to the end (Turnheim 2023); this may need active influence (cf. Le Quéré et al. 2019). Decline could ultimately be accepted—otherwise one could try to resist it and keep something alive, pour financial resources into it and declare war on its ending. From this point of view, the failure to intervene and resist—the failure to act, the veto by doing nothing—can also be an active measure⁴ (cf. Weber 1978; Streeck and Thelen 2005). Turnheim (2023: 56) calls this “inaction” a “particular form of intervention: neglectful or self-consuming governance”.

But one can see how decisions are made that lead to discontinuity, at least in the areas subject to this decision-making power. When NASA pulled out of the space shuttle programme, realistically speaking, it will not have been the decision of the NASA leadership alone, nor will it have been made entirely of its own free will. But a formal act of termination certainly took place. When Siemens sold its nuclear division, this did not mean that nuclear technology ended everywhere, but that it ended at Siemens—together with the management and knowledge structures, the personnel and the value chain that was once built up and maintained. Thus, it seems advisable to search for those *combinations* of active action and existing developments, of new and existing processes and efforts that make the governance of discontinuity tangible. It will be a matter of identifying situational as well as processual, structural, and mobile aspects of the governance of discontinuity.

In practice, there are hardly any cases in which the *public* or *private* can manage entirely on their own. On the contrary, we regularly see that these areas are somehow intertwined—for example, when Siemens sold its nuclear division as a company, this was a corporate matter closely linked to one country’s national nuclear policy; when the government closes nuclear power plants, this affects the energy industry, among many other things; households must be prepared for changes in electricity quality and prices, and must figure out whether or not to support a more sustainable energy policy.

The underlying problem is, in brief, that people act, resulting in structures that in turn influence action (Berger and Luckmann 1966; Giddens 1984). It is therefore important to consider how discontinuation governance as action reacts to existing structures or questions old ones, dissolves them, or even creates new ones. *Action and structures intertwine*. Structures of discontinuing action are individual pieces or types of actions and actors, concatenations, clusters, habitualisations,

institutionalisations, socialisations, knowledge structures and distributions, and so on. If a discontinuation has already taken place, any further discontinuation already refers to prior knowledge, patterns of action, even instruments and other institutionalised (repertoires of) routines equipped with rules and knowledge of rules (Cairney 2012; Colebatch 2006). Or there is recourse to modes of governance that do not come directly from discontinuation; work is done analogously to other governance. Combinations of exceptional and analogue modes of governance can be found.

From a governance analysis perspective, it is also important to remember that not all problems are *perceived* or *addressed* by decision-makers, partly because it would be too burdensome to address them or break them down into manageable parts. Thus, starting to exit can seem like an oversized hurdle because it has never been done before (if that is indeed the case) or could trigger consequences (side-effects, collateral damages) that encompass more than just the discontinuation issue.

4.2.3 *The things–meanings nexus*

Discontinuation governance targets a spectrum from perceptions, frames, knowledge structures on the one hand, to built environment, architecture, and infrastructure on the other hand. What has been introduced as a social construction of discontinuity is realised both in the breaking up of thinking patterns and dismantling of what has been built in stone and steel. It is about breaking down previously valid knowledge and old certainties as well as dismantling production plants, buildings, and the structural realisation of infrastructure in hardware and information technology structures such as software.

What has been said so far about governance can also be applied to the terms policy and politics (or whatever distinctions the respective contextual language offers). It is not so important which of the terms one uses, but for what and how. Much of what is said about policy today comes very close to the concept of governance, especially the departure from top-down and governmental focus (Colebatch 2009). One can also see the work on problem conceptions, policy alternatives and decision-making politics as dimensions of governance (Kingdon 1984). Governance is also realised in material and digital structures.

4.3 Existing conceptualisations

There are several concepts that have been around for a while to help understand decline in governance, policy, or administration studies. These are the two prominently represented terms—“termination” and “dismantling”—but alongside them the lesser-noted should also be mentioned. In the following, some typical perspectives in research on science, technology, innovation, and policy will be identified. It will be discussed which aspects might be helpful for our collection of building blocks for a conceptualisation of discontinuation governance. It starts with concepts from the field of policy and governance studies and ends with references from science and technology studies. In between, I highlight the emergence of discontinuation

aspects in socio-technical transition studies as well as in studies on socio-technical-economic, innovation, and more recent discontinuation governance studies.

4.3.1 Discontinuation concepts in studies of governance, policy, administration

Although there is some attention for questions of discontinuation, work on “termination”, “dismantling”, “reversal”, “removal”, or “retrenchment” never really became a core topic in policy studies research and textbooks. The abandonment or dismantling of socio-technical systems, deeply embedded in society and the economy, has not been studied yet from that angle.⁵ Our focus is somewhat different from these existing literatures, however, for two main reasons: first, the focus isn’t on a particular actor or social group (firm, industry, or an entire policy branch such as welfare), but on technologies and socio-technical systems and the regimes that carry them that involve and interact with many actors. More importantly, we are interested in a *particular kind of discontinuation*, which is driven or *motivated* by the desire on the part of relevant governance actors *to address one or more perceived particular social issues* (e.g., protection of the EU lighting industries and climate change, if you think of the incandescent light bulb phase-out within the EU ecodesign framework; safety and environmental effects with regards to the ban of DDT by the Stockholm Convention; safety and risk issues in the case of the German nuclear phase-out). The perception of adverse effects of a specific socio-technical system is at the core of the mobilisation process. It very often requires production of knowledge. Second, our emphasis is on understanding by whom and how “issues” are being *articulated*, framed, and put on political agendas in related actor arenas—in other words, how “problem”-driven political agendas manage to question and *challenge incumbent governance arrangements* within and around a socio-technical system, and possibly may result in *deliberate discontinuation governance efforts*, which may be more or less successful over time.

Policy termination

In the policy studies literature, there is some attention for the governance of discontinuation of particular policies and programs, often referring to the term “*policy termination*” (cf. Bauer 2009). Policy termination may either result from a changed formulation or perception of a policy problem, or from a changed formulation or perception of a policy solution (van de Graaf and Hoppe 1996: 211–227; Stegmaier et al. 2014: 114; on perception change regarding dam removal, see Clark 2009: 403). This can easily be translated into “governance termination” as the termination of governance that contributes to maintaining a socio-technical system, if we want to opt for the broader notion of “governance” that encompasses policy as one stream next to problem recognition and politics, as well as the focus on the broader collectivity of those involved (cf. Kingdon 1984).

Studies of policy termination offer some addition to our insights and hints for further research. Bardach conceives of the *politics of policy termination* “as a special

case of the policy adoption process” which “is exceedingly difficult” (Bardach 1976: 123; cf. Turnhout 2009). He compares different cases of programmes, policies, and organisational entities with less or more technoscientific orientation, including the US participation in the Vietnam War. He distinguishes the “explosion type endings” occurring “through a change in policy effected by a single authoritative decision” from the “very long whimper” type coming “not from a single policy-level decision but from a long-term decline in the resources by which a given policy is sustained” (ibid.: 125), the latter gradual development is also called “decrementalism” (Lambright and Sapolsky 1976). Termination meets “coalitions of proponents and opponents” in contest over terminating a policy (Bardach 1976: 126), dividing the first into “Oppositionists”, “Economizers”, and “Reformers”, the second described as the guardians of the status quo in administration, political system, and organised interest. A first obstacle for easily deciding to pursue termination seems to be that policies are often built on a nimbus of having an infinite future (ibid.: 128). Second, opponents to termination, Bardach suggests, mobilise useful interrelationships between political and moral order (ibid.: 127), as expressed “in the general moral repugnance... towards the deliberate disruption of arrangements which people have learned to rely on for a significant portion of their livelihoods or careers” (ibid.: 128). Third, Bardach suggests policymakers are “reluctant to admit—or seem to admit—past mistakes” (ibid.: 129). Fourth, pro-termination coalitions seem to hesitate to damage an existing regime (ibid.: 129). Finally, some regimes seem to reward novelty and innovation rather than termination—whereby the latter is apparently not so easily regarded as the actual innovative approach. Termination is facilitated, Bardach suggests, by “change in administration”, “[d]elegitimation of the ideological matrix in which the policy is embedded”, “turbulences” which shake optimistic expectations, “cushioning the blow” in case of policy failure or heavy crisis, and the experience that strategic “designing policies for eventual termination would facilitate their transformation or even their complete destruction when the time was ripe” (Bardach 1976: 130).

Frantz (2002) reconstructed for a case how a government has used resources and political argument to make a policy termination successful: how goals were articulated, how problems were defined, and how a variety of solutions to the problem were used. Frantz discovered that it is not, as often assumed, the government and administration that hold the key to attempts at termination at all. She shows how much “the skilful use of political argument and resources empowered the opponents of closure in their battle against the outwardly more powerful forces of the government... how the government succeeded only when it made better use of its political resources” (Frantz 2002: 25).

In another study, Frantz (1997) carved out how the high costs of policy termination come about. She starts from the observation that often “policy terminations are promoted as cost saving moves when, in fact, there are often considerable short term costs” (Frantz 1997: 2097), both monetary and psychological (cf. Behn 1978; deLeon 1978). Frantz, based on a study of termination in a public health system, categorises costs to prevent damage to community, constituents, and staff (Frantz

1997: 2111). In a strongly economically dominated governance-making environment, it would be extremely important for discontinuation governance research to know 1) what costs are incurred, 2) how they are calculated, and 3) how they compare with (cost) alternatives to discontinuation solutions (cf. also Joly et al. 2022: 45). Choices, framings (cf. Liersch and Stegmaier 2022), concerns, justice perceptions (cf. Johnstone and Hilescher 2017), resistance against discontinuation (cf. deLeon 1978), among others, could thus be better contextualised. In this context, it is also relevant to see whether and which measures are taken to cushion the impact of discontinuation (cf. Hogwood and Peters 1982), which is probably one key aspect of a special governance to discontinue another governance as opposed to governance that is dedicated to coordinating and deciding about the process. Again for health policy, Sato (2002) and Sato and Narita (2003) reconstructed the abolition of the leprosy prevention law in Japan in the 1990s through leadership. Sato (2002) introduced the figure of the “skillful terminator” who set the issue on the agenda, negotiated, achieved consensus, and got the thus delegitimised policy abolished. This I would call a “discontinuation entrepreneur” (a variant of a policy entrepreneur or institutional entrepreneur, who seeks policy initiative and change as an antidote to persistence or inertia in a field under pressure to change). Interestingly, the role of science remained instrumental and limited (Sato and Frantz 2005). How expertise is used to initiate or justify discontinuation is a relevant question for research.

Policy dismantling

Policy dismantling stands for “a distinctive form of policy change, which involves the cutting, reduction, diminution or complete removal of existing policies” (Bauer and Knill 2012: 31) with the two dimensions of policy intensity and policy density. Bauer et al. (2012), on social and environmental policy for instance, emphasise the quantifiable shrinking of spending for a policy branch, which as a consequence of this leads to, for example, a dry out of welfare state measures or a weakening of air pollution control. “Policy dismantling” is usually used as an opposite term to “policy expansion” (cf. Knill et al. 2018), whereby Gravey and Jordan (2019) also distinguish “limited expansion” and “limited dismantling”. Both authors also present a dismantling strategy typology, which helps to better grasp active dismantling action: “no dismantling decision”, “passive dismantling strategies”, “active dismantling decision”, and “active dismantling strategies” (cf. Bauer and Knill 2014). This can be a key typology also for discontinuation governance-in-action.

There is also attention in policy literature for the dismantling of public administration institutions when a state lacks a system of integrative political institutions (Vogelsang-Coombs and Keller 2013). Gravey and Jordan (2019) are shifting the dismantling focus from a mostly national to an international level. Policy dismantling touches upon technoscientific questions when addressing environmental (Lenschow et al. 2020) and energy policy (Bürgin 2018; Barnett et al. 2020; Prontera 2021). In addition to this advanced concept of dismantling, we often find

only metaphorical use, which at least suggests a sense of the active and deliberate de-aligning and shrinking of state and welfare institutions, but which is not problematised further in its mechanics and practice (Pike et al. 2018; McCarthy 2017).

It has been correctly observed that discontinuation leads to the shrinking or even dissolution of an existing governance. However, this insight should not lead to overlooking the sometimes considerable effort required to invent and operate a governance of discontinuation. At the latest when a discontinuation falters, one should realise that active attempts can also get bogged down, incorrectly dosed or addressed, or even fail. The problem with this is twofold: firstly, it is not easy to identify what results in a discontinuation in the overall character, what it is based on, at which often confusingly distributed points it starts and ends. Second, it is not easy to accurately measure the intensity, extensiveness, and power of discontinuation efforts in relation to shrinkage or contraction. This is quite similar to the question of how and how far dis-inscription by using an “anti-programme” to disinscribe the original programme (Akrich and Latour 1992) actually works.

Although the observation of shrinking and expanding policies is a valuable one, it doesn't account for the policy that is expanded to shrink another policy; exactly what this chapter focuses on with “active, purposeful discontinuation governance”. In other words, discontinuation is not mere retreat and downsizing, it is the construction of new forms of governance to support the discontinuation of existing orders. Some dismantling research supports this view, such as the observations—that also help to develop the “dismantling” notion further—about how “two major types of knowledge-boundary dismantling work” (“full boundary dismantling work”, “boundary perforating”) helped to shift the locus of innovation in NASA as a knowledge-intensive organisation as well as the identity of professionals (Lifshitz-Assaf 2018). Whether one sees it positively or negatively from the point of view of the professionals, this study indicates that something else is emerging, partly because something existing has been dismantled. This deserves attention for dismantling and discontinuation research: what changes and emerges as a result of the abandonment?

Policy reversal

The notion of *policy reversal* is used as a concept signifying the opposite of “policy adoption” and is defined as the “undoing of past policy” (Lowry 2005: 395), of, for instance, regulatory policies through deregulation, or criminal, social, taxation policy through its repeal, perhaps not being “mere innovations or marginal modifications of existing policies, but rather replacements of accepted policy goals with opposite goals” (Lowry 2005: 395). This is a problematic definition, as it doesn't include the aspect that something must happen to the “accepted goals” before they might be considered for reversal, such as an erosion of acceptance and legitimation, as well as the redefinition of what the problem and its policy answer is. It also doesn't account for the extra effort required to find a *governance to discontinue* another governance. The way the notion is used also assumes a symmetry between adoption and reversal, while experience teaches that adoption and reversal (or

implementation and discontinuation) usually involve rather different attitudes, justifications, objectives, crafts, and competencies, among others.

In environmental management and policy there is a small, slowly growing body of reflections on the decision-making and the entire policy process of *dam removal* (Lejon et al. 2009; Clark 2009; Johnson and Graber 2002). Two decades ago, the “science of dam removal” in the US was called “undeveloped and most agencies faced with dam removal lack a coherent purpose for removing dams” (Doyle and Stanley 2003: 453). This means, there is a very late-coming learning and institutionalisation process going on for the governance of the abandonment of a very particular assemblage of socio-technical infrastructure, that of river dams for energy production, that has been developed with the technological and economic modernisation of countries.

Still, policy scholarship scarcely uses dam removal politics as an example for studying *policy reversal* (Lowry 2005). The latter suggests investigating whether the reversal of policy, from building to removing dams, creates “a new type of politics... different patterns of policy diffusion and adoption” (Lowry 2005: 395). This resonates with our focus here on a governance that emerges or is used to end another governance. With regards to American states, Lowry finds that “these patterns of political behavior for policy reversals are roughly comparable to those for policy adoption” (p. 395). However, he also sees some differences in that reversals may come from national rather than from regional governance levels, they are more gradual than for new governance, and states will adopt reversals in view of fiscal health and relevant interest groups rather than of innovation. Policy reversal tends to profit from “the entrenchment of status quo interests,... the willingness of the state to pursue innovations in related areas. Measures of fiscal capacity, urbanization, ideology, and institutional capacity, however, will not be significant determinants” (Lowry 2005: 402). Several policy-oriented studies on dam removal use Kingdon’s streams model (1984) to further investigate the evolution of the idea of dam breaching into a viable policy alternative until the streams of problem perceptions, alternatives, and opportunities converge (Haeuber and Mitchener 1998; Clark 2010; Lowry 2005).

The discussion about the nexus between discontinuation and failure was excluded. On the one hand, there is the risk of placing the two perspectives too quickly and unclearly next to or within each other, which can at least quickly lead to a judgement that what is being terminated must have failed after all. On the other hand, the question should be raised as to how the relationship between discontinuation and failure is *de facto* negotiated and whether, in the process, judgements of failure fulfil a function or whether discontinuation is also carried out with other perceptions and justifications.

4.3.2 Discontinuation in studies of socio-technical regimes

Existing transition theory focuses on system (regime, innovation) dynamics, but *active governance-making* has long been black boxed (Geels and Schot 2007; Rip 2012). Theorising governance (or policy, politics) is usually blind to *socio-technical* aspects of change (Cerna 2013; Stachowiak 2013). Theories of socio-technical

transition or change either look at the transformation patterns with technology in focus (Geels and Schot 2007; Dolata 2013) or at the governance side without any specific socio-technical focus (Borrás and Edler 2014). However, questions of governance are constitutive to understanding (from a practitioner's point of view, also to implementing) socio-technical system transitions. Questions need thus to be raised over who governs, whose framings count and whose objectives are prioritised (Smith and Stirling 2010), which problem perceptions and power relations are used to give direction to discontinuation governance, which knowledges and normativities are transformative (Stirling 2014; Stegmaier et al. 2014), and which instruments and legitimations (Borrás and Edler 2014) are mobilised.

The *governance practice-oriented* approaches (cf. Köhler et al. 2019) that have socio-technical regimes or technological social contexts on their radar can be understood as reflexive attempts at shaping new technologies, or transforming socio-technical regimes, such as “constructive technology assessment” (CTA; Rip 2018; Rip et al. 1995; cf. Aukes et al. 2023), “strategic niche management” (SNM; Rip and Kemp 1998; Geels and Raven 2006; Schot and Geels 2008), “ethical, legal and societal issues (ELSI) studies” (Forsberg 2014; Myskja et al. 2014; Rip 2009; Zwart and Nelis 2009; Yesley 2008), “transition management” (TM; Kern and Smith 2008; Kemp and Loorbach 2006; Smith and Kern 2009), or “transformative innovation policy” (TIP; Schot and Steinmueller 2018a, 2018b). They have all developed quite detailed understandings of how to influence and govern socio-technical change if one wants to achieve something specific in the process. CTA and SNM strive for a more socially acceptable technology development through shared learning and other interaction. ELSI and RRI, the same, as well as a normatively responsible technology development. TM and TIP above all aim at system change towards more sustainable societies. As a by-product, there are also indications of the conditions of the circumstances of such efforts, which advance the understanding of governance with regard to socio-technical dynamics itself; however, this is not the focus. What is missing here are indications of specific ways of dealing with discontinuation and destabilisation. Even if such developments do occur, they are not the main goal, or cannot be communicated in this way, so as not to drive the promise of rather painless change *ad absurdum*.

Discontinuation can be interpreted as a kind of intended regime change. In the light of the technological substitution pathway described by Geels and Schot (2007: 410) discontinuation can be thought of as being the case when a technology drops off the present socio-technical regime as the result of (or at least associated with) a specific moment of shock in the broader political-cultural landscape (also cf. Pierson 1994: 266). This may indeed hold true for the abandonment of nuclear energy right after the 1986 Chernobyl and 2011 Fukushima-Daiichi disasters. The shock hypothesis does, however, obviously not apply to such abandoned socio-technical systems and technologies as the incandescent light bulb (ILB), DDT, or stuttering efforts to phase-out of the internal combustion car engine. Rather it seems that more diffuse, less abrupt changes in the landscape and the offer of alternative technologies from niches (like energy-saving lamps and related technologies, less dangerous pesticides, and alternative car engine technologies) can be associated

with boosting discontinuation in these areas, in combination with policies and political initiatives pertinent for changes.

Some studies emphasise policy-driven discontinuation in terms of regime destabilisation through collective action as “script for performative dramas: pressure mechanisms, obstruction mechanisms and overflow mechanisms” (Baigorrotegui 2019) and national decarbonisation pathways in the context of specific energy policies and cultures (Stephenson et al. 2021). User focus in policy-focused transitions suggests that to achieve decarbonisation, “users... need to be involved in niche construction, as well as in regime destabilisation” forming “a recursive and interactive relationship” between users and policy (Martiskainen et al. 2021: 137).

The research on socio-technical systems warns us not to underestimate, given the complexity, how difficult it is to imagine a central or omnipotent body from which one could simply control such a system, govern it authoritatively. Exceptions, such as the 2011 decision in Germany to phase out nuclear energy after the Fukushima-Daiichi reactor disaster, show how powerful politics can be, but then only for a specific national framework in which nuclear energy production and power plant infrastructure are abandoned. Mostly, it will come down to reconstructing the multiple threads, overlaps and fractures in the assemblage of a section of a system along which attempts are made to redirect a system.

Essential here are the considerations of Joly et al. (2022) on the circumstances under which governance can work in the direction of destabilisation and discontinuation. They address less the actual negotiations, arrangements, windows of opportunity, and actions. They suggest paying attention to three complementary dimensions: 1) social mobilisation, 2) objectification and publication of hidden costs, and 3) construction of credible public policies (ibid.: 45). This can only be a start, because discontinuation governance is not limited to this. Besides the adaptation of normal rules, routines, and procedures, quite specific instruments and regulations, strategies and coalitions are forged, agendas are set and existing ones are changed (Geels and Turnheim 2022), to name a few aspects—for instance, the threads that need to be pulled together until a “policy of ‘controlled rundown’” (Turnheim and Geels 2012), which directly and indirectly removes the preconditions for continuation, can be implemented and maintained. In the light of a multi-levelled perspective on socio-technical systems, it would be important to locate these processes and follow their dynamics across the levels and along the pathways. It would be particularly fruitful to apply this perspective also to governance dynamics, for example to show how discontinuation governance emerges, matures, and grows out of niches—and how the discontinued technology returns into a niche, continues, and triggers a need for aftercare governance in marginal remnants after its decline.

4.3.3 Discontinuation in studies of socio-technical-economic regimes

Discontinuation has an economic dimension. Discontinuing a socio-technical regime or a part of it involves not only public governance, civic movements, but also *industrial regime, corporate management, and consumer choice* (cf. Geels 2014; Girod

et al. 2014). The latter are often active agents, not just passive respondents to external pressure. However, in both roles they sometimes use the option of not continuing (e.g., giving up on less sustainable practices), divesting (e.g., large pension funds or insurers exiting from investments in fossils), leaving a sector (Siemens giving up its nuclear branch in 2011), or dealing with the fact that an industry, market, or business model is in decline (e.g., Sabatier et al. 2012). With a view to governance, we do not only include state actors, but all elements that negotiate, build, maintain, or dissolve the socio-technical order (in this case) with or against each other (Stegmaier et al. 2014; Hoppe 2010; Benz 2006). However, it should not be expected that product and service discontinuation will be the same for all kinds of industry or business (Crowley 2017). So, here we look at how the socio-technical-economic regime deals with developments that (could) lead to discontinuity (in this volume, with a focus on the linkages from economic to socio-technical governance and sustainability). We find research that already captures this: for example, how civic movements and economic interests divide on the question of expanding or dismantling fossil energy production (Curran 2020; Stephenson et al. 2021) and both within formal negotiation formats (e.g., the German “coal commission”) and informal protest platforms (e.g., the struggle for the Hambach forest and open-cast lignite mining, with forest occupations and demonstrations, police clearing of the forest and judicial condemnation of the clearing as unlawful; Liersch and Stegmaier 2022).

In other cases, the economic dimension will also manifest itself as a policy that accompanies, promotes, sets the framework for, or also limits the economy. *Economic policy* or the governance of the economy always includes dealing with the discontinuation of innovation, the divestment of economic activities, not least the expiry of support measures and subsidies, and the closure of companies and the dismissal of workers. Seen in this light, there is a wealth of potential topics based on which a discontinuation governance of the economic could be developed. The field will only be roughly outlined here; for reasons of space, it cannot be treated exhaustively. This topic is mentioned here as a reminder not to neglect the economic dimension in connection with policymaking and governance arrangements. In any case, public policy and private business activities are not only seen in their interrelationship as external to each other, but are also treated as a linked, decidedly public-private partnership. Thus, both economic activities that tend to be independent and those that are actively linked to public political-administrative activities must also be included in discontinuation governance considerations, as well as the structures.

In political economic thought, for instance, on a macro level, historical discontinuity is presented as major *disorder* (in the form of World War II) that has created “the conditions for the creation of a new period of order in the international political economy”, “a new global economic order” (Biersteker 1993: 16) replacing the previous imperialist, socialist, and nation-state-focused liberal orders, as well as the “international economic *disorder* of the inter-war years” (ibid.: 14). As part of that discontinuation process is the emerging process of decolonisation—the “breakup of the old colonial empires” (ibid.: 15). Interestingly, Biersteker also reflects the accompanying de-alignment and re-alignment of theoretical systems either intellectually paving the way for or

being yielded by changes of this scale (*ibid.*: 9, 21). Similarly, Hall (1993) has suggested an investigation of the linkages between changing policy paradigms, periodic discontinuities in policymaking, and directions of research programmes.

Decline in political economic thought

Those who use the concept of “decline” today must keep in mind that it has had a bad reputation, at least among British economic historians, because one side has used it to sing a swan song to the welfare state Britain (Chalmers 1985; Tomlinson 2000; Fry 2005), while the other side has found the diagnosis of decline unsubstantiated. On the meta-level, there is literature that discusses decline for its use in struggle about theory and interpreting the direction of British politics (Hall 1993; Bernstein 2004). “Decline” is seen as a fighting concept, and some of the proponents of describing the decline of Great Britain are accused of unsound scholarly work (Middleton 2006), holding against it studies that promise to prove growth (Matthews et al. 1982). So, one can do without the use of the decline term, hope that readers have bad memories—or redefine “decline” and explicitly separate it from the old debate. As far as I can see, research on phase-out, socio-technical destabilisation, and the “death” of technology has used the notion rather innocently, without explicitly distinguishing itself from the economic-historical debate.

From a political economic standpoint, decline is thus associated with an ailing state (Mokosch 2019), with collapsing senescent industries (that have lobbied so successfully against adjustment to challenges that they collapse all the more; Brainard and Verdier 1997; cf. Hillman 1982), with transition and recovery (Stuart and Panayotopoulos 1999). Transitions in less prominent sectors, such as recording studios (Leyshon 2009) or free music software (Harkins and Prior 2021), are sometimes discussed in connection to decline, as are how central actors in the computer industry decline in power as a consequence of socio-technical change (Dolata 2009). The literature on urban decline reminds us that by no means is the study of discontinuation and destabilisation confined to national-level analyses, but urban social worlds (Friedrichs 1993) can offer manifold and complex frames of analysis, such as on strategic options for dealing with population losses (van Leuven and Hill 2021). Finance policy is another field often neglected in discontinuation and destabilisation research.

Divestment

Divestment shows how political business is. Divestment is a term used in particular in connection with the exit from fossil investments. It is about social movements and campaigning, business strategy and policy framing business behaviour towards climate warming. Informed by the rather recent field of research in global environmental politics on the political economy of commodity trade, Neville (2020: 4), for instance, investigates social movements and strategies of “divestment from fossil fuels as climate action, considering the unintended or spillover consequences of reinvestment in other industries” (*ibid.*). Protagonists are NGOs focusing upon

climate change and justice (Ayling and Gunningham 2017: 136). Neville observes that because of the perception that fossil fuels destabilise the climate, divestment considers “fossil fuel markets as risky for investors” (2020: 4).

According to the economic logic of divestment, the external costs are internalised, which leads to investors moving to other areas and recognising that sustainable management leads to savings and new opportunities (cf. Halstead et al. 2019). Consequently, Neville sees the resulting dismantling of the fossil fuels regime, which in turn may lead to a transformation of related regimes, the economy, and society. Neville suggests that “[d]ivestment efforts delegitimize the fossil fuel sector, countering its political and cultural power” (2020: 4; cf. Bergman 2018). The questions that follow for further discontinuation governance research are to what extent these causal attributions are empirically confirmed in each case, which corporate and public governance frameworks are created or used for this, and how the systemic destabilisation and the actively pursued regime discontinuation are weighted.

From a financial political viewpoint, it should also be asked how and how far the readjustment of “political economic practices of financialization, capitalization, and assetization” (Neville 2020: 8) through divestment leads to again growth or degrowth, and whether and how this changes these practices. What is *divestive discontinuation* in practice and as a regime arrangement? Other research considers the role of international institutions, such as OECD, OPEC, WTO, UNFCCC, and IEA, in governing the transition away from fossil fuels (van Asselt 2014), non-state governance in climate policy (Ayling and Gunningham 2017), and open confrontation at extraction sites over exiting from investments or keeping them going (Curran 2020; Liersch and Stegmaier 2022).

Exit

In *management and organisation theory*, there is literature on the decline of particular organisations (Cameron et al. 1987; Caves et al. 1984; Mone et al. 1998; Lamberg and Pajunen 2005), which tends to focus on unsuccessful adaptation (e.g., because of an inability to overcome inertia or “wrong” strategies) to changing environments. Ghezzi (2013) distinguishes enterprise-driven (and firm-specific) from environment-driven discontinuities. In much of this literature, the decline of an organisation is seen as a long-term process that goes through different phases. Decline is seen not only as an inevitable result of external impulses that can hardly be ignored, “but also as an endogenous and strategic reaction to performance problems” (Turnheim and Geels 2012: 37). Weitzel and Jonsson (1989) suggest distinguishing the five stages of “blinded”, “inaction”, “faulty action”, “crisis”, and “dissolution”. They argue that the lack of an appropriate response leads to the decline of organisations. The literature on organisational decline also emphasises that there is not one decline path, but several possible pathways depending on the nature and speed of external pressures and endogenous responses. Turnheim and Geels (2012, 2013) have actively drawn on this literature and theories to make sense of destabilisation and decline at the level of industries and inter-organisational fields.

Recent management studies tend to view exit as a natural part of a company's overall strategy (cf. Cefis and Marsili 2007; Graebner and Eisenhardt 2004; Villalonga and McGahan 2005; Mohamad et al. 2015). From this perspective, exit is not necessarily synonymous with failure since the decision to exit can also mean an increase in efficiency or the realisation of profits (Cefis and Marsili 2007: 1; Dupleix and D'Annunzio 2018).

Obsolescence

Obsolescence reminds us of the fact that discontinuity is caught between planned and unplanned, desired and undesired. In the area of consumer products, the loss of functionality, which leads to the replacement or disposal of the product, has a positive character from the point of view of manufacturers and sellers, who have an interest in products not lasting forever and not becoming hits on the second-hand market, so that new products need to be purchased. Studies could show to what extent obsolescence is an expression of the throwaway culture⁶ that is obsessed with disposing of products (while they could just as well be maintained, repaired, mothballed, used as a source of spare parts, museumised, etc.). In other areas, the end of usability is more associated with a loss of investment and market share. Legislators and consumers may each have opposing stances on the industry view. Of course, there are consumers who like to replace old clothes with new and fashionable ones; old electronic items with new ones with updated features.⁷ But at the same time, consumers may be more interested in ensuring that what they buy doesn't break down too quickly, because otherwise they lose more money than they have or want to spend (Kuppelwieser et al. 2019). The legislator stands between them if, on the one hand, they want to promote production and trade (and skim off taxes), i.e., they do not necessarily promote the longevity of products, but, on the other hand, the legislator may also want to limit the unbridled throwaway mentality on sustainability considerations in some areas (Ober et al. 2017).

However, this attribution of obsolescence is not only based on how far it is planned, but also on replaceability with new things and dysfunctionality in the face of changed circumstances (Mellal 2020). It is carried out for products as well as for production plants and processes, organisations, and bodies of knowledge (Warmington 1974). Mellal also points to a form of obsolescence that is still often overlooked, namely the situation where an alternative would be available but it does not move forward even though it could. The question is why we continue with the old; what political conditions are set so that the new alternative is not chosen and the old technology is not terminated; and how much discontinuation governance knows about such hidden alternatives based on existing but unused obsolescence.

How to deal with the fact that knowledge becomes obsolete (Margulles and Raia 1967) when a socio-technical regime comes to an end (and something else takes its place) is also a question discussed as a problem of obsolescence, but only very little for discontinuation and destabilisation. Linked to this is the even more complicated situation when this occurs, but remnants of the old regime remain and

need to be taken care of. In this case, the old knowledge is largely fading away, but it still must be preserved in relevant parts in order to be available for special uses, maintenance obligations, waste products, or late effects.

We will find here a variety of interconnections between business and public, economic, and political occasions and practices, structures and instruments that aim at or at least entail discontinuation. Thus, this area calls for in-depth observation, analysis, and discussion of where 1) obsolescence is employed or abandoned, desired, or not tolerated, 2) how this discontinuation is engineered or subverted in practical terms, and 3) how this is related to political and normative ideas about how it could be justified to let some things break faster or less quickly, to accelerate or stop the decline.

4.3.4 Discontinuation in studies of innovation regimes

Studies of innovation regimes and sustainability policies have also discovered discontinuation. They treat it not only with exit and destabilisation terms, but also with the distinctive concepts of “exnovation” and “outnovation”. The difference between the notions of ex- and outnovation seems to be that while exnovation is used to address the life-cycle end as the end of an innovation, outnovation addresses the letting go of a part of a larger socio-technical system in a move that can in itself be quite innovative in doing things differently than before. Exnovation occurs rather passively, outnovation deliberately.

Exnovation

The notion of “exnovation” was originally used in terms of innovation through external impulses,⁸ as a quasi-branded consultancy term. Recently, it has also been used in environmental sociology to contrast the introduction of the new against the discontinuation of the old (Kropp 2014; David 2014; Gross and Mautz 2015), and the social and governance nature of the process is emphasised that abolishes technologies thereby making space for new ones (Paech 2013; Sveiby et al. 2012). David and Gross (2019) emphasise that “exnovation” addresses the “natural” flip-side of innovation”. From the perspective of the firm, “exnovation” was apparently first introduced by Kimberly (1981)

who described innovation as a series of processes which in combination define an “innovation life-cycle”. The final process of the model is exnovation, where the organisation must discard existing practice associated with a previously implemented innovation, thereby allowing the adoption of a new innovation, where the life cycle starts again.

(Patterson et al. 2009: 27)

A fruitful aspect implied is that innovation can become obsolete. The question for governance and management is whether there is enough capacity and capability to end

one innovation or maintenance path and turn to another. Problematic with the “exnovation” notion is that authors often jump directly from in- to exnovation, for instance, when explaining that “exnovation implies active rejection of an innovation that has been invested in previously” (Gross and Mautz 2015: 3; Kimberly 1981: 91), no mention of the fact that what was an innovation might have been the norm for quite some time before it becomes questioned to such an extent that its discontinuation might become visible on the governance horizon. Furthermore, although seen as a governance task, there is hardly any specification of an “exnovation governance” (be it public or corporate governance).

Outnovation

The notion of “outnovation” has been used by Levain et al. (2015) to consider discontinuation as a specific type of innovation, in terms of an “inverse innovation” or “innovation through withdrawal” as suggested by Goulet and Vinck (2012). Outnovation means a change, which proceeds through the withdrawal or subtraction of a part—or the whole—of a socio-technical regime (Pellissier 2021: 172). Pellissier suggests the notion of “outnovation” is an act of innovation policy that removes a substance or product from the regime, as was the case for DDT: innovation by substitution (although in other cases it could also lead to other pathways). Levain et al. (2015) and especially Pellissier emphasise the active part of registering and banning a pesticide—as public action. Pellissier shows that the use of pesticides is not free but must be carried out in accordance with rules; that registration does not distinguish between products that are considered toxic and those that are not, but selects those whose use seems to be compatible with the registration rules. A tension can thus be seen within the registration system, which, on the one hand, allows products under certain conditions, but, on the other hand, can prohibit them (Pellissier 2021: 172).

In this way, Pellissier also raises questions about the continuity of regimes. She explains that bans on pesticides enrich the set of instruments of controlled use, while the regime does not change radically, but may even be reinforced (ibid: 195–196). However, Pellissier also points out that the prohibition of a substance or product for which no alternatives by substitution exist, or do not yet exist, could lead to a different situation. Prohibition without substitution challenges the dialectic between innovation and prohibition (ibid.: 196). It will be an important task of research on decline, discontinuation, and destabilisation to find contrasting cases and to identify the constellations and processes and then learn to distinguish between them.

In all these empirical questions, the concept of “outnovation” is synonymous with that of discontinuation. Authors who use the notion of discontinuation, however, do not emphasise that it is about the countermovement to an innovation, but refer to any termination, whether of an incomplete, recently completed, tentatively established, or firmly established regime or one that is increasingly perceived as weak and undesirable.

4.3.5 Discontinuation governance studies: Pathways and configurations

As result of their comparative studies of discontinuation governance, Stegmaier et al. (2023) view “discontinuation” as a property of a trajectory⁹ in which the constituting relations become misaligned to such an extent that the trajectory’s distinctive character is lost, as one possible result of various permutations of distributed agency, emergence, contingency, or deliberate governance.¹⁰ Discontinuation governance entails two complementary aspects, in which groups of governance actors undertake towards and eventually within a window of opportunity a spectrum of actions (including use of policy instruments) intended directly to effect both the discontinuation of a trajectory itself (governance of discontinuation) and of governance practices that help stabilise it (discontinuation of governance). The governance of discontinuation is here understood as governing the discontinuation of a particular governance problem as the result of a changed framing (formulation, perception) of a socio-technical regime (cf. van der Graaf and Hoppe 1996). The discontinuation of governance practices, in turn, is seen as the discontinuing of a particular way of solving a policy or a governance problem as the result of a changed framing (formulation, perception) of a problem or solution.

Their research found that a trajectory can become the addressee of discontinuing (besides and most in contrast to “building” and/or “maintaining”) governance. Since the empirical reality of governance targets is complex, often composed of nested entities, and the targeted trajectories are rather “moving targets”, the “targeted trajectory” (e.g., DDT, incandescent light bulbs, or nuclear energy production) is distinguished from the “wider trajectory” (pesticides, electric lighting/energy efficiency for energy-using products, and the nuclear industrial-technical-military complex). When a phase-out or ban occurs, some characteristic patterns can be seen: specific configurations that evolve over time (pathways). Both are important: the configuration as a particular structural state, and the emergent character of it when on the way. While these patterns could also be used to describe dynamics that emerge, they are intended here as markers of strategic directions of governance action: 1) how these modes of influence on a socio-technical target object are used in a targeted way, or 2) how a bundle of measures leads recognisably towards this direction. In contrast, the phase model of destabilisation enactment (Turnheim and Geels 2012), for example, can be understood as a reactive or response scheme, in which it is largely a matter of reacting appropriately and counteracting destabilisation, but if this does not help and the de-alignment trend intensifies, at least still accompanying or managing the decline. The discontinuation governance pathways, also in their specific sequence in each case, follow more the logic of a proactive scheme which is based on the assumption that discontinuation is intended and should therefore be fostered.

When a “window of opportunity” opens, different patterns can be observed:

- Ending pathway: Two forms of governance-induced ending, often associated with the notions of “*phase-out*” and “*ban*”, which are the incremental or the abrupt discontinuation of a trajectory.

- Weakening pathway: Three preparatory modes of discontinuation—*control* (producing intelligence, limiting use by critical observation/social control effect), *restriction* (scope of usage), and *reduction* (scope of production)—which together can lead to final discontinuation in terms of ban or phase-out, but which can also “only” lead to a development that persists, but in a somewhat constrained, retrenched, or limited way.

These pathways cover the core of each discontinuation governance phenomenon: the way to ultimate closure, at once or in steps. Another set of pathways captures discontinuity in relation to continuity after a window of opportunity has opened and has been used or not used:

- Expiration pathway: Two possible progressions, either what is discontinued gets *replaced* (substituted)—here, the relation of the discontinued trajectory to the one that takes its place is part of the discontinuation governance; or *abandonment* occurs, which means that discontinuation governance is independent of anything that could take the place of the old and that the gap it leaves is not filled directly.
- Continuance pathway: When no discontinuation occurs at all, in cases in which efforts of discontinuation governance are induced and a destabilisation of the trajectory could be observed, but this doesn’t lead to discontinuation (not yet, not within foreseeable time, or due to flaws in the process or advocacy coalitions breaking apart before success).

These types describe rough alternatives. In the individual cases and with even more detailed historical considerations, it will probably be found that some trajectories do not completely disappear for a long time. What is left is often a remnant of usage and knowledge, infrastructure, and function, for a transitional period, until all its functions are replaced by new ones (think of plastic production, which cannot be done without petroleum products, if the goal is fossil-free production). At other times, it may be a matter of decision, for example if DDT can still be used for very limited purposes or if lightbulbs are intended for special uses. In short, it seems as if almost nothing disappears completely at first (cf. Stegmaier 2023).

4.3.6 How (far) STS grasps discontinuation and its governance

Abandonment of technologies and socio-technical systems occurs not infrequently. However, similar to governance, administration, and policy studies, science and technology studies is not known for a broad consideration of discontinuation and destabilisation. The emergence of novel technoscience in the form of scientific, technological, medical, engineering knowledge, artefacts, and practices is usually prioritised over all forms of decline. However, it is Kuhn (1962) who had already posed the key question in his studies on scientific revolutions:

What is the process by which a new candidate for paradigm replaces its predecessor? Any new interpretation of nature, whether a discovery or a theory, emerges first in the mind of one or a few individuals... How are they able to, what must they do, to convert the entire profession or the relevant professional subgroups to their way of seeing science and the world? What causes the group to abandon one tradition of normal research in favor of another?

(Kuhn 1962: 144)

The empirical cases are legion. However, it is crucial to see how socio-technical systems, technological regimes, or technologies are (or have been) disappearing or are being ended. Research on discontinuation and destabilisation has not yet made a real breakthrough. The authors of the studies of the Ural computer (Koretsky, Zeiss and van Lente 2022), unravelling (Koretsky 2023) and 16 mm film (van de Leemput and van Lente 2023) set out to change this. And they have precursors who have developed important clues, as we see below.

Trajectories of erosion, decay, and fossilisation

Shove and Walker conceptualise the “trajectories of erosion, decay, and fossilisation” (Shove and Walker 2007: 767) as parallel movements to innovation. This prominent and extensive focus on decline in STS turns out to be at the same time a particularly problematic way of prioritising progress. It overlooks the fact that, firstly, innovations can also be aborted; secondly, that sometimes innovations are deliberately intended to function as bridging technologies (halogen lamps as a temporary replacement for conventional incandescent lamps, as well as energy-saving and LED lamps as long as they were not yet fully functional; hybrid drives as an intermediate step to electric cars; gas as an intermediate step to all-round energy supply with renewables while nuclear and coal are discontinued); and thirdly, that innovations of governance are in some cases newly developed in order to be able to undermine or bring down a strongly established existing regime. Moreover, Shove and Walker limit themselves to such downward trajectories as evolutionary rather than managed or controlled processes; to decline as the result of an inherently uncontrollable process (Pantzar and Shove 2010: 459). Shove portrays emergence and novelty as bright, whereas the unmaking, erosion, and decay as dark—the “shadowy side of innovation” (2012). Shove reproduces the “conceptual and empirical emphasis on novelty” (2012: 364) that she criticises.

Unviability

However, there are in STS a few important studies addressing the issue of ending directly. Latour presents the drama of the end of the automated train system Aramis in France, which he compares to the Concorde supersonic aeroplane in side-remarks (Latour 2002/1992). In each of the cases, their respective technological-political dimensions are profoundly linked. One of the socio-technical regimes was

abandoned before its introduction, the other only after three decades of operation, during which it was always controversial. The termination of political support for the Aramis project led to the death of the socio-technical system as a whole. When it had almost matured sufficiently, the political will to use it was still lacking—and it never came. To fully mature (for example, the complex software) would still have required a not easily determinable time and an enormous additional budget. Some parts that were too complicated had already been simplified during the development process, while others, such as the control software, were not. Latour makes an important observation here: that when projects become too complex, individual parts can be left out without terminating everything (discontinuation of unviable components). If this is not done in sufficient numbers,¹¹ the whole system could become unwieldy, too complex, and possibly be up for disposal. What was not managed was both technological sophistication and the excessive expectations of the stakeholders—a tension between technology maturation and project management that is difficult to resolve and points to the close link between governance and technology: the specific concoction of the socio-technical regime. In the end, it's hard to decide whether Aramis was feasible, either technologically or regarding its governance. It is a question of perspective whether one sees Aramis as a collapse of innovation or the end of a short lifetime. The fundamental patterns do not seem very different.

Concorde, the civil supersonic aircraft, was a technically functioning system, albeit with quirks, which was only terminated after a fatal accident at Paris Charles de Gaulle airport after 27 years of operation. This is remarkable because the end had already been threatened during its development: the costs of production and operation were high, acceptance of the enormous noise pollution among the population in the neighbourhoods of airports was low, and potential customers did not want to take the acceptance risk (Japan cancelled an order because of this). In 1973, the US even banned civil supersonic flight. Concorde was a politically charged intergovernmental project of the French and British governments, from which the British partners did not withdraw only because they did not want to incur the wrath of the French over the necessary breach of contract. With Concorde, then, we register a tense mixture of political will (France) and political unwillingness (UK), technological maturity (basic functionality) and technological inadequacy (noise). Moreover, the political-regulatory framework changed due to bans on civil supersonic flight. It can be said that Concorde was kept alive artificially for some time (with great effort, with many popular rejections), while Aramis did not even see the light of day, but was stopped before birth.

De-inscription and non-use

For cases in which technologies are already in use, script analysis may offer another lead, e.g., when Akrich and Latour (1992) refer to “de-inscription” as one form of rejecting or renegotiating what is prescribed by designers’ programmes for users. While designers assume projected users with typical forms of use, interests,

competences, and taste, and inscribe this vision like a “programme” in an artefact (Latour and Woolgar 1979; Akrich 1992), actual users may not comply with the programme of action and the delegation of roles. Users may then elaborate an alternative “anti-programme” and use it to de-inscribe the original programme thereby reshaping the artefact. The artefact as such will not (necessarily) be abandoned. Through the concept of the gender script, it is proposed to capture all the work that involves not only the inscription but also the de-inscription of representations of masculinity and femininity in technical artefacts (Oudshoorn and Pinch 2003). In many studies there are some elements embedded that relate to governance or policy. Discontinuation comes in when users refuse to use or change the inscribed, intended programmes for use. In that respect, the slowly growing scholarship on non-use and no-longer-use after long use, or after test use before full adoption, always has the potential to be re-read for a discontinuation governance focus. Here, non-users are seen as active agents in the destabilisation of technologies during or after introduction, before or after longer use (cf. Oudshoorn and Pinch 2003; Wyatt 2003; Melby and Toussaint 2016; Weiner and Will 2016).

Conceptual discontinuity

The ANT approach with its symmetrisation of human and non-human entities among many other categories as a methodological programme and objective breaks with conventional presuppositions about the separation of nature, technology, and society. Instead, hybrids such as the ozone hole are considered, composed of CFCs, refrigerators, industrialists, politicians, chemists, and meteorologists (Latour 1993). In this way, ANT not only lays the groundwork for methodological and theoretical rethinking, but also political potential and, importantly in this paper, the inclusion of politics and governance, administration, and regulation in STS analyses. The diagnosed crisis of the moderns also becomes the level of consideration for the crisis of large-scale, unsustainable business-as-usual modernisation and other challenges that politics and governance are already forced to consider together in practice. In the same way, feminist STS have offered challenges to rediscover the customary order of gender relations and to re-inform and re-address socio-political issues of notions of gender, assigned function and performance in science and technology. Breaking down gender stereotypes goes hand in hand with breaking down the practices and rules that assign an unequal role to female members of society. Gender research suggests discontinuation needs. Later, new biotechnological and medical STS research showed how nature can become both a construction and demolition site for outdated concepts of the body, gender, science models and the boundaries of technology (vis-à-vis bodies and brains). Postcolonial research showed how American-European or Western-Northern science and technology, in conjunction with politics and policy, have provincialised the horizon and what might be de-universalised in response. With this rough overview, I only want to hint at the great and broad potential of STS to address in much greater depth numerous questions relevant to the political shaping of society, also from the perspective of the leveraged, deconstructed, delegitimised, and discarded thought models and socio-technical regimes.

Doing with less or without

Goulet and Vinck note that responses to the problems facing modern industrialised and technologised societies involve reducing or even abandoning certain technologies, substances, or other artefacts essential to ways of life and production; and that this is even happening at an increased rate. They suggest a critique of the sociology of translation in that it tends to overemphasise the making of new connections and the breaking of existing associations (attachments). They focus on mechanisms of dissociation and detachment. To speak of mechanisms of dissociation and detachment suggests a view that sees not whole substantial terminations or exits, but the making of cut-offs, disconnections, reductions, dissolutions, and distances from each other of elements that have hitherto been seen as belonging together. In this way, parts remain, while others no longer have a function, or at best do so in a different place and in a different way. The aim is to better understand the detachment processes at work in most innovations (Goulet and Vinck 2012). In doing so, Goulet and Vinck refer to an entire discipline of innovation studies from Schumpeter to organisational studies, transition studies, regime dynamics to Callon, which consider innovation without a detailed look at withdrawal and destruction. The focus is on complementing innovation research with the withdrawal perspective. Key forms found are banning through delegitimation and prohibition, as well as disintermediation as “removal of an actor or an intermediary object... considered harmful” (Goulet and Vinck 2017: 108).

Maintenance and care as forms of doing less with new things are only recently receiving more attention (see van de Leemput and van Lente 2023), yet almost never in terms of the ending of care-taking or maintenance endeavours, such as the category of “aftercare” for the care-taking of some remaining components of a socio-technical regime until they are also finished, as introduced by Stegmaier et al. (2014) to address typical policymaking practices in the discontinuation context.

4.4 Challenges for research about discontinuation governance

From the preceding considerations, we identify the following key challenges for describing and operating discontinuation governance. Why both? Because, on the one hand, we still have a lot to learn about discontinuation work and circumstances and, on the other hand, because practitioners are also regularly faced with the question of identifying challenges and opportunities for action.

4.4.1 Extinction: Discontinuation in studies of bio-physical / socio-technical-ecological regimes

A largely neglected field in studies of decline, discontinuation, and destabilisation is the reduction of biodiversity and extinction of species as a side effect or declared goal of management and governance actions. This is also about the overexploitation of nature through clearing, settlement, and reclamation, through the destruction of

habitats and populations living there and entire species besides alteration beyond recognition or destruction of landscape and habitat through resource extraction. Examples like deforestation, poaching, and extinctive hunting of predatory animals extend far back into human history. Overfishing and habitat degradation are more recent effects of industrialisation and human overpopulation. As unintended side effects, religiously legitimised subjugation of nature, or targeted profit-seeking, many of these examples involve human action, not infrequently legitimised by permissive laws or tolerated by lax law enforcement. Socio-technical systems are related to this in various ways, whether as means or ends. Socio-technical and economic systems carry the potential of a discontinuation practice with them as part of their basic equipment, whenever they are based on mining, harvesting, or fishing. Not everything leads immediately to extinction, but problems such as overexploited fish stocks suggest that food production means risking extinction of stocks. Other systems have the simple goal of material and profit exploitation until nothing is left: oil exploration, rare earths, fishing as an industry in itself, for instance. Side effects occur when a socio-technical economic system exploits natural resources and thereby undermines other livelihoods. This area goes beyond socio-technical change and is sometimes referred to as socio-technical-ecological change (Smith and Stirling 2010; Folke et al. 2005). Extinction as a form of discontinuation is yet to be discovered. This context also includes reflections on the “finite earth” view, which straddles The Limits of Growth report (Meadows et al. 1972) and Chakrabarty’s analysis of the planetary biological and geomorphological role of humans with the opportunity to destroy the livelihoods of themselves and other life forms through interventions they cannot control (Chakrabarty 2021).

4.4.2 When discontinuation governance is more than just public policy

Another challenge relates to the difficulty of discovering governance in areas that are not commonly associated with or do not have clear links to “governing”. For this reason, I have mentioned the above terms from the field of management and economics. Why should discontinuation governance only occur in governmental, administrative contexts and not also in private-public contexts (private companies providing or using civil infrastructure) or be based on informal rather than formal institutions and organisations (such as civic engagement) or public-private partnerships?

4.4.3 Values, political-societal missions, normative attitudes, and power

There is a broad socio-legal dimension to discontinuation that requires far more attention. Markard et al. (2023) remind us that “When technologies decline, there will be struggles between actors that seek to disrupt legitimacy (delegitimation) and those that try to maintain or re-establish legitimacy (legitimation)”. The struggles are indeed manifold and broader than this. Legitimacy is a means to achieve something in the governance arena—for or against discontinuation. As we have

seen in case studies (Liersch and Stegmaier 2022; Oudelaar 2015), government agencies sometimes act outside the legal bounds (eviction of a protest camp on an illegal legal basis), and citizens' groups or activists also operate in grey areas of legality (occupation of land owned or granted for exploitation by open-cast mining companies and power plant operators). In doing so, they try to delegitimise the other and to present and maintain their own position as legal and legitimate. Due to the slow pace of justice, research will face a long haul, especially when going through the instances and in relation to current political, managerial, and activist actions. We see the nesting of normativity at various levels, procedural innovation, and areas of law, especially in European and federal contexts. Little attention is paid to the global level of contractual discontinuation governance under international law (e.g., the Minamata Convention banning and phasing out mercury in consumer products; cf. Bulten 2016). At the same time, there are often extra-judicial, discursive, mediated, and little formalised negotiations of legitimacy, which is why one must do much more than investigate legal texts and court decisions.

4.4.4 Size, scale, and magnitude

Comparing studies of decline, discontinuation, and destabilisation, one may get the impression that preference is given to larger socio-technical systems (or production lines, product ranges) associated with big infrastructures or widespread substances. Size, scale, and magnitude seem to make them weightier examples. However, one should not underestimate the interconnectedness of smaller objects and their governance, such as a "simple" light bulb (Stegmaier et al. 2021). On closer examination, the incandescent light bulb relates to industrial and environmental policy, the change in what is regarded as illuminants and as lighting culture, with energy issues, jobs, technological innovations, and competences in semiconductors, for example. The Ural computer can be read as an example of the ability to operate large-scale computing systems at the transition to accommodating large computing power in smaller devices, while the Ural project also failed due to the development and availability of parts and software code, among other things (Koretsky 2023). Instead, research into such unfamiliar realms, as suggested by Latour (1996), benefits from avoiding the measurable and looking for connections and their meaning as they are made or cut. The same is true for how narrow or wide a domain is, or for the nestedness of the immediate usage environment, value networks, and embedding regimes.

4.5 Conclusion

Discontinuation is not the opposite of innovation, but of continuation. Innovation in discontinuation involves 1) novel socio-technical systems that offer the chance to substitute the incumbent, and 2) innovative governance strategies and formats dedicated to the specific discontinuation goal. A governance to discontinue a governance can thus be found as well as a governance to be discontinued. It is about the connections between both in context.

Nor should we be under the misconception that discontinuation governance is only applied to climate-damaging or ecologically undesirable socio-technical systems. On the contrary, it also affects politically and economically undesirable systems, and sometimes also puts an end to the expansion of sustainable energy production (as can be seen in the example of the actively undermined and ruined photovoltaic and wind power industry in Germany after the nuclear phase-out, where instead the focus was on supposedly cheap gas and oil, but at the same time obstacles were erected to renewables; cf. IRENA and ILO (2021: 45) on job losses since 2011).

There is a considerable need for research, because for a long time the counter-movement to the emergence of new socio-technical systems and their regimes has remained underexposed (Koretsky et al. 2023). There is a need to better understand practices, rules, and the conditions of the possibility that a discontinuation effort is undertaken and successful. For practitioners in politics, business, civil society and the media, science and technology, it has always been important to somehow manage to get rid of and end things that are no longer useful or desired. It seems that this focus has often been dealt with rather implicitly and informally—apart, of course, from the big debates and struggles over nuclear phase-out or nuclear capping, discrimination, or the absence of the rule of law. Increasingly, however, we are seeing open political, economic, and general social struggles about the direction of development of socio-technical regimes, for example regarding the crises of growth, climate, biodiversity, food, air quality or the exploitation of natural resources. Exiting fossils and terminating policies is becoming quite a trendy approach to socio-technical and societal transition. One speaks directly about what and how something can or should be stopped: activists against a fossil-fuelled world, governments and managements in fear of missing the boat on technological development, or that in crises, the supply of energy, raw materials, and supplier products fails. Incidentally, this also applies to the opponents of climate protection policy, who in turn want to put an end to the transformation efforts.

Our research helps to open eyes to the challenges of making something that has been practised and maintained for a long time stay the same or change it so much that it is no longer the same as it was before. It is about stopping in order to be able to continue.¹²

Notes

- 1 Throughout this volume, we present our different and various justified ways of speaking and conceptualising in order to make a series of explicit contributions to this. This is also the case here.
- 2 In this general sense, but without the theoretical frame, Kern and Howlett (2009) have used the verb “discontinued” and the noun “discontinuation” in the context of energy policy and transition management. In general policy studies literature, Berry referred to the “discontinuation” of health policy programmes and their “rapid dismantling” (Berry 1974: 354). Lindenberg (1989: 364) addressed the “discontinuation” of public services. We introduced it with the sketch of a research programme on discontinuation governance of socio-technical systems a few years later (Stegmaier et al. 2012a, 2012b).
- 3 This refers to the negotiation of what is the case and what should be done about it, and how: such as perceptions of problems, of situations/factors etc. that lead to problems for those who perceive them, the struggle about who defines with/against whom with which

- explanation and justification, who has a more plausible or legitimate view on a matter, or what the governance answer could or should look like. This is also about how views on problems and their handling are communicated and translated in the policy realm and beyond, what objects are at stake, how they can serve as “boundary objects” (Star 2010) for processing from different sides without consensus or are not suitable for this.
- 4 Weber includes this in his definition of social action “which includes both failure to act and passive acquiescence” (1978: 131). Streeck and Thelen (2005: 29) speak of “institutional exhaustion” as a specific kind of institutional change leading to “a process in which behaviors invoked or allowed under existing rules operate to undermine these”, which aligns with Weber’s “failure to act and passive acquiescence”.
 - 5 It would be worth a study of its own to find out why this side of the coin has been so neglected.
 - 6 See <https://blogs.griffith.edu.au/social-marketing-griffith/2020/04/14/my-2020-resolution-being-the-change-i-want-to-see/> for an iconic article published in *LIFE* magazine in August 1955 featuring the notion “throwaway living”.
 - 7 Joly et al. (2022) explain that the debate on planned obsolescence may point to the drift of a system that values permanent change and novelty for novelty’s sake.
 - 8 Cf. <http://4managers.de/management/themen/exnovation/>.
 - 9 We focus on “streams” and “trajectories” to emphasise the processual and interactive character of socio-technical and governance phenomena and to avoid ex ante assumptions about levels and hierarchies.
 - 10 This and the following definitions have already been used in this form in conference presentations (Stegmaier and Kuhlmann 2016; Stegmaier 2017).
 - 11 Or too much, so that, in other cases, not enough remains from the envisaged system.
 - 12 If this feels strangely wrong, to stop something, this should also be investigated: how it is that continuation feels so much better than discontinuation. One reason could be that there is not always a sense of urgency for change and termination, for stopping to do things that we are used to doing.

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