Institutional Dynamics in Sustainability Transformations:
Advancing the Productive Functions of Failure and Decline

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Article IV: Phasing out not in: Exnovation Governance for Sustainability and the Powering Past Coal Alliance.

Overview of articles included in this cumulative Ph.D. thesis

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Foreword

The research presented in this doctoral dissertation was conducted as part of the project 'Leverage Points for Sustainability Transformation' at Leuphana University in Lüneburg, Germany, running from April 2015 to March 2019. Focusing on the root causes of unsustainability, the goal of this project is to "critically examine potentially important leverage points for sustainability" (Leuphana University of Lüneburg n.d.). The core argument underlying this project is that sustainability science and policy makers to date have largely failed to deal with the underlying causes of unsustainability, instead focusing on relatively 'shallow' problems or interventions that offer little potential for transformational change towards increased sustainability (Abson et al. 2017). The project is situated around three realms of leverage believed to offer more powerful areas of intervention: (i) the restructuring of institutions; (ii) re-connecting people and nature; and (iii) re-thinking ways that knowledge is produced. The core focus of this doctoral research is located within the first work package, which aims to understand processes of institutional change in order to assess how structures can be leveraged for sustainability transformation (Leuphana University of Lüneburg n.d.).

Alongside core publications, the nature of this project resulted in my participation in a number of cross-cutting research efforts and project-wide integration activities. The related publications can be found on page *viii*.

List of Articles

This dissertation is compiled in a cumulative way. The following peer-reviewed articles are included for consideration:

Article I: **Derwort, P**., Newig, J. and Jager, N. (2018). Towards productive functions? A Systematic Review of Failure, its Causes and Consequences. *Policy Sciences,* 1-18.

Article II: Newig, J., **Derwort, P**. and Jager, N. (2019). Sustainability through institutional failure and decline? Archetypes of Productive Pathways. *Ecology and Society 24*(1):18.

Article III: **Derwort, P**., Jager, N. and Newig, J. (2019). How to explain major policy change towards sustainability? Applying the Multiple Streams Framework and the Multi-Level Perspective on Socio-Technical Transitions to the German 'Energiewende'. Revise and resubmit with major revisions in *Policy Studies Journal*.

Article IV: **Derwort, P.** (2019). Phasing out not in: Exnovation Governance for Sustainability and the Powering Past Coal Alliance. Conditionally accepted for publication in *Energy Research and Social Science*.

Related work not included in the dissertation

This doctoral dissertation was embedded in the project 'Leverage Points for Sustainability Transformation' at Leuphana University (see Foreword). Being part of this project resulted in a number of research collaborations that did not directly contribute to this dissertation but nevertheless influenced my thinking on sustainability transformations during this period. These are:

Article V: Fam, D., Clarke, E., Freeth, R., **Derwort, P.**, Klaniecki, K., Kater-Wettstädt, L., Juarez-Bourke, S., Hilser, S., Peukert, D., Meyer, E. and Horcea-Milcu, A.I. (2019). Interdisciplinary and transdisciplinary research and practice: Balancing expectations of the 'old' academy with the future model of universities as 'problem solvers'. *Higher Education Quarterly*.

Article VI: Dorninger, C., Abson, D.J., Apetrei, C.I., **Derwort, P.**, Ives, C.D., Klaniecki, K., Lang, D.P., Langsenlehner, M., Riechers, M., Spittler, N., and von Wehrden, H. (2019). Leverage Points for Sustainability Transformation: A review on interventions in food and energy systems. *Ecological Economics*.

Book: Horcea-Milcu, A.I., Fischer, J., Lang, D.J., Thale-Bombien, L., Abson, D.J., Apetrei, C., Clarke, E., **Derwort, P.**, Dorninger, C., Duse, I.A., Freeth, R., Jager, N., Klaniecki, K., Lam, D., Leventon, J., Newig, J., Peukert, D., Riechers, M., Schaal, T. (2019). *Balance Brings Beauty: Strategies for a Sustainable Southern Transylvania*. Pensoft, Sofia.

Abstract

The world currently faces important issues concerning climate change and environmental sustainability, with the wellbeing of billions of people around the world at risk over the next decades. Existing institutions no longer appear to be sufficiently capable to deal with the complexity and uncertainty associated with the wicked problem of sustainability. Achieving the required sustainability transformation will thus require purposeful reform of existing institutional frameworks. However, existing research on the governance of sustainability of sustainability transformations has strongly focused on innovation and the more 'creative' aspects of these processes, blinding our view to the fact that they go hand with the failure, decline or dismantling of institutions that are no longer considered functional or desirable. This doctoral dissertation thus seeks to better understand how institutional failure and decline can contribute productively to sustainability transformations and how such dynamics in institutional arrangements can serve to restructure existing institutional systems.

A systematic review of the conceptual literature served to provide a concise synthesis of the research on 'failure' and 'decline' in the institutional literature, providing important first insights into their potentially productive functions. This was followed up by an archetype analysis of the productive functions of failure and decline, drawing on a wide range of literatures. This research identified five archetypical pathways: (1) crises triggering institutional adaptations toward sustainability, (2) systematic learning from failure and breakdown, (3) the purposeful destabilisation of unsustainable institutions, (4) making a virtue of inevitable decline, and (5) active and reflective decision making in the face of decline instead of leaving it to chance. Empirical case studies looking at the German energy transition and efforts to phase out coal in the Powering Past Coal Alliance served to provide more insights on (a) how to effectively harness 'windows of opportunity' for change, and (b) the governance mechanisms used by governments to actively remove institutions.

Results indicate that the lock-in of existing technologies, regulations and practices can throw up important obstacles for sustainability transformations. The intentional or unintentional destabilisation of the status quo may thus be required to enable healthy renewal within a system. This process required active and reflective management to avoid the irreversible loss of desirable institutional elements. Instruments such as 'sunset clauses' and 'experimental legislation' may serve as important tools to learn through 'trial and error', whilst limiting the possible damage done by failure. Focusing on the subject of scale, this analysis finds that the level at which failure occurs is likely to determine the degree of change that can be achieved.

Failures at the policy-level are most likely to merely lead to changes to the tools and instruments used by policy makers. This research thus suggests that failures on the polity- and political level may be required to achieve transformative changes to existing power structures, belief-systems and paradigms. Finally, this research briefly touches on the role of actor and agency in the governance of sustainability transformations through failure and decline. It finds that actors may play an important role in causing a system or one of its elements to fail and in shaping the way events are come to be perceived.

Drawing on the findings of this research, this dissertation suggests a number of lessons policy makers and others seeking to revisit existing institutional arrangements may want to take into account. Actors should be prepared to harness the potential associated with failure and decline, preserve those institutional elements considered important, and take care to manage the tension between the need for 'quick fixes' to currently pressing problems and solution that maintain and protect the long-term sustainability of a system.

Keywords: Institutional Change; Failure; Decline; Productive Functions; Sustainability Transformation; Systems Thinking; Socio-technical Systems; Energy Policy

1 Introduction

One of the biggest threats currently facing the world is that of climate change, the effects of which could put the wellbeing of billions of people around the world at increased risk over the next decades (Costello et al. 2009). There is a growing body of evidence to demonstrate that humanity is now the global driving force behind environmental change (see Griggs et al. 2013), with human actions risking irreversible changes to global ecosystems. However, despite substantial focus on sustainability issues by governments, business and civil society, indicators for sustainable development continue to point in the wrong direction (United Nations 2018), with humanity remaining on an unsustainable trajectory and a lack of real political progress towards sustainable development (Drexhage and Murphy 2010).

In modern societies, human activities are organised through institutions, defined as "the structures that make societal interactions predictable and guide human actions towards collective goals" (Abson et al. 2017), or the rules of the game in a society.[1] Serving as both a guide and constraint for human action, institutions thus play a crucial role in achieving sustainability transformations (ibid). Faced with the increased complexity and uncertainty of sustainability issues, however, existing institutional arrangements no longer appear to be sufficient (Connor and Dovers 2004). To achieve the required sustainability transformation thus requires "purposive institutional change" (ibid.), or the reform of existing institutional frameworks (Khan et al. 2011).

Existing research on the governance of sustainability transformations to date has mainly focused on institutional evolution, looking at what sustains institutions and how they evolve over time (see e.g. Thelen 2009). While the design of institutions means that they are resistant to change once established, they are by no means static and, in fact, continually change in a number of ways. In most cases, transformative change is the result of gradual and incremental change, unfolding over a prolonged period of time (see e.g. North 1990; Streeck and Thelen 2005). In some cases, however, change can be more abrupt and discontinuous, with non-linear changes leading to a "restructuring" of existing institutional arrangements (Young 2010), for example, following natural disasters or catastrophes (Birkland 2006b), where long periods of stability are interrupted by periods of rapid change (Jones and Baumgartner 2012). Further, the current sustainability discourse is found to focus strongly on innovations that are better equipped to stimulate sustainability.[2] This interest in the 'new' (Shove 2012) is reflected in an

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[1] A more detailed definition of institutions can be found in Section 2.1.
[2] The following account closely follows the arguments presented in Newig et al. (2019).

increase in research on institutional innovations (e.g. Pahl-Wostl 2007; Mieg and Töpfer 2013), policy and governance innovations (Meadowcroft and Fiorino 2017), democratic innovations (Mattijssen et al. 2015) and technological innovations (Smith et al. 2010).

This focus on the more 'creative' aspects of sustainability governance has been critiqued for overlooking the fact that such transitions commonly go hand in hand with the decline or dismantling of existing structures (Newig 2013). With the existing literature paying only scarce attention to processes of institutional failure and decline, it currently fails to adequately examine how existing configurations break down or redundant institutions persist (Shove 2012) and lacks a systems-oriented view on institutional change (Ostrom 2005). As argued by Newig et al. (2019), by focusing so strongly on the 'new' and innovative aspects of transformations, scholars and practitioners alike largely fail to take into consideration alternative or complementary perspectives to achieve sustainability transformation, namely the elimination of institutions that are no longer functional or desirable. Furthermore, in a systematic review of the literature on failure and decline, Derwort et al. (2018) discuss that even in those instances where the scholarly literature does focus on the subject of failure, the potentially productive functions of failure and decline remain little discussed. As a result, it remains unclear how such processes can be initiated or steered in the desired direction.

1.1 Objective of the doctoral work

The overall aim of this doctoral research is thus *to contribute to a better understanding of how institutional failure and decline can contribute productively to sustainability transformations and how such dynamics (transformations) in institutional arrangements can restructure existing (institutional) systems*. Within this context, 'productive' is defined as "changes toward more sustainable solutions that benefit the common good rather than particular interests, that help protect the natural resources and life-support systems, and that embody lasting solutions rather than those undermining societal foundations" (Newig et al. 2019).

1.2 Structure of the dissertation

This dissertation is organised as follows: **Section 2** of this framework paper provides the conceptual background on which the remainder of this dissertation is built, highlighting the current state-of-the art on institutional theory and current thinking on the role of failure and decline in bringing about institutional change. On the basis of these findings, this section identifies the research gaps in the existing literature and more clearly formulates the research

aims. **Section 3** briefly explains the research design and chosen methodology. The results of the individual constituting articles and a synthesis of the key findings are discussed in **Section 4**. Finally, **Section 5** concludes by reflecting on the relevance of these findings, the limitations of this dissertation and avenues for future research.

Some of the findings presented in this framework paper have been published in international journals. Appropriate references to own (co-authored) published material have been included.

2 Conceptual Background

To orient this research and embed it in the wider conceptual literature, the analysis presented in this doctoral dissertation draws strongly on the literature on institutional change. This chapter first specifies how institutions are defined in the literature (Section 2.1), followed by a brief conceptual discussion of the dynamics of institutional systems, focusing on the themes of *stability versus change*, the *dynamics of change processes*, and the *duality of structure and function* (Section 2.2). Section 2.3 outlines how failure and decline are currently perceived in the literature dealing with institutional systems – which has recently witnessed a 'boom' in research on the study of various forms of institutional failure – and its connections to the study of failure and decline in socio-technical and social-ecological systems research. Following this overview of the literature, Section 2.4 identifies the outstanding research gaps that this thesis seeks to address. The final section of this chapter (Section 2.5) formulates the five research aims of this doctoral dissertation.

2.1 Defining institutions

Institutional systems encompass the relationship between civil societies and formal institutions. Institutions have been defined in various ways. One of the most widely used definitions of institutions is by North (1990), who defines institutions as "the rules of the game in a society or, more formally, [the] humanly devised constraints that shape human interactions". Fukuyama (2014) defines institutions as the "stable, valued, recurring patterns of behaviour whose most important function is to facilitate human collective action". Institutions thus guide and constrain our interactions (Dovers and Hezri 2010; Stacey and Rittberger 2003) and are considered to be the "building blocks" of social order (Connor and Dovers 2004; Streeck and Thelen 2005). By defining what actors are allowed to do, or prohibited from doing, in certain situations, institutions are able to mediate and make

predictable transactions between individuals, groups and states in complex environments (Genschel 1997; Dovers and Hezri 2010).

Within institutions, a distinction can be made between *formal* and *informal* institutions. Formal institutions are understood as the 'formal constraints' (North 1990) or "the rules and procedures, usually written and explicit, which are communicated, and enforced through official channels like executives or legislatures" (Hassenforder et al. 2015). Informal institutions have been defined as "socially shared rules, usually unwritten, that are communicated, and enforced outside of officially sanctioned channels" (Helmke and Levitsky 2004), such as norms and values. The analysis presented in this dissertation deals with formal institutions (such as laws and regulations) that are collectively binding.

2.2 Dynamics in institutional systems

Describing five 'archetypical pathways' through which failure and can decline are found to be productive, Newig et al. (2019) focus on a number of recurrent themes that delimit and distinguish processes of institutional change. They are the themes of *stability versus change* (Leroy and Arts 2006), the different *dynamics of change processes* (Jones and Baumgartner 2012; Streeck and Thelen 2005), and the *duality of structure and function* (Newig 2013). In doing so, the authors draw on the ideas of Pahl-Wostl (2009), who argues that institutional systems are considered 'complex adaptive systems' and that, while they are essentially stable, they are in fact capable of learning and adapting to changing circumstances (see also Siebenhüner and Suplie 2005; Dunlop and Radaelli 2013).

The first recurrent theme concerns the issue of **stability versus change**. In order to provide the necessary stability, institutions are essentially designed to be resistant to change, where their tendency to be self-reinforcing and self-reproducing can lead to a 'lock-in' of existing systems (Arthur 1989). Mahoney and Thelen (2010) argue that this idea of persistence is built into the very definition of an institution, making it natural for theories to focus on explaining continuity rather than change. This is echoed by others like Pierson (2004), who argues that formal institutions are resistant to change as political systems reinforce the "already considerable obstacles to movement off an established path". Until recently, theories often implicitly assumed institutions to be static (Grin 2018), in doing so emphasizing structural constraints and continuity (Streeck and Thelen 2005). Looking at institutions in this fashion, however, masks the fact that institutions are, in fact, continuously evolving (North 1990). The dynamics of these changes constitute another recurring theme found in the literature.

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The second theme thus concerns the different **dynamics of change processes** in institutional systems (e.g. Hall 1989), which refers both to the *speed* and *source* of change in institutional systems. In terms of the former, some theories consider change as occurring slowly and gradually (e.g. Mahoney and Thelen 2010; Streeck and Thelen 2005), while others perceive long periods of stability punctuated by periods of rapid change (Jones and Baumgartner 2012). In some cases, an individual case of institutional change can be described along different narratives to suit policymakers' needs (see e.g. van der Heijden 2013). With respect to the source of change, destabilising forces can either be endogenous or exogenous in nature, or a combination of both (Young 2002; Greif and Laitin 2004). With respect to the former, endogenous forces can undermine the self-reinforcing behaviour of institutional systems from within, such as a shift in goals (Howlett and Cashore 2009) while in the latter, changes taking place outside the system itself may result in a weakening or demise of an institution. If an institution is sufficiently robust, it may be able to withstand the impact of such destabilising forces without collapsing or undergoing transformative change (Young 2002). The consequences of a shock are not always known from the beginning; relatively minor events may "catch fire" unexpectedly if the internal dynamics of a system are close to a tipping point (Grossman 2015). Once pushed over the edge, institutional change occurs either with respect to its structure, or function.

This brings us to the third and final recurring theme, concerning the **duality of structure and function**. The structure of an institution refers to its organisation or arrangement of constituent parts, or *how* it performs its functions. The function of an institution, on the other hand, focuses explicitly on the task or purpose served by it. Institutional change can affect either of these two constituent parts, or both, resulting in the four different constellations of institutional change or stability, presented in Table 1[3].

Table 1: Typology of institutional change based on structure and function (Source: Newig 2013)

	Preservation of structure	Decline or substantive change of structure
Preservation of function	(a) Stable institution	(b) Institutional transition / adaptation
Dysfunction or substantive change of function	(c) Path-dependent re-orientation	(d) Institutional collapse

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[3] The following account closely follows the arguments presented in Newig et al. (2019), drawing on the earlier work of Newig (2013) in which this theme is first presented.

When both the structure and function of an institution essentially remain unchanged, an institution stays stable (a). Conversely, when both change fundamentally the existing institution will collapse (d), either because it ceases to exist entirely or because the changes are so substantial that a new institution is effectively created in its place. In quadrant (b), the function of an institution remains in place, while its structure is altered substantially. Finally, in quadrant (c), the structure of an institution remains unchanged, while serving a new function – referred to as 'conversion' or the "redeployment of old institutions to new purposes" by Streeck and Thelen (2005).

2.3 The role of 'failure' and 'decline' in institutional change

While much of the institutional change literature focuses on explaining the emergence of *new* institutions, the *direction* of change has received less attention (Bauer and Knill 2014). However, as explored by Derwort et al. (2018) in a systematic review of the literature, the field of policy sciences has experienced a marked update into the study of (institutional) failure as an important source of change in recent years. What is termed here as 'institutional failure' is, in fact, an 'umbrella concept' for various, partly overlapping realms of failure (Derwort et al. 2018), including 'institutional failure' (Acheson 2006; Ritchie et al. 2013), 'policy failure' (Dunlop 2017a; McConnell 2015; Bovens and Hart 2016), 'government failure' (Keech and Munger 2015; Fike and Gwartney 2015), 'governance failure' (Howlett and Ramesh 2014; Peters 2015), and 'regulatory failure' (Lodge 2002; Short 2013).

As demonstrated in our systematic review, the subject of 'policy failure', in particular, has increasingly received attention in the recent literature, with three special issues devoted to the subject in the last few years. *Public Policy and Administration* focused on the persistence of policy failures (Howlett et al. 2015), the *Journal of European Public Policy* connected the literatures on public policy and foreign policy fiascos (Oppermann and Spencer 2016a), and *Policy and Politics* focused on the relationship between failure and learning (Dunlop 2017b). Policy failure, here, is often defined as the inability to achieve formulated goals or targets (e.g. McConnell 2010, 2015), or the failure to do so cost-effectively (Murray and Dollery 2005).

Another subset of this literature focuses strongly on the dynamics of change following sudden events, so-called 'focusing events' that can be defined as "harmful or revealing the possibility of potential greater future harms" (Birkland 1998) which suddenly and rapidly gain attention. This includes the study of crises (e.g. Stern 1997; Frantzeskaki 2009; Boin et al. 2008;

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Anderies et al. 2006) – defined as "periods of disorder in the seemingly 'normal' development of a system" (Boin et al. 2005) – and natural or man-made disasters or catastrophes (e.g. Birkland 2006a, 2009; Eburn and Dovers 2015; Boin 2008) such as earthquakes or oil-spills. While some of these occur due to endogenous or internal failure (e.g. a political crisis) and others come as the result of an external shock, they all serve to draw the attention of policy-makers, thus opening as a 'policy window' for reform (Kingdon 1984). This strand of literature thus clearly recognises how focusing events may serve as a window of opportunity for institutional change (Brundiers 2016; Birkmann et al. 2010; Saurugger and Terpan 2016).

Finally, there is a disparate and often loosely connected literature devoted to the subject of 'decline', exploring the various possible reasons behind the decline of institutions. (see also Newig et al. 2019). First, one reason is that they simply wear off over time, referred to as "exhaustion" by Streeck and Thelen (2005), in which institutions may become obsolete under changed circumstances, or they become too complex to be maintained. This obsoleteness is also reflected in work by Fukuyama (2014), who argues that institutions decline when they fail to adapt to changing circumstances due to political rigidity or incumbent political actors defending the status quo. Second, institutions may formally remain intact, yet no longer be required under changed circumstances, a process Streeck and Thelen refer to as "drift". Finally, as new institutions are introduced old ones may simply become obsolete and gradually be displaced.

2.4 Research Gaps

Despite a growing scientific understanding of the subject of failure and decline, a number of important research gaps can be identified:

Firstly, while failure in institutional systems is closely associated with the subject of 'learning' (e.g. Rose 1991; O'Donovan 2017; Dunlop 2017a, 2017b), it largely continues to be regarded as something to be avoided. Thus, while a great deal of attention has been paid to the negative consequences of failure and decline, **insights into their potentially 'productive functions' are sparsely discussed and scattered throughout the literatures** on the subject. This limited understanding of failure further hampers the development of a 'typology' that can capture the different ways in which can be productive for sustainability transformations.

Secondly, while widely acknowledged that negative events such as crisis and failure may leave behind something positive in their wake, by and large the literature fails to go beyond

general statements such as that they may open a 'window of opportunity' for reform and learning (e.g. Stern 1997; Wallis and Dollery 2002). As a result, **our understanding of how failure and decline can serve as a 'window of opportunity' for change is severely limited**.

Finally, the institutional change literature currently remains characterised by a dominant focus on the creative aspects of institutional change, or the creation of something 'new'. As a result of this 'innovation bias', **existing research insufficiently considers the question of how we can remove those institutions/structures that are no longer considered sustainable or desirable** without the loss of vital structures and/or functions.

2.5 Research aims

Based on the research gaps outlined in the previous section, this dissertation seeks to answer the following research aims. Conceptually, this dissertation seeks to address the first research gap by formulating the following research aims:

Aim #1:   *Conceptual clarification and stocktaking*: Through a systematic survey of the academic literature, the aim is to provide an overview of the state-of-the-art of the research field, outlining the types of failure, causes of failure and determinants of the potential for productive learning and adjustment.

Aim #2:   *Formulating archetypical pathways of productive functions*: Through an inquiry into the principal literatures, the aim is to formulate archetypical pathways that encapsulate the ways in which institutional failure and decline are potentially related to productive, more sustainable outcomes.

As a first step (Aim #1), conceptual clarification serves to overcome existing confusion with regard to the different types of failure. Insights from this research provide important clarity on the state-of-the-art and, in doing so, set the stage for the further study of the productive potential of failure and decline. This improved understanding of (a) what constitutes failure, and (b) how it may be productive for sustainability transformations enables the identification of a wide range of examples discussed in various literatures. A logical next step (Aim #2) is, therefore, to find recurrent and overarching patterns of productive functions in the academic and scholarly debate. Arriving at such archetypical pathways may significantly move forward the debate on the subject of this dissertation.

To complement this theoretical exploration of institutional failure and decline, this doctoral research looks at two empirical cases from the field of energy transitions. The energy system

is considered to play a crucial role in the drive towards a more sustainable development (Vera and Langlois 2007; Rösch et al. 2017). While the fossil energy system provided the basis from which all sectors of the economy (such as agriculture, transport and building) could expand (see e.g. Schlör et al. 2012), it also brought with it a wide range of damaging impacts, including global warming, air pollution, and biodiversity loss (Dincer 2000; Kampa and Castanas 2008). A successful sustainability transformation will therefore not be possible without fundamental changes to our current energy system. It is insufficiently clear at this point, however, how such changes in energy systems can come about in practice. This dissertation thus seeks to address the following two empirical research aims:

Aim #3: *Identify how 'windows of opportunity' can be used to affect change in a system*: Through an empirical case study of the German *Energiewende*, the aim is to identify how windows of opportunity are used to achieve transformational change in practice.

Aim #4: *Identify mechanisms used to restructure existing (energy) systems*: Through an empirical case study of the 'Powering Past Coal Alliance', the aim is to identify governance mechanisms used to remove institutions that are no longer considered functional or desirable.

Where the conceptual research aims provide the theoretical underpinnings for the focus on the productive functions of failure and decline, the empirical research aims of this dissertation seek to provide more clarity on questions that arise from the conceptual literatures. As demonstrated above, some of the literature on institutional change relies on the idea that a 'policy window' or 'window of opportunity' may be required for change to take place. However, this literature largely remains vague on how these mechanisms work in practice, other than that they may lead to reform or learning. To better answer this question, Aim #3 seeks to strengthen our understanding of how a window of opportunity can be used to achieve transformational change in practice, by applying it to an empirical example of institutional change in the German energy system. Finally, with much of the discourse dominated by a focus on innovation, the last research aim (Aim #4) seeks to identify and put forward ways in which governments can actively remove or do away with institutions, rather than leaving it to chance. Within the scope and focus of this dissertation, answers to this specific research aim serve to improve our understanding of how governance mechanisms can be used to initiate or steer processes of failure or decline.

Taken together, the answers to these individual aims result in the final research aim of this doctoral dissertation:

Aim #5: *Synthesis*: Going beyond individual contributions, this dissertation asks what overarching lessons can be learned from this study.

The individual contributions of research (Aims #1-4) are found in the four papers included in this dissertation. Focusing on the synthesis (Aim #5) of these individual aims, this framework paper provides a final conclusion of the overall research objective.

3 Research Design and Methodology

This dissertation consists of four different contributions [Articles I – IV] which together contribute to the overall research objective. The research presented here is located at the interface between the rational-scientific and constructivist paradigms. While the rational-scientific tradition is based on a value-neutral and objective evidence-based standard (McConnell 2015; Kay and Boxall 2015), the constructivist paradigm operates under the assumptions that (a) reality is socially constructed and (b) that research is a product of the values of researchers (see e.g. Schwandt 2007; Creswell 2009; Mertens 2015). Elements of both approaches can be found throughout this dissertation. In the *Verstehen-* and *Erklären-* traditions of social science research (Nachmias and Frankfort-Nachmias 1987), this dissertation seeks not to predict social phenomena, but to *understand* the object of study and *explain* how institutional change occurs.

Articles I and II lay down much of the conceptual groundwork for the research presented in this dissertation. Its findings draw on a wide range of literatures including from the fields of ecology, evolutionary economics and anthropology. Together, they form the foundation for the empirical research undertaken in Articles III and IV, presenting the results of two qualitative case studies in the field of energy transitions. A qualitative research design is chosen for this dissertation. While this research design entails that findings are generalizable to only a limited range of cases (see Mahoney and Goertz 2006), this approach is well-suited due to its ability to reflect the complexity of a situation and provide a depth of understanding about phenomena that cannot be achieved through other methods (Creswell 2009, 2007; Corbin and Strauss 2008). An overview of the research design is presented in Figure 1 below.
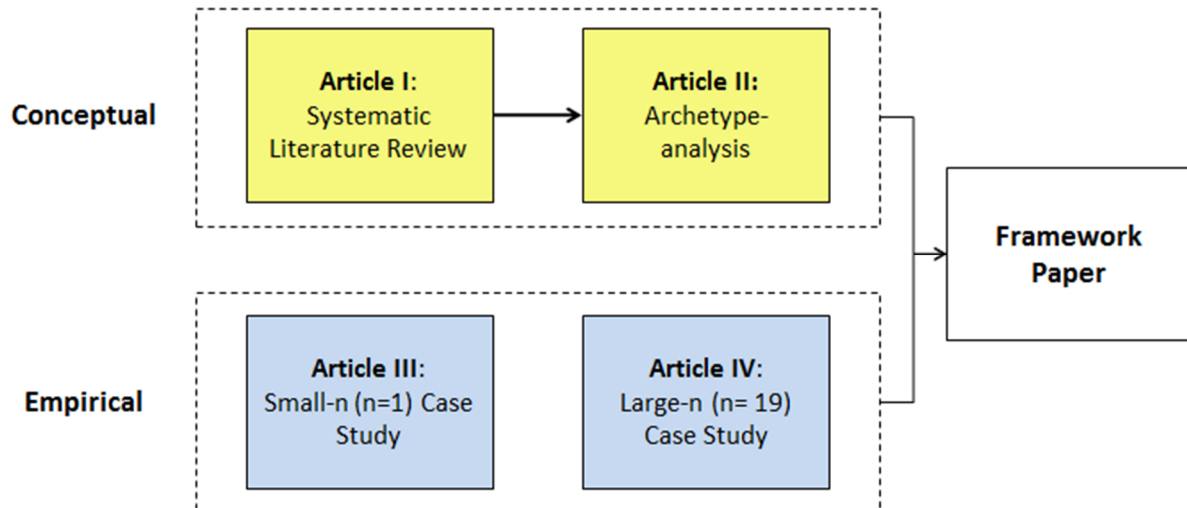
Figure 1: Research design of the dissertation

In light of the first research gap identified in Chapter 2, **Article I** presents the results of a systematic review of the literature on institutional failure and decline. Systematic reviews are particularly useful in those circumstances where a large body of accessible research is available, as they "efficiently integrate existing information" (Mulrow 1994) and enable a "concise synthesis of a large body of research" (Boland et al. 2017). This review was conducted following the PRISMA guidelines (see Moher et al. 2009) to ensure rigour, transparency and replicability not offered by more 'traditional' literature reviews (Mallett et al. 2012). In doing so, the authors consolidate the present academic body of research of 'failure' and 'decline' in the institutional context and provide first insights into the 'productive' potential of failure and decline.

Building on the work presented in the first article, **Article II** presents the results from an archetype analysis of the productive functions of failure and decline, based on an iterative reading of literature, including, but not limited to, the fields of anthropology, ecology and evolutionary economics (for more on this approach, see: Eisenack et al. 2018). These archetypes are presented as a 'diagnostic tool' (Newig et al. 2019), with the article going beyond the description of institutional failures presented in Paper I and suggesting five conceptual archetypical mechanisms through which failure and decline are found to facilitate sustainability transformations.

Having established the conceptual foundation, the empirical contributions presented in Article III and IV seek to address the two remaining research gaps. Currently, our understanding of how failure and decline can serve as a 'window of opportunity' for change is limited. **Article**

III seeks to address this research gap by examining the German energy transition in the period leading up to and following the 2011 Fukushima nuclear disaster in Japan. A single-case study design is chosen for its high level of detail or completeness of the case-description and a high degree of internal validity (Yin 2014; Gerring 2007). In terms of research methods, the article applied a document analysis as a means to identify important actors or agencies and construct a narrative of events. Document analysis here holds a distinct advantage over other research methods due to its ability to include broad coverage over a long time span (for more on this method, see: Bowen 2009; Yin 2014).

Addressing the final research gap identified in Section 2.4, **Article IV** presents the results of an empirical case study of the Powering Past Coal Alliance (PPCA). In contrast to Article III, the author applied a broad case study design, applying this concept to an empirical case study of 19 partner countries and regions in the PPCA. Here, a qualitative document analysis of publicly available information (e.g. IEA country reports, energy statistics, policy documents and legislation, newspapers) served to construct the clusters of exnovation governance approaches. In this particular set-up, this method served as a means to deal with issues of efficiency, cost-effectiveness and availability posed by research at this global scale not offered by alternative qualitative research methods such as interviews (Bowen 2009). The individual methods used are described in greater detail within the individual articles.

4 Key Results

4.1 Conceptual clarification and stocktaking

With conceptual ambiguities concerning the various aspects and types of failure preventing the development of "cumulative theory building into the causes and consequences of policy success and failure" (Howlett 2012), the first aim of this dissertation is to clarify and provide a structured overview of the state-of-the-art on the subject, particularly in relation to its productive potential. The findings to this research aim are discussed at length in a systematic review of the literature (Derwort et al. 2018), which goes beyond definitions of individual 'types' of institutional failure by distinguishing failure in the realms of *policy*, *polity* and *politics* (see Table 2 for an overview). The remainder of this paragraph focuses on the most important findings of the research presented in this article.

Table 2: Productive functions of failure: Intervention types and instruments in the dimensions of the political system (source: Derwort et al. 2018)

	Individual policies (policy)	System structure (polity)	Political dynamics (politics)
Type of learning	Instrumental	Social	Political
Target of intervention	Tools & instruments	Beliefs & paradigms	Power structures & discourses
Impact on system	Low-level intervention, incremental change; system remains stable	Break-up inertia & path-dependency	Creates room for new ideas

First, some concepts of failure focus on the failure of specific policies or their policy-making process (e.g. policy failure, policy fiasco). The consequences of failures at this level are likely to be relatively limited and unlikely to have a strong destabilising effect on the wider institutional system. Given this limited impact, change is likely to be incremental and limited to the fine-tuning of tools or instruments, with reform and learning at this relatively 'shallow' level commonly referred to as 'first order changes' (Hall 1993) or 'instrumental learning' (May 1992). While changes may lead to the adoption of new policy tools or instruments, the productive potential of failures at this level is considered limited, as overarching policy goals are likely to remain unchanged.

Second, a number of definitions focus on failure at the structural or polity-level, focusing on the inability of the institutional system to deliver (e.g. institutional failure, governance failure). The consequences of failure at this level are likely to be deeper than those following the failure of individual policies and may trigger deeper structural, institutional change in the political system or a change to its underlying beliefs and paradigms. This is particularly the case where such failures occur repeatedly. Hence, failures at this level of the system may serve to break existing patterns of inertia, lock-in and path dependency (Ball 2005; Boin et al. 2008), such as a change in the *type* of policy instruments used, without challenging the overarching goals of the system. The literature commonly refers to this type of change as 'second-order change' (Hall 1993) or 'social learning' (May 1992). While the productive potential of failure at the polity-level is considered larger than at the policy-level, it does not fundamentally alter existing paradigms.

Finally, there are those definitions that address failures in the political process, focusing on the politics dimension of the institutional system and the quality and legitimacy of processes within them. In this realm, failures may lead to "the break-up of incumbent power structures and discourses" (Derwort et al. 2018), thus allowing actors set up alternative coalitions and

giving policy entrepreneurs the opportunity to advance new or previously rejected changes (Grossman 2015; Saurugger and Terpan 2016; Walsh 2006). Failure in the political realm may thus lead to a break with the status quo and strive for reformism, questioning the relevance and stability of the system (Van Assche et al. 2012). Referred to as 'political learning' (May 1992) or 'third order change' (Hall 1993), failure at this level has the stronger transformative potential as it may lead to a broad societal debate in which actors question "not only the goals of policy and the instruments that can be used to attain them, but also the very nature of the problem that they are meant to be addressing" (ibid.: 279).

Article I further identifies a number of factors which are considered to enable or hinder the activation of a failure's productive potential. A distinction is made between factors on the individual level (e.g. mental traits of policy-makers), institutional level (e.g. institutional capacity) and the social or political level (e.g. political uncertainty).

4.2 Formulating archetypical pathways of productive functions

Article II identifies five archetypical pathways of how to harness the productive potential of failure and decline, depending on whether the system is still functioning or not, and whether or not is considered desirable to preserve the system in its current state (Newig et al. 2019). These archetypes are:

(1) Institutional adaptation in the wake of crisis

(2) Systematic learning from failure

(3) Purposeful destabilisation of unsustainable institutions

(4) Making a virtue out of decline

(5) Active and reflexive management of decline

A summary and comparison of the five archetypical productive functions is found in Table 3.

In our analysis of these productive functions, we strongly focused on the *structure* and *function* of institutions. If institutions are both structurally and functionally stable, they are likely to persist unless this equilibrium is somehow disturbed. One such possible disturbance comes in the form of a crisis, defined as "periods of disorder in the seemingly 'normal' development of a system" (Boin et al. 2005). By lying bare the weaknesses and dysfunctionalities of an institution, crises carry with them the potential to invoke a process of institutional adaptation and improvement through (a) reform, and/or (b) learning (***Archetype 1***) aimed at improving the functioning of the system.

Even without the immediate trigger posed by crisis or failure, there can be systematic learning from earlier failures (***Archetype 2***). Learning can take place in relation to own earlier experience, termed 'endogenous learning' by Newig et al. (2016). Alternatively, lessons can be drawn from the failures of others, i.e. through 'exogenous learning' (ibid.). This form of learning is likely to include some form of 'policy transfer' (Stone 2012), where lessons are learned from other jurisdictions, earlier comparable situations within one's own jurisdiction, or from other policy fields.

In some cases, a system may be both stable and functioning, yet be considered normatively undesirable from a sustainability perspective. The article (Newig et al. 2019) explores how, in this case, a conscious decision could be made to purposefully destabilise an institution (***Archetype 3***). In doing so, we build on the earlier work by Geva-May (2004), who argued the destabilisation of an existing institution may be required to overcome institutional inertia, and Turnheim and Geels' (2013) work on socio-technical transitions explaining how the destabilisation of existing institutions may be required to allow new alternatives to take hold. Institutional destabilization can also take place without being replaced with an alternative.

While the previous archetypes addressed the strengthening or deliberate removal of existing institutions, the final two archetypes are concerned with situations in which institutional decline is deemed inevitable. This results in institutions becoming obsolete (where the structure remains intact but no longer serves a function), or gradually being replaced by new ones (the structure gradually disappears, its functions taken over by new institutions). One possible scenario would be to re-use institutional structures for novel purposes, thus making a virtue out of inevitable decline (**Archetype 4**). Alternatively, a decision could be made to actively reflect and decide on the desirability of a declining and increasingly dysfunctional institution (**Archetype 5**). As previously argued by Newig (2013), by actively intervening in the decline-process, we may prevent the irreversible loss of important institutional elements such as knowledge, networks or actor capacity and allow for a smooth transition.

Table 3: Archetypes of Productive Functions in comparison (source: Newig et al. 2019)

	1. Adaptation in the wake of crisis	2. Systematic learning from failure	3. Purposeful destabilization	4. Making a virtue of inevitable decline	5. Active and reflexive management of decline
Focusing event or trigger	Sudden focusing event	No specific trigger needed	No specific trigger needed	Rather incremental shift	Critical institutional decline
Initial constellation	Crisis reveals dysfunction of institution	Openness to learn from failed experiences with parallels to current system	Stable, locked-in, but normatively undesirable system	Gradual decline that cannot be halted, but redirected and turned into something new, useful, productive	Existing institutions decline; this gradual decline can either be halted or accelerated
Functionality of current system	Functioning but weaknesses revealed by crisis	Good, but improvements possible	Stable and functioning but unsustainable	Fundamentally challenged or declining	Declining or about to decline
Action by institutional regime actors	Adapt, reorganize: Respond to failure	Learn from failure	Destabilize, dismantle	Innovate; create	Reflect and decide: Active decision-making to speed-up or halt decline
Harnessing failure or decline as ...	An opportunity to improve and strengthen resilience of current system	Sources of knowledge, and ultimately as opportunity to improve current system	Opportunity to abolish an unsustainable system (and pave the way for a more sustainable alternative)	Opportunity to move into different direction	Opportunity to reflect and take an informed decision on whether to accelerate or halt a declining institution
Institutional change type (see Table 1)	Institutional transition / adaptation: Renewal and strengthening of existing system	Institutional transition / adaptation: Improvement of current system	Institutional collapse, or major reform	Path-dependent re-orientation through innovation	Either stabilize institution (avoid loss of vital structure) or accelerate institutional collapse to avoid inefficient structure
Institutional capacity needed	Flexibility to adapt in the face of crisis; capacity for 'intelligent' failure	Institutionalization of evidence-based approaches to policy-making; reflective analysis of own situation	Political force to bring about major change; developed viable alternatives	Political structures fostering creativity	Structures for monitoring of decline; active and informed decision-making; deliberative capacity; clarity on goals
Role of science	Thorough analysis of crisis pathways	Systematic aggregation of relevant evidence	Provision of scenarios of consequences of destabilization	Provision of innovative ideas to re-use obsolete institutional structures	Analysis of strengths and weaknesses of declining institution

4.3 Identifying how 'windows of opportunity' can be used to affect change in a system

Article III illustrates in a real-world context how an external shock enables transformational change from both an institutional and socio-technical perspective by zooming in on the empirical example of the German energy transition or *Energiewende*. This paper examines the same series of events through two complementary theoretical lenses – the Multiple Streams Framework (see e.g. Kingdon 1984; Weible and Schlager 2016; Jones et al. 2016) and the Multi-Level Perspective (e.g. Kemp 1994; Geels 2002; Geels and Schot 2007). Our analysis reveals that the 'window of opportunity' is understood differently depending on the analytical lens applied.

Adopting an institutional lens, the German energy transition is explained through three separate policy windows that occurred between 1990 and 2011, in which the ultimate case of institutional change would not have been possible without the two instances that preceded it. Change here comes about through shifts in one of the different 'streams' (problem stream; policy stream; political stream). In the first two cases, change occurred in the absence of a sudden focusing event, instead coming about gradually; rather accidentally around the time of German reunification, and following the election of a new coalition government in 1998. In 2011, however, the nuclear disaster at Fukushima served as a classical focusing event in the sense of Birkland (1997), firmly directing attention to the issue of nuclear safety in Germany and resulting in a policy U-turn by the German government. In all three instances, however, the policy window resulted in legislative reforms in the energy sector.

From a socio-technical perspective, on the other hand, the 2011 Fukushima nuclear disaster opened one single window of opportunity for technological regime change. Having gradually emerged in protected niches, by 2011, alternative energy technologies were available and ready to be deployed, particularly in the form of solar-photovoltaics and onshore-wind. They were, however, unable to exert the pressure required to destabilise the dominant technological regime comprising of large, centralised forms of electricity production such as coal- and nuclear power. While the nuclear disaster itself constitutes the focusing event required to put the issue on the political agenda, the real disruption to the energy regime came about as a result of the German government's decision to shut the last nuclear power plant by 2022. This decision fundamentally undermined support for nuclear energy as a means for electricity production. Ultimately, however, our findings indicate that it is highly doubtful that this external shock would have led to a regime shift, had it not been for the large investment and

stimulation programmes for renewable energies that Germany implemented in the preceding decades.

4.4 Identifying mechanisms used to restructure existing (energy) systems

As outlined in Article II, the destabilisation or decline of certain institutions may be required to enable a sustainability transformation to take place. Steering developments in the desired direction will require policy-makers to actively engage in this process. Within energy systems, some of the literature refers to this process as 'exnovation', understood as "the purposive termination of existing (infra)structures, technologies, products and practices" (Heyen et al. 2017) that are not suitable for climate protection.

Building on the conceptual archetypes, Article IV identifies a range of governance mechanisms used to purposefully remove coal from electricity production among signatories to the Powering Past Coal Alliance. Applying the exnovation governance framework by Heyen et al. (2017) to this empirical case study, this contribution analyses the phase-out of coal-fired electricity generation from (1) a *political dimension, (2)* a *policy dimension.* The possible combinations of exnovation governance approaches are presented in Figure 2 below.
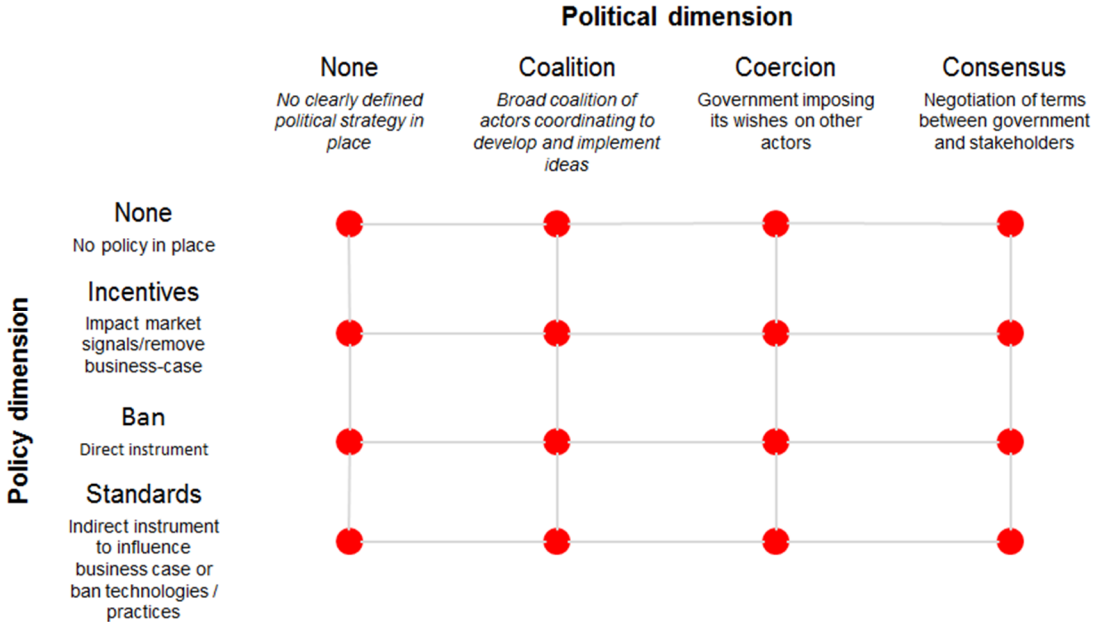
Fig. 2: Possible exnovation governance approaches

While exnovation can be achieved in the short term in cases where alternatives are easily available or minimal investments are required, an extended time-horizon may be required in

those cases where no immediate alternatives are available or to give affected actor-groups (e.g. businesses; communities) time to adjust (Bardach 1976; deLeon 1978).

4.5 Synthesis

Having addressed the research aims individually, this section seeks to synthesize the various insights that emerged from this research and set these into the wider context of sustainability transformations, drawing a number of overarching conclusions. This section focuses, in turn, on the subjects of system destabilisation and subsequent re-stabilisation (Section 4.5.1), the relevance of scale (4.5.2) and the role of actors and agency (4.5.3).

4.5.1 System destabilisation and re-stabilisation

As our systematic review of the literature revealed, there is little evidence to indicate that processes of destabilisation and reinstitutionalisation are used intentionally within a public policy framework (Derwort et al. 2018). Furthermore, the literature is found to be unclear on how these processes can deliberately and purposefully be steered, with or without a particular alternative in mind. Our second publication (Newig et al. 2019) thus offers an important contribution to the field, with the proposed archetypes offering an entry-point for further studies of the productive functions of failure. The research suggests that a number of factors should be taken into account for a transformation towards sustainability to take place.

Our findings indicate that institutions can throw up important obstacles for sustainability transformations through a lock-in of existing technologies, regulations and practices. In such cases, their destabilisation or complete removal may be required. In our first archetype, this destabilisation occurs unintentionally through endogenous or exogenous shocks to the system, that serve to upset the *status quo*. While crises may allow for the 'healthy renewal' of a system (Carpenter et al. 2002), due to the complex nature of most societal and institutional systems, it may be impossible to reliably predict and control the outcome of interventions. Furthermore, if no viable alternative exists to replace the dominant (institutional) regime, or no coalition of actors is able to impose its favoured solution over those of competing coalitions, such a 'vacuum' may prevent the subsequent re-stabilisation of the system, as witnessed, for example, in the Arab Spring (Newig et al. 2019). Rather than invoking a crisis directly, in such cases, policy-makers may have to be ready for when a 'window of opportunity' presents itself. Viewed through different conceptual frameworks, this research has found that such windows may present themselves through 'policy windows' that open at

different levels of the political system (the policy-, problem- and/or political streams in Kingdon's MSF), or the technological system.

Policy-makers can also achieve this destabilisation through intentional actions by actively destabilising or removing existing institutions, represented by our third archetype. Processes of destabilisation thus involve the purposeful termination of existing infrastructures and practices (Heyen et al. 2017) or the deliberate 'unmaking' or deconstruction of structures to make place for alternatives that are incompatible with dominant structures (Feola 2019). Such an approach to destabilisation requires the active and reflective management of the dismantling of old institutions. We argue that, in doing so, attention should be paid to preserving or transferring those elements of the old institutions that continue to be necessary or desirable to avoid the irreversible loss of desirable institutional elements (Newig et al. 2019). The research also indicates that, in some cases, the governance of the historical institutions should involve a carefully managed transition period in the 'clean-up' of institutional remnants. However, the longer the remnants of old institutions stay, the greater the persisting institutional complexity and inefficiencies are likely to be.

Finally, failure-thinking can be integrated into modern law through a number of instruments. With respect to the destabilisation of existing institutions, so-called 'sunset clauses' can be inserted into legislation that ensure laws terminate at the end of a pre-determined date or after a determined period of time unless specific legislative action is taken to decide otherwise (Steinhaus 2008; Ranchordás 2014). By forcing legislators to review legal instruments (at least on paper), sunset clauses may serve as a useful tool to overcome institutional inertia (Moloney 2007). With respect to re-stabilisation, through 'experimental legislation' (see also Beck and Schürmeier 2004; Ranchordás 2014), legislators have the tools available to them to learn through "experience, experimentation and feedback" (Nair and Howlett 2017) or 'trial and error' (Stone 2012). Such experiments enable policy-makers to provide a protected niche for innovative policy instruments and/or technologies, whilst simultaneously limiting the possible damage done by failures.

4.5.2 Scale

Importantly, this research touches upon the subject of scale, both in terms of the *scale of a problem* and the *scale at which it is governed* (see Young 2002; Termeer and Dewulf 2014). The problem scale "captures the different levels at which a problem plays out" (ibid: 39). Within the context of this research, the 'problem' is understood as the failure that occurs. The

governance scale, on the other hand, captures the level of the institutional system at which the failure manifests itself (ibid).

The scale or 'size' of a failure is a well-studied subject in the institutional change literature. While some failures may be small and relatively isolated, others may be widespread or fundamentally upset the order of a system. Overall, large events are considered to be more likely to trigger systems-level changes than are smaller, more routine events as they are more likely to heighten the salience of a certain issue (e.g. Stern 1997; Birkland 2006b). Hinterleitner (2018) further argues that the extent of the failure is also dependent on the proximity and visibility of failures to mass publics, which suggests that the size and importance of an event are, at least in part, socially constructed.

The research presented in this dissertation contributes to this field through its identification of failure on different levels of the institutional system: the policy-, polity- and political level. On the lowest level, failures on the policy-level are likely to have a limited impact and may easily be overcome, with changes likely to be limited to the tools and instruments used to achieve their goals. As such, they are unlikely to fundamentally alter or put into question existing paradigms. Hence, achieving deeper-level change to the design or intent of a system is likely to hinge on higher-order failure on the polity- and/or political level. Adopting a constructivist perspective of failure, in which the *perception* of failure rather than rational-scientific measurements of its effects determine the scale of failure, suggest that policy-makers can actively seek to influence the narrative around failures in their quest to achieve a fundamental shift towards sustainability. In doing so, policy-makers should keep in mind the complexity and interaction at different scales in institutional systems, in which the sustainability of subsystems may ultimately come at the expense, or even serve to undermine, the stability of higher-order systems (Newig et al. 2019, drawing on Voinov and Farley 2007).

4.5.3 Actors and agency

While some of the literature on sustainability transformations strongly considers the role of agency in sustainability transformations (see e.g. Fischer and Newig 2016 for a systematic overview of actors and agency in the transitions literatures), this was not the primary focus of this dissertation. Nevertheless, a number of relevant research findings can be reported here. Rather than being considered as "passive targets" (Stone 2017), actors play an important role both in 'shaping' failure and in its aftermath.

In our discussion of the constructivist perspective of failure, Derwort et al. (2018) highlight the role that actors play in shaping failure. By offering differing accounts of the same set of events, competing advocacy coalitions seek to construct the (extent of) failure through so-called 'argumentative processes' (Kay and Boxall 2015; Zittoun 2015), or rhetorical and political 'framing contests' (Bovens and Hart 2016). The findings of this article support the earlier findings that the subsequent dominant interpretation of failure is a strong reflection of the underlying power relations among rival factions in the political arena and/or society (Marsh and McConnell 2010; Oppermann and Spencer 2016b). Following this reasoning, those events which negative impacts primarily or exclusively affect disenfranchised actors with little to no agency are unlikely to register as a failure.

Rather than 'simply' shaping failure, actors can also play an important role in *causing* a system or one of its elements to fail. While in many cases this failure may be unintentional, for example, through a lack of competence or expertise, failure can also result from intentional behaviour. This dissertation has explored – particularly in relation to the third archetype – the ways in which failure may be used to purposefully unlock and destabilise existing institutions to help pave the way for more sustainable alternatives. Potential instruments to achieve this goal within the context of the energy system were identified in Article IV.

Actor coalitions continue to play an important role in the aftermath of failure. While political actors may seek to downplay the extent of a failure or crisis, or the role they have played therein, so as to diffuse political tensions and defend the status quo (Stern 1997), revisionist actors are likely to construct interpretations that enforce their calls for reform. One of the ways in which a window for reform may open up may be through a shake-up in the balance of power or a change in political actors, which may serve to break existing lock-ins and/or overcome the tendency towards stasis.

While this dissertation has paid only limited attention to the role played by pioneers or frontrunners, our findings indicate that these actors may play an important role in the renewal of a system. Through the creation of technological solutions in protected niches, or the development of alternative policy proposals, these actors are ready to offer viable alternative pathways in the aftermath of negative events.

5 Conclusions

The work presented in this doctoral dissertation has contributed to a betterment of our understanding of failure and decline within institutional systems. Rather than being considered as something negative, this work has clearly outlined the case for the productive potential of such events. Coming at a time in which negative events have appeared to dominate the news cycle, and against the backdrop of a series of natural disasters, including extreme weather events and the die-off of animal species, this research offers an important counterweight to previous studies on the subject of failure.

5.1 Overall conclusions and recommendations

The research presented in this doctoral dissertation goes beyond general observations such as that 'failure builds character' or that it 'allows us to re-imagine ourselves' (Pépin 2017). Instead, it starts off by offering a systematic overview of the institutional failure literature, aimed at improving our analytical understanding of the subject. Here, special attention was paid to the ways in which failure may advance the effectiveness of public policy and the wider political system (which were termed 'productive functions'), potentially opening up a 'window of opportunity' as a leverage point for institutional change on the various levels of the political system. This was followed by the development of five conceptual archetypes of such productive functions, outlining how each pathway works and discussing ways in which to harness the potential of failure in these pathways. While these conceptual archetypes allow us to analyse and understand the sequence of events that occurred in the past, they offer only limited explanatory power for current or future developments. A slow and gradual decline, for example, may be difficult to detect in real-time until its effects start to become felt by those affected and even harder to reliably predict in advance.

Nevertheless, the insights drawn from this work speak to a number of important lessons for policy-makers and others who seek to revisit existing institutional arrangements. First, this research has shown that actors should be ready to use a window of opportunity opened by a shock event whenever it occurs. While, in some cases, this window may be opened through the purposeful destabilisation of a system, such direct interventions should be approached with great care due to the nature of complex systems. Actors should thus be ready to offer sufficiently developed alternative solutions to 'fill' the gap left by institutional failure. Within the political system, this will result in competing policy proposals and ideas being offered. In socio-technical energy systems, such solutions are offered through niche-technologies that

seek to gain access to the system. Second, policy-makers should be prepared to harness the potential that comes with decline. In order to safeguard those institutional elements they consider important, policy-makers should engage in preserving these institutional elements, which may involve transferring these from the old institution to another. Third, policy-makers will invariably need to balance short-term priorities with long-term objectives. In the short term, technical solutions may cause an issue to quickly move down the policy agenda, allowing policy-makers to demonstrate their ability and commitment to deal with the problem at hand (McConnell 2015). In the long-term, however, it does little to address its root causes and may actually serve to exacerbate the problem (Derwort et al. 2018). This tension may be particularly visible in the aftermath of an acute crisis or natural disaster, where policy-makers face large pressure to deal with the immediate situation. In many cases, it may also not be possible to start with such a "blank slate" (Agrawal 2011), forcing policy-makers to work with the remnants of the old institutions.

5.2 Limitations and future research avenues

While the argument set out in this dissertation focuses specifically on dynamics in institutional systems, the productive potential of 'failure' and/or is also discussed for other types of transitions, i.e. social-ecological and socio-technical transitions. In social-ecological systems, this aspect features strongly in its discussion of resilience, with crises creating space for "reorganisation, renewal and novelty" (Folke et al. 2005). Similarly, in socio-technical systems, the removal of established technologies and practices are considered to make way for new and potentially more sustainable alternatives (Fichter et al. 2010; Turnheim and Geels 2013). Despite strong connections between the literatures (see e.g. Frantzeskaki 2011), it was not possible to fully explore these links within the confines of the scope of this dissertation, offering important potential for future research efforts.

Adopting a system's perspective, this dissertation has largely focused on the structure and function of institutions, with a limited focus placed on the role of individual actors or actor coalitions, conflict and agency. Focusing on these aspects of institutional dynamics thus offers another opportunity for further research. In this context, particular potential exists in further linking analytical strands of the institutional change literature to the more intervention-oriented governance literature. Such research could also explore the role played by informal institutions in institutional change towards sustainability.

Finally, empirically, further research is needed to test the archetypes developed in this dissertation so as to develop a better understanding of how they work in reality and under which conditions. Currently few – if any – systematic comparisons exist between cases. While such an attempt was undertaken in the early stages of Article II, ultimately this did not lead to a sufficiently large number of reliable cases. An important potential for future research is thus to establish a large-N comparative (meta-) study of institutional dynamics along the five productive functions, systematically comparing cases across different countries, sectors and decades. Such a quantitative study would further serve to overcome the problems of generalizability posed by small-n case studies. Automated and computer-assisted methods such as text-mining may be essential to establish a sufficiently large database of reliable cases.

These future directions have the potential to further advance our understanding of the productive role of processes of failure and decline for achieving a transformation towards sustainability. This research comes at an important point in time. With a growing body of research warning about the environmental and social problems caused by global warming and biodiversity loss, it is easy to become paralysed in the face of fundamental threats to the environment, society and our individual wellbeing. While in no way arguing that all such negative events contain a silver lining, the research presented in this dissertation offers an important 'other way' to look at failure and decline and constitutes an important first step to identify and act on their productive potential.

6 References

Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., et al. (2017). Leverage points for sustainability transformation. *Ambio, 46*(1), 30-39.

Acheson, J. M. (2006). Institutional failure in resource management. *Annual Review of Anthropology* (Vol. 35, pp. 117-134).

Agrawal, A. (2011). Economics: A positive side of disaster. *Nature, 473*(7347), 291-292.

Anderies, J. M., Ryan, P., & Walker, B. H. (2006). Loss of Resilience, Crisis, and Institutional Change: Lessons from an Intensive Agricultural System in Southeastern Australia. *Ecosystems, 9*(6), 865-878.

Arthur, W. B. (1989). Competing Technologies, Increasing Returns, and Lock-In by Historical Events. *The Economic Journal, 99*(394), 116-131.

Ball, A. (2005). Environmental accounting and change in UK local government. *Accounting, Auditing and Accountability Journal, 18*(3), 346-373.

Bardach, E. (1976). Policy Termination as a Political Process. *Policy Sciences, 7*(2), 123-131.

Bauer, M. W., & Knill, C. (2014). A Conceptual Framework for the Comparative Analysis of Policy Change: Measurement, Explanation and Strategies of Policy Dismantling. *Journal of Comparative Policy Analysis: Research and Practice, 16*(1), 28-44.

Beck, W., & Schürmeier, C. (2004). Die kommunalrechtliche Experimentierklausel als Reforminstrument. *Landes- und Kommunalverwaltung, 14*(11), 488-491.

Birkland, T. A. (1998). Focusing events, mobilization, and agenda setting. *Journal of Public Policy, 18*(1), 53-74.

Birkland, T. A. (2006a). *Learning from disaster: The process and politics of learning from earthquakes and other extreme events.* Paper presented at the 8th U.S. National Conference on Earthquake Engineering, San Francisco, April 18-22, 2006

Birkland, T. A. (2006b). *Lessons of disaster: Policy change after catastrophic events.* Washington, D.C.: Georgetown University Press.

Birkland, T. A. (2009). Disasters, lessons learned, and fantasy documents. *Journal of Contingencies and Crisis Management, 17*(3), 146-156.

Birkmann, J., Buckle, P., Jaeger, J., Pelling, M., Setiadi, N. J., Garschagen, M., et al. (2010). Extreme events and disasters: A window of opportunity for change? Analysis of organizational, institutional and political changes, formal and informal responses after mega-disasters. *Natural Hazards, 55*(3), 637-655.

Boin, A. (2008). Learning from crisis: NASA and the Challenger disaster. In A. Boin, A. McConnell, & P. 'T Hart (Eds.), *Governing after Crisis*: Cambridge University Press.

Boin, A., 't Hart, P., Stern, E., & Sundelius, B. (2005). *The Politics of Crisis Management: Public Leadership under Pressure.* Cambridge, UK & New York, NY: Cambridge University Press.

Boin, A., McConnell, A., & 't Hart, P. (2008). *Governing after Crisis. The Politics of Investigation, Accountability and Learning.* Cambridge, New York: Cambridge University Press.

Boland, A., Cherry, M. G., & Dickson, R. (Eds.). (2017). *Doing a systematic review: a student's guide* (2nd ed.). Los Angeles: Sage.

Bovens, M., & Hart, P. t. (2016). Revisiting the study of policy failures. *Journal of European Public Policy, 23*(5), 653-666.

Bowen, G. A. (2009). Document Analysis as a Qualitative Research Method. *Qualitative Research Journal, 9*(2), 27-40.

Brundiers, K. (2016). *Disasters as Opportunities for Change Towards Sustainability.* Dissertation, Arizona State University,

Carpenter, R. A., Brock, W. A., & Ludwig, D. (2002). Collapse, Learning, and Renewal. In L. H. Gunderson, & C. S. Holling (Eds.), *Panarchy. Understanding Transformations in*

Human and Natural Systems (pp. 173-193). Washington, Covelo, London: Island Press.

Connor, R., & Dovers, S. (2004). *Institutional change for sustainable development*. Northampton: Edward Elgar.

Corbin, J. M., & Strauss, A. L. (2008). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (3rd ed.). Los Angeles, CA [u.a.]: SAGE Publications.

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., et al. (2009). Managing the health effects of climate change. Lancet and University College London Institute for Global Health Commission. *The Lancet, 373*(9676), 1693-1733.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). Thousand Oaks, CA [u.a.]: SAGE Publications.

Creswell, J. W. (2009). *Research design: qualitative, quantitative, and mixed methods approaches* (3rd ed.). Los Angeles, CA [u.a.]: SAGE Publications.

deLeon, P. (1978). Public policy termination: An end and a beginning. *Policy Analysis, 4*(3), 369-392.

Derwort, P., Jager, N., & Newig, J. (2018). Towards productive functions? A systematic review of institutional failure, its causes and consequences. *Policy Sciences*, 1-18.

Dincer, I. (2000). Renewable energy and sustainable development: a crucial review. *Renewable and Sustainable Energy Reviews, 4*(2), 157-175.

Dovers, S. R., & Hezri, A. A. (2010). Institutions and policy processes: the means to the ends of adaptation. *Wiley Interdisciplinary Reviews: Climate Change, 1*(2), 212-231.

Drexhage, J., & Murphy, D. (2010). Sustainable Development: From Brundtland to Rio 2012. Background Paper prepared for consideration by the High Level Panel on Global Sustainability at its first meeting, 19 September 2010, UN Headquarters, New York. International Institute for Sustainable Development.

Dunlop, C. A. (2017a). Pathologies of policy learning: What are they and how do they contribute to policy failure? *Policy and politics, 45*(1), 19-37.

Dunlop, C. A. (2017b). Policy learning and policy failure: Definitions, dimensions and intersections. *Policy and politics, 45*(1), 3-18.

Dunlop, C. A., & Radaelli, C. M. (2013). Systematising Policy Learning: From Monolith to Dimensions. *Political Studies, 61*(3), 599-619.

Eburn, M., & Dovers, S. (2015). Learning lessons from disasters: Alternatives to royal commissions and other quasi-judicial inquiries. *Australian Journal of Public Administration, 74*(4).

Eisenack, K., Gotgelf, A., Kasymov, U., Lutz, P., Perez, P., Oberlack, C., et al. (2018). Second Research Workshop on Archetype Analysis in Sustainability Research, Workshop Report, 28th Feb. - 2nd March 2018. Berlin: Humboldt Universität zu Berlin.

Feola, G. (2019). *Breaking out! Six propositions on the deliberate unmaking of unsustainable socioecological systems*. Paper presented at the Leverage Points 2019 international conference on sustainability research and transformation, Lüneburg,

Fichter, K., von Gleich, A., Pfriem, R., & Siebenhüner, B. (Eds.). (2010). *Theoretische Grundlagen für erfolgreiche Klimaanpassungsstrategien* (nordwest2050 Berichte). Bremen / Oldenburg: Projektkonsortium 'nordwest2050'.

Fike, R., & Gwartney, J. (2015). Public choice, market failure, and government failure in principles textbooks. *Journal of Economic Education, 46*(2), 207-218.

Fischer, L.-B., & Newig, J. (2016). Importance of Actors and Agency in Sustainability Transitions: A Systematic Exploration of the Literature. *Sustainability, 8*(5).

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive Governance of Social-Ecological Systems. *Annual Review of Environment and Resources, 30*, 441-473.

Frantzeskaki, N. (2009). *How crisis influence societal transitions.* Paper presented at the IHDP Open Meeting, Bonn,

Frantzeskaki, N. (2011). *Dynamics of Societal Transitions; Driving forces and feedback loops*. Doctoral thesis, Delft University of Technology, Delft.

Fukuyama, F. (2014). Political Decay. In F. Fukuyama (Ed.), *Political order and political decay* (pp. 455-466). London, UK: Profile Books Ltd.

Geels, F., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy, 36*, 399-417.

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy, 31*(8-9), 1257-1274.

Genschel, P. (1997). The dynamics of inertia: Institutional persistence and change in telecommunications and health care. *Governance, 10*(1), 43-66.

Gerring, J. (2007). *Case Study Research. Principles and Practices*. Cambridge: Cambridge University Press.

Geva-May, I. (2004). Riding the wave of opportunity: Termination in public policy. *Journal of Public Administration Research and Theory, 14*(3), 309-333.

Greif, A., & Laitin, D. D. (2004). A Theory of Endogenous Institutional Change. *American Political Science Review, 98*(4), 633-652.

Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M. C., Shyamsundar, P., et al. (2013). Sustainable development goals for people and planet. *Nature, 495*(7441), 305-307.

Grin, J. (2018). Stasis and change. In H. K. Colebatch, & R. Hoppe (Eds.), *Handbook on Policy, Process and Governing* (pp. 418-437). Northampton, MA: Edward Elgar Publishing.

Grossman, P. Z. (2015). Energy shocks, crises and the policy process: A review of theory and application. *Energy Policy, 77*(1), 56-69.

Hall, P. A. (Ed.). (1989). *The Political Power of Economic Ideas: Keynesianism across Nations*. Princeton, NJ: Princeton University Press.

Hall, P. A. (1993). Policy Paradigms, Social Learning, and the State. The Case of Economic Policymaking in Britain. *Comparative Politics, 25*(3), 275-296.

Hassenforder, E., Barreteau, O., Daniell, K. A., Pittock, J., & Ferrand, N. (2015). Drivers of Environmental Institutional Dynamics in Decentralized African Countries. *Environmental Management, 56*(6), 1428-1447.

Helmke, G., & Levitsky, S. (2004). Informal Institutions and Comparative Politics: A Research Agenda. *Perspectives on Politics, 2*(4), 725-740.

Heyen, D. A., Hermwille, L., & Wehnert, T. (2017). Out of the Comfort Zone! Governing the Exnovation of Unsustainable Technologies and Practices. *GAIA, 26*(4), 326-331.

Hinterleitner, M. (2018). Policy failures, blame games and changes to policy practice. *Journal of Public Policy, 38*(2), 221-242.

Howlett, M. (2012). The lessons of failure: Learning and blame avoidance in public policy-making. *International Political Science Review, 33*(5), 539-555.

Howlett, M., & Cashore, B. (2009). The Dependent Variable Problem in the Study of Policy Change: Understanding Policy Change as a Methodological Problem. *Journal of Comparative Policy Analysis, 11*(1), 33-46.

Howlett, M., & Ramesh, M. (2014). The two orders of governance failure: Design mismatches and policy capacity issues in modern governance. *Policy and Society, 33*(4), 317-327.

Howlett, M., Ramesh, M., & Wu, X. (2015). Understanding the persistence of policy failures: The role of politics, governance and uncertainty. *Public Policy and Administration, 30*(3-4), 209-220.

Jones, B. D., & Baumgartner, F. R. (2012). From there to here: Punctuated equilibrium to the general punctuation thesis to a theory of government information processing. *Policy Studies Journal, 40*(1), 1-20.

Jones, M. D., Peterson, H. L., Pierce, J. J., Herweg, N., Bernal, A., Lamberta Raney, H., et al. (2016). A River Runs Through It: A Multiple Streams Meta-Review. *Policy Studies Journal, 44*(1), 13-36.

Kampa, M., & Castanas, E. (2008). Human health effects of air pollution. *Environmental Pollution, 151*(2), 362-367.

Kay, A., & Boxall, A.-M. (2015). Success and Failure in Public Policy: Twin Imposters or Avenues for Reform? Selected Evidence from 40 Years of Health-care Reform in Australia. *Australian Journal of Public Administration, 74*(1), 33-41.

Keech, W. R., & Munger, M. C. (2015). The anatomy of government failure. *Public Choice, 164*(1-2).

Kemp, R. (1994). Technology and the transition to environmental sustainability. The problem of technological regime shifts. *Futures, 26*(10), 1023-1046.

Khan, J., Kronsell, A., & Hildingsson, R. (2011). *The Role of Institutional Innovations in the Transition to Low-Carbon Futures.* Paper presented at the 2nd International Conference on Sustainability Transitions, Lund,

Kingdon, J. W. (1984). *Agendas, alternatives, and public policies.* Harlow; Essex: Pearson.

Kuhn, T. S. (1962). *The Structure of Scientific Revolutions* (Second edition, enlarged, 1970 ed., Vol. 2, International Encyclopedia of Unified Science). Chicago: The University of Chicago Press.

Leroy, P., & Arts, B. (2006). Institutional Dynamics in Environmental Governance. In B. Arts, & P. Leroy (Eds.), *Institutional Dynamics in Environmental Governance* (Vol. 47, pp. 1-19). Dordrecht: Springer.

Leuphana University of Lüneburg (n.d.). Leverage Points for Sustainability Transformation: Institutions, People and Knowledge. Project Description. Lüneburg: Leuphana University of Lüneburg.

Lodge, M. (2002). The wrong type of regulation? Regulatory failure and railways in Britain and Germany. *Journal of Public Policy, 22*(3), 271-297.

Mahoney, J., & Goertz, G. (2006). A Tale of Two Cultures: Contrasting Quantitative and Qualitative Research. *Political Analysis, 14*, 227-249.

Mahoney, J., & Thelen, K. (2010). A Theory of Gradual Institutional Change. In J. Mahoney, & K. Thelen (Eds.), *Explaining Institutional Change: Ambiguity, Agency, and Power* (pp. 1-37). New York, NY: Cambridge University Press.

Mallett, R., Hagen-Zanker, J., Slater, R., & Duvendack, M. (2012). The benefits and challenges of using systematic reviews in international development research. *Journal of Development Effectiveness, 4*(3), 445-455.

Marsh, D., & McConnell, A. (2010). Towards a framework for establishing policy success. *Public Administration, 88*(2), 564-583.

Mattijssen, T. J. M., Behagel, J. H., & Buijs, A. E. (2015). How democratic innovations realise democratic goods. Two case studies of area committees in the Netherlands. *Journal of Environmental Planning and Management, 58*(6), 997-1014.

May, P. J. (1992). Policy Learning and Failure *Journal of Public Policy, 12*(4), 331-354.

McConnell, A. (2010). Policy success, policy failure and grey areas in-between. *Journal of Public Policy, 30*(3), 345-362.

McConnell, A. (2015). What is policy failure? A primer to help navigate the maze. *Public Policy and Administration, 30*(3-4), 221-242.

Meadowcroft, J., & Fiorino, D. J. (Eds.). (2017). *Conceptual Innovation in Environmental Policy.* Cambridge, MA & London, UK: The MIT Press.

Mertens, D. M. (2015). *Research and Evaluation in Education and Psychology: Integrating Diversity with Quantitative, Qualitative, and Mixed Methods* (4th ed.). Thousand Oaks, CA: SAGE Publications.

Mieg, H. A., & Töpfer, K. (Eds.). (2013). *Institutional and Social Innovation for Sustainable Urban Development* (Routledge Studies in Sustainable Development). Oxon, UK & New York, NY, USA: Routledge.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. J., & The PRISMA Group (2009). Preferred Reporting Items for Systematic Reveiws and Meta-Analyses: The PRISMA Statement. *PLOS Med, 6*(7), e1000097.

Moloney, N. (2007). Law-making Risks in EC Financial Market Regulation after the Financial services Action Plan. In S. Weatherill (Ed.), *Better Regulation* (pp. 321-368). Oxford and Portland, OR: Hart Publishing.

Mulrow, C. D. (1994). Systematic Reviews: Rationale for systematic reviews. *BMJ, 309*(6954), 597-599.

Murray, D., & Dollery, B. (2005). Institutional breakdown? An exploratory taxonomy of Australian University failure. *Prometheus, 23*(4), 385-398.

Nachmias, D., & Frankfort-Nachmias, C. (1987). *Research methods in the social sciences* (3rd ed.). New York, NY: St. Martin's Press.

Nair, S., & Howlett, M. (2017). Policy myopia as a source of policy failure: Adaptation and policy learning under deep uncertainty. *Policy and politics, 45*(1), 103-118.

Newig, J. (2013). Produktive Funktionen von Kollaps und Zerstörung für gesellschaftliche Transformationsprozesse in Richtung Nachhaltigkeit. In J. Rückert-John (Ed.), *Soziale Innovation und Nachhaltigkeit. Perspektiven sozialen Wandels* (pp. 133-149). Wiesbaden: Springer VS.

Newig, J., Derwort, P., & Jager, N. W. (2019). Sustainability through institutional failure and decline? Archetypes of productive pathways. *Ecology and Society, 24*(1), 18.

Newig, J., Kochskämper, E., Challies, E., & Jager, N. W. (2016). Exploring governance learning: How policymakers draw on evidence, experience and intuition in designing participatory flood risk planning. *Environmental Science & Policy, 55*(January 01), 353-360.

North, D. C. (1990). *Institutions, Institutional Change, and Economic Performance*. Cambridge & New York: Cambridge University Press.

O'Donovan, K. (2017). Policy Failure and Policy Learning: Examining the Conditions of Learning after Disaster. *Review of Policy Research, 34*(4), 537-558.

Oppermann, K., & Spencer, A. (2016a). Studying fiascos: bringing public and foreign policy together. *Journal of European Public Policy, 23*(5), 643-652.

Oppermann, K., & Spencer, A. (2016b). Telling stories of failure: narrative constructions of foreign policy fiascos. *Journal of European Public Policy, 23*(5), 685-701.

Ostrom, E. (2005). Doing Institutional Analysis: Digging Deeper than Markets and Hierarchies. In C. Ménard, & M. M. Shirley (Eds.), *Handbook of New Institutional Economics* (pp. 819-848). Berlin & Heidelberg: Springer.

Pahl-Wostl, C. (2007). Transition towards adaptive management of water facing climate and global change. *Water Resources Management, 21*(1), 49-62.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change, 19*(3), 354-365.

Pépin, C. (2017). *Die Schönheit des Scheiterns: Kleine Philosophie der Niederlage* (C. Gutberlet, Trans.). München: Carl Hanser Verlag.

Peters, B. G. (2015). State failure, governance failure and policy failure: Exploring the linkages. *Public Policy and Administration, 30*(3-4), 261-276.

Pierson, P. (2004). *Politics in Time. History, Institutions and Social Analysis*. Princeton: Princeton University Press.

Ranchordás, S. H. (2014). *Sunset Clauses and Environmental Legislation: Blessing or Curse for Innovation?* Dissertation, Tilburg University,

Ritchie, L. A., Gill, D. A., & Farnham, C. N. (2013). Recreancy Revisited: Beliefs about Institutional Failure Following the Exxon Valdez Oil Spill. *Society and Natural Resources, 26*(6), 655-671.

Rösch, C., Bräutigam, K.-R., Kopfmüller, J., Stelzer, V., & Lichtner, P. (2017). Indicator system for the sustainability assessment of the German energy system and its transition. *Energy, Sustainability and Society, 7*(1), 1-13.

Rose, R. (1991). What Is Lesson-Drawing? *Journal of Public Policy, 11*(1), 3-30.

Saurugger, S., & Terpan, F. (2016). Do crises lead to policy change? The multiple streams framework and the European Union's economic governance instruments. *Policy Sciences, 49*(1), 35-53.

Schlör, H., Fischer, W., & Hake, J.-F. (2012). The history of sustainable development and the impact of the energy system. *International Journal of Sustainable Society, 4*(4), 317-335.

Schwandt, T. A. (2007). The SAGE Dictionary of Qualitative Inquiry. (3rd ed.). Thousand Oaks, CA: SAGE Publications.

Short, J. L. (2013). Self-Regulation in the Regulatory Void: "Blue Moon"or "Bad Moon"? *Annals of the American Academy of Political and Social Science, 649*(1), 22-34.

Shove, E. (2012). The shadowy side of innovation: Unmaking and sustainability. *Technology Analysis and Strategic Management, 24*(4), 363-375.

Siebenhüner, B., & Suplie, J. (2005). Implementing the access and benefit-sharing provisions of the CBD: A case for institutional learning. *Ecological Economics, 53*, 507- 522.

Smith, A., Voß, J.-P., & Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy, 39*(4), 435-448.

Stacey, J., & Rittberger, B. (2003). Dynamics of formal and informal institutional change in the EU. *Journal of European Public Policy, 10*(6), 858-883.

Steinhaus, J. (2008). *Gesetze mit Verfallsdatum - ein Instrument des Bürokratieabbaus?* Magister, Westfälische Wilhelms-Universität Münster, Münster.

Stern, E. (1997). Crisis and learning: A conceptual balance sheet. *Journal of Contingencies and Crisis Management, 5*(2), 69-86.

Stone, D. (2012). Transfer and translation of policy. *Policy Studies, 33*(6), 483-499.

Stone, D. (2017). Understanding the transfer of policy failure: Bricolage, experimentalism and translation. *Policy and politics, 45*(1), 55-70.

Streeck, W., & Thelen, K. (Eds.). (2005). *Beyond Continuity. Institutional Change in Advanced Political Economies*. New York: Oxford University Press.

Termeer, C., & Dewulf, A. (2014). Scale-sensitivity as a governance capability: Observing, acting and enabling. In F. Padt, P. Opdam, N. Polman, & C. Termeer (Eds.), *Scale-Sensitive Governance of the Environment* (pp. 38-55). Chichester, West Sussex [u.a.]: Wiley.

Thelen, K. (2009). Institutional change in advanced political economies: First annual lecture of the bjir. *British Journal of Industrial Relations, 47*(3), 471-498.

Turnheim, B., & Geels, F. W. (2013). The destabilisation of existing regimes: Confronting a multi-dimensional framework with a case study of the British coal industry (1913-1967). *Research Policy, 42*(10), 1749-1767.

United Nations (2018). The Sustainable Development Goals Report 2018. New York: United Nations.

Van Assche, K., Beunen, R., & Duineveld, M. (2012). Performing success and failure in governance: Dutch planning experiences. *Public Administration, 90*(3), 567-581.

van der Heijden, J. (2013). Different but equally plausible narratives of policy transformation: A plea for theoretical pluralism. *International Political Science Review, 34*(1), 57-73.

Vera, I., & Langlois, L. (2007). Energy indicators for sustainable development. *Energy, 32*(6), 875-882.

Voinov, A. A., & Farley, J. (2007). Reconciling sustainability, systems theory and discounting. *Ecological Economics, 63*(1), 104-113.

Wallis, J., & Dollery, B. (2002). Wolf's model: Government failure and public sector reform in advanced industrial democracies. *Review of Policy Research, 19*(1), 177-203.

Walsh, J. I. (2006). Policy failure and policy change. British security policy after the cold war. *Comparative Political Studies, 39*(4), 490-518.

Weible, C. M., & Schlager, E. (2016). The Multiple Streams Approach at the Theoretical and Empirical Crossroads: An Introduction to a Special Issue. *Policy Studies Journal, 44*(1), 5-12.

Yin, R. K. (2014). *Case study research: design and methods* (5th ed.). Los Angeles: SAGE.

Young, O. R. (2002). *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale* (Global Environmental Accords: Strategies for Sustainability). Cambridge, Mass.: MIT Press.

Young, O. R. (2010). Institutional dynamics: Resilience, vulnerability and adaptation in environmental and resource regimes. *Global Environmental Change, 20*(3), 378-385.

Zittoun, P. (2015). Analysing policy failure as an argumentative strategy in the policymaking process: A pragmatist perspective. *Public Policy and Administration, 30*(3-4), 243-260.

Annex

RESEARCH ARTICLE

CrossMark

Towards productive functions? A systematic review of institutional failure, its causes and consequences

Pim Derwort[1,2] · Nicolas Jager[1,2] · Jens Newig[1,2]

Abstract

Recognised as an integral part of the political process, the topic of institutional failure has recently received increased attention in the literature, particularly with respect to policy failure. Nevertheless, the difference between various types and aspects of failure is unclear conceptually, hampering the development of cumulative theory building into its causes and consequences. Furthermore, while ample attention has been paid to negative consequences, insights into the possibly 'productive functions' of failure are scattered and largely remain on the fringes of existing research. The present paper offers a systematic review of the failure literature, particularly its definitions, causes and consequences, setting existing research in the different scholarly fields in relation to each other. Special emphasis is placed on the ways failure may serve to advance the effectiveness and efficacy of public policy and the wider political system, opening 'windows of opportunity' as leverage points for institutional change. In doing so, we identify a number of factors which may facilitate or hinder the activation of this productive potential on an individual, institutional, and societal level.

Keywords Policy failure · Government failure · Reform · Learning · Leverage points

Introduction

Failure by political institutions to adequately respond to societal problems is ubiquitous (e.g. McConnell 2015; Richardson 2007; Kirkpatrick 2012; Sparrow 2008). What we term 'institutional failure' as an umbrella concept embraces various, partly overlapping realms, e.g. 'policy failure', 'government failure', or 'regulatory failure', and becomes manifest in different ways, e.g. through 'crises' (Stern 1997; Alink et al. 2001), 'breakdowns' (e.g. Murray and Dollery 2005) 'fiascos' (Bovens and Hart 1995), and 'blunders' (King and

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Crewe 2013). Policy failure, in particular, has recently gained increasing attention in the literature, witnessed by no less than three special issues in the past 3 years. *Public Policy and Administration* investigated the persistence of policy failures (Howlett et al. 2015), the *Journal of European Public Policy* brought together the separate literatures on public policy and foreign policy fiascos (Oppermann and Spencer 2016a), and most recently, *Policy and Politics* highlighted how rarely failure is averted or followed by learning (Dunlop 2017b).

Why study failure at all? Given its widespread occurrence, failure is an integral part of the political process. An understanding of public institutions, their genesis and performance would remain incomplete disregarding the multiple aspects of failure. From a problem-solving perspective, proper understanding of processes and causes of failure—i.e. the negative and undesirable aspects of failure—may be necessary in order to avoid it in the future. Therefore, scholars have studied how failure erodes trust and confidence in major social actors and institutions, including governments and intergovernmental organisations (Prakash and Potoski 2016), how established political systems may degenerate (e.g. Farazmand 2012) and with them, their problem-solving and governance capacities (Alink et al. 2001).

However, while ample attention has been paid to such negative consequences, the potentially desirable aspects of failure and decline have received less systematic attention in the failure literature to date. And yet, it is almost a truism that negative episodes, such as crisis and failure, may also provide positive aspects and open 'windows of opportunity' for reform and learning (e.g. Stern 1997; Wallis and Dollery 2002) and may thus serve as a 'leverage point' for systemic change (Abson et al. 2017). Yet, much of the literature fails to go beyond such platitudes. Not only does this inhibit policy-makers' ability to learn from past experiences or mistakes, it also critically hampers efforts to systematically assess and better understand in which ways, and under which conditions, failure may lead to subsequent success. Crises, for example, are often followed by a period of reform as old structures make way for something new. Deeper insights into what have been termed the 'productive functions' of failure (Newig 2013) may thus prove instrumental in coping with the consequences of failure, for deriving adequate and intentional responses, and for supporting the resilience of the wider institutional system.

It is against this backdrop that this article reviews the available literature on institutional failure with a view to its potential productive functions. We put forward no original argument. We rather attempt a first organised stock-taking of claims and insights about productive consequences of failure by reviewing 111 recent articles on institutional failure. We seek to highlight the ways in which productive functions of failure can unfold and intentionally be approached to advance the effectiveness of public policy and the wider political system. A closer look at the factors enabling and preventing the activation of failure's productive potential will provide further insights into how and when institutional failure may serve as a leverage point towards achieving collective purposes. As a first systematic attempt in this direction, the paper thus aims to strengthen the conceptual basis for future studies on the productive functions of failure.

The paper is organised as follows. The "Methods" section briefly explains the research methodology. The "Concepts of failure" and "Causes of failure" sections lay the foundation to study the productive (and unproductive) consequences of failure. We begin by identifying the different topics and aspects commonly associated with the concept of institutional failure and map out the conceptual ambiguities surrounding the terms. This exercise aims to avoid the "conceptual confusion" over the different aspects and types of failure, which so far has prevented the development of "cumulative theory building into the causes and

consequences of policy success and failure" (Howlett 2012, 545). As governance systems are complex and multiple interactions exist between structural institutional arrangements and particular (sets of) policies (see e.g. May and Jochim 2013), we consider the full spectrum of institutional failure. This approach acknowledges that public problem solving is multi-dimensional, covering the political dimensions of policy, polity and politics, as well as multiple systemic levels, from the individual (micro) to the societal (macro) level. Both of these analytical categories—political dimensions and societal levels—will serve to guide the review and analysis in the subsequent sections and ultimately helps to understand and structure our 'findings' on the productive potentials of institutional failure and decline. We explore the different definitions and causes found in each of the different political dimensions. Building on this, "Consequences of failure—exploring its productive potential" section focuses on the consequences of failure. While not sparing the 'negative' consequences, the main part reviews the potentially productive functions of failure, as well as the factors conditioning their activation. The final section draws out the most important findings and implications of our review.

Methods

This review was conducted following the PRISMA guidelines (Moher et al. 2009), a set of items used for reporting in systematic reviews. We have closely followed the PRISMA checklist and documented our steps (see also Online Appendix) throughout all stages of this research. In the following section, we provide an in-depth description of our approach.

In order to identify the relevant literature for our review, we searched the Scopus database using the search strings specified in Online Appendix 1. Despite the limitations inherent to a focus on published academic literature, we believe this approach is justified for two main reasons: Firstly, as we aim for the consolidation of the present academic body of research, we targeted peer-reviewed publications. Second, this strict approach strengthens the transparency and replicability of our review.

Search strings included and combined terms related to various forms of institutional failure (e.g. government failure, policy failure, bureaucratic failure) and decline, collapse and deinstitutionalisation. By formulating a search string with a relatively high sensitivity and low specificity, we deliberately 'cast a wide net' to capture as many relevant papers as possible. The search was limited to publications in English, including all results up to April 2017.

Our search yielded a total of 8388 results. To filter only the most relevant records, we established a number of exclusion criteria developed alongside the research question. The criteria listed in Fig. 1 were used to assess the publications' relevance based on their title, abstract and keywords in a first-stage screening, excluding those that failed to meet any one of these criteria. The remaining articles were then assessed for eligibility in a second-stage screening of the full text using the same exclusion criteria. This resulted in a final selection of 111 publications to be included in our systematic review (Online Appendix 2). Figure 2 gives a breakdown of the number of publications per year and an overall trendline.

Both the first-stage and second-stage screenings were undertaken by the first author. To minimise errors and personal bias, extensive and rigorous trial-screening was undertaken by all of the authors at every stage until agreement on the correct interpretation of the exclusion criteria was high and all reviewers arrived at a common understanding for screening.
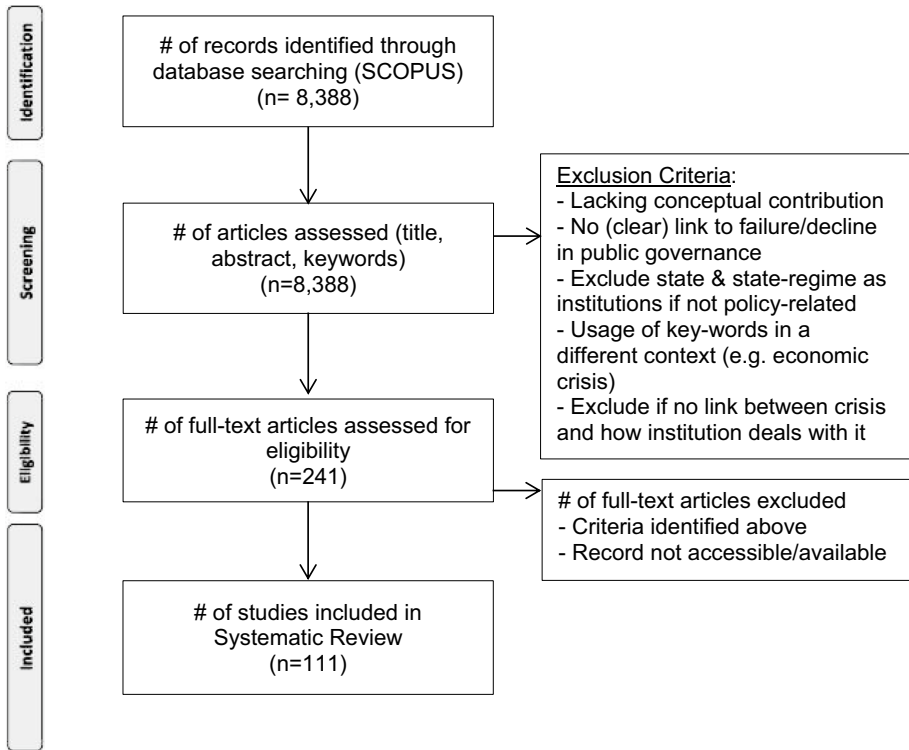
Fig. 1 Systematic case selection process as PRISMA flow diagram (Moher et al. 2009)

The assessment of the included publications was undertaken through a catalogue of questions and variables operationalising our research questions. Following a comprehensive pretest for specification and calibration of the variables, following the same procedures of trial and calibration as during screening, coding of individual papers was undertaken by single reviewers. The coding scheme (Online Appendix 3) applied to the selected publications largely consists of open-ended questions. Relevant text fragments were identified through a qualitative content analysis of publications and coded according to the relevant variables, enabling the subsequent analysis presented in this paper.

Concepts of failure

Failure and crisis are not singular, clear-cut concepts, but instead comprise of a wide variety of different and at times closely connected types. An overview of definitions can be found in Online Appendix 4. Despite this review's focus on conceptual contributions, we found that the majority of included publications do not offer an explicit definition of the concept discussed. Nevertheless, there appears to be some consensus on which aspects the different concepts of failure entail. Overall, definitions can be distinguished regarding the domain of the political system they address. First, there are concepts of failure with policy as the centre of focus (e.g. policy failure, policy fiasco), discussing
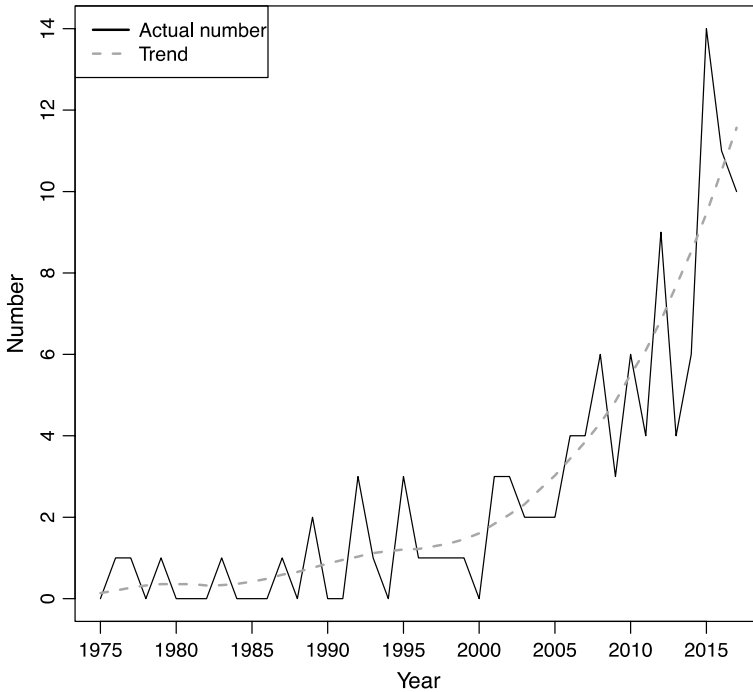
Fig. 2 Number of publications per year. *Note*: Publications for 2017 include January to April only. The dashed line indicating the broader trend was calculated through Friedman's 'Supersmoother' algorithm

the failure of specific policies, or their policy-making process. Second, there are those which focus on the structures, particularly on the government apparatus, or the polity-level (e.g. institutional failure, governance failure), discussing the inability of the institutional system to deliver. Finally, several definitions address the failures of the political process, focusing on the politics dimension and the qualities and legitimacy of processes. While these domains may be analytically separated, several definitions address multiple domains of the political system and, hence, stress the interlinkages between these, highlighting, e.g. how political struggles influence particular policy-making and failure in one dimension may not lead to failure in another (see e.g. McConnell 2015).

Failure in the policy realm is often defined as the inability to achieve goals or targets formulated in a particular policy or series of policies (e.g. McConnell 2010, 2015), or the failure to do so in a cost-effective (Murray and Dollery 2005) or coherent manner. A number of definitions of policy failure (Hall 2011; Hajnal 2010) and government failure (e.g. Keech and Munger 2015; Harris 2007) focus exclusively on substantial or content-related criteria or benchmarks for success. Commonly used indicators to measure performance in this context include the physical measurement of effectiveness, e.g. in terms of water quality (Juhasz 1989), commonly comparing outcomes to the initial goals. Discussions of government failure, in particular, strongly focus on content-related benchmarks, commonly assessing the ability to achieve intended outcomes in relation to indicators such as the efficient allocation of resources or optimal social welfare through traditional cost–benefit analyses and economic modelling.

Going beyond individual (policy) failures, several definitions consider the structural dimension upon which failures build up, thus focusing on the polity-, or structural level. Fike and Gwartney (2015), for example, refer to the importance of the 'structure of incentives' leading to the counter-productive use of resources. Some of the definitions of governance failure (e.g. van der Steen et al. 2015) similarly focus on the inability on a system level to deliver the goals of a policy programme. Definitions of crises, in particular, concentrate exclusively on shocks to the institutional structure (Alink et al. 2001) and wider sociopolitical order (Boin et al. 2008).

Lastly, focusing on the aspects of politics, success or failure is often considered in relation to the legitimacy of policies and the wider political system. This legitimacy can be assessed in different ways; indicators here relate to the representation of different interests (e.g. Farazmand 2012), the use of correct and legal procedures or accountability (Benitez et al. 2012; Dolfsma 2011), distributional equity (Acheson 2006; Cullis et al. 1993), and the existence of political and/or public support (Howlett 2012; McConnell 2010). A strong focus on accountability and legitimacy is found in discussions of governance failure, in which goals are commonly modified through processes of negotiation and reflection. Without predetermined reference points or criteria by which to judge, the inability to self-organise or formulate shared objectives is therefore judged a failure (Peters 2015; Walker 2014).

In these attempts to define failure, two 'lenses' (Howlett 2012) or 'counter-tendencies' (McConnell 2015) can be distinguished within the literature. The first is a *constructivist lens*, in which failure is construed through argumentative processes (e.g. Kay and Boxall 2015; Zittoun 2015) or rhetorical and political 'framing contests' (Bovens and Hart 2016), rather than considered to exist in its own right (Dunlop 2017b). The production of a dominant interpretation of failure reflects underlying power relations in the political arena or society (Marsh and McConnell 2010; Oppermann and Spencer 2016b), as a "socially and politically significant group of people" (McConnell et al. 2008) needs to perceive something to be a failure for it to considered one.

In contrast, the *rationalist, scientific lens* (McConnell 2015) aims to draw a clear line between evidence and evaluation and has sought to develop specific and objective indicators to measure clearly defined goals, thus allowing an assessment to be made of whether something is functional or failing (Kotrusová and Výborná 2015). This lens includes a 'technical' approach to failure that sees (policy) success and failure as purely technical issues that can easily be solved (Howlett et al. 2015), and a 'politico-administrative' approach focusing on highly complex procedural and political aspects that are difficult to analyse (Howlett et al. 2015; Dunlop 2017b). While some definitions may be firmly grounded in one of these lenses, many contain elements of both.

Causes of failure

In order to learn from failure or positively use it as a leverage point for systemic change, it is important to first understand what causes it. We find a wide array of causes throughout the selected publications, nearly all of which focus on the underlying roots of failure, rather than mere triggers. Triggers, in this respect, are considered as short-term events that start something which is already primed to happen, while causes are understood to be the deeper reasons for an action or event to occur in the first place. We distinguish between three levels of causes found in the literature (see also McConnell et al. 2008; Dunlop 2017b): individual (micro), institutional (meso) and societal (macro-) level causes. On an epistemological

level, the publications analysing causes of failure tend to adhere to a rational-scientific as opposed to a constructivist view on failure.

Levels of causality

Micro-level causes of failure occur on the level of individual actors, mostly on the part of a policy-maker or administrator. Despite being only little discussed in the reviewed publications, a number of sources of failure can be found on the individual level, particularly in relation to government failure and policy failure. An important distinction is made here between 'intentional' failure, as the result of intentional behaviour on the one hand, and 'unintentional' or accidental failure on the other hand. Commonly mentioned causes of intentional individual-level failure are self-interested behaviour of actors in the political system (e.g. Kortt and Dollery 2012; Harris 2007) and corruption (Backhouse and Medema 2012), with policy-makers pursuing private goals over societal interest. Unintentional sources of failure are largely the result of either cognitive and behavioural limitations (Hajnal 2010) and include a lack of competence or expertise of individual bureaucrats (Short 2013; Wibe 1992), human errors by individual decision-makers (Bovens and Hart 1995; McConnell 2016), individual personality traits such as over-confidence (Brummer 2016) and a lack of prudence or foresight (Howlett 2014).

Meso-level causes of failure are found on an institutional level and include intra-organisational factors. The literature on government failure, in particular, strongly addresses structural sources of failure: One of the most frequently cited causes of government failure is the lack of incentive for the efficient use of organisational resources (e.g. Vining and Weimer 1999), resulting in low morale and poor management/performance (Meier and Bohte 2003; Andrew 2008), aggravated further where promotion is based on longevity rather than effectiveness (Young 1977; Backhouse and Medema 2012). Another important source of failure is the existence of information asymmetries between the public and private sector (Acheson 2006; Helm 2010). Here, governments are perceived to inherently have less information and knowledge at hand than the private parties they are tasked with regulating. Other important operational sources of failure include a lack of (financial) resources, skills or capacity to design and enforce policies (Short 2013; Vining and Weimer 1999), weak or absent checks and balances (Benitez et al. 2012), and deficient feedback mechanisms (Mitchell and Simmons 1995), with political processes failing to provide the information required to reach socially optimal policies (Cullis et al. 1993). While the policy failure literature similarly traces meso-level causes back to these institutional design and capacity issues, it often focuses specifically on sources of failure in the implementation stage (Vince 2015), such as the use of incomplete or out-of-date policy information (Wibe 1992; Schuck 2014), inadequate planning (Kotrusová and Výborná 2015), poor choice of regulatory instruments (Hansen 1983), and the lack of diversity and dissent in policy-making processes (Bovens and Hart 2016). Discussions of governance failure, finally, focus strongly on procedural sources of failure, considering the failure of parties to coordinate and cooperate on an personal, organisational, and systemic level as an important source of meso-level failure (Jessop 1998; Peters 2015). Where institutions are insufficiently flexible to deal with new challenges or changing circumstances, they will be susceptible to rejection or replacement (Prakash and Potoski 2016; Mol 2009).

Finally, *macro-level* causes of failure are found in the wider societal, economic, and natural environment. While these causal factors are found outside the political system, there is an important interaction between system actors and their environment. One important

external source of failure is the power of private sector, interest groups, and the public, whose opposition can result in a policy or other measure being unsuccessful (e.g. Acheson 2006; Gibb 2015). In those situations where there is a mismatch between the underlying principles of a policy and those held by the community, this can be an important source of failure (Leong and House 2012). The crisis-related literature most strongly considers macro-level causes, focusing on society-wide crises and external shocks. Such crises are often economic or political in nature, but can similarly be caused by natural disasters, infrastructure breakdown or (industrial) accidents (Boin et al. 2008), often involving a large degree of social unrest or threats to national security (Grossman 2015).

Establishing causality

Locating the actual causes of failure is subject to debate. Recent research (e.g. Howlett et al. 2015) argues that the persistence of policy failure suggests its causes lie beyond mere technical causes which would be relatively easy to correct. Particularly in the case of so-called wicked problems—complex problems with multiple causes lacking clear solutions—policy-makers may tend to focus on the symptoms of a problem, thereby remaining on a technical or operational level, rather than address its underlying social causes (e.g. McConnell 2010), which would require also a broader time perspective (Brändström and Kuipers 2003). While technical, short-term solutions may allow an issue to move down the policy agenda and demonstrate policy-makers' ability and commitment to deal with a problem, it does little to address its root causes (McConnell 2015).

Beyond the focus on single causes, several contributors stress that there may be multiple, complex, and interacting factors which together result in failure (McConnell et al. 2008; Bressers et al. 2013; Mol 2009). In this line, McConnell (2016) emphasises that to argue that "one factor *alone* is the cause of a failure would be to neglect the range of individual, institutional, and societal factors that interacted to produce that failure—as well as their complex interdependencies" (675).

Finally, it is argued that, like measuring failure, establishing causality is not a purely rational-scientific or value-neutral exercise, with the nature and significance of causal factors considered to be contestable and dependent on one's wider perspective on society (McConnell et al. 2008). Without a scientifically objective standard by which to judge, under constructivist approaches, success or failure is constructed socially through "informed debates" (Ugyel and O'Flynn 2017) among competing interests. Under such constructivist approaches, technocratic evidence-based expert enquiries into the causes of failure are often set against public enquiries with a stronger focus on public perceptions of performance (Kay and Boxall 2015).

Consequences of failure—exploring its productive potential

Based on this informed understanding of how different concepts of failure fit together, and what causes failure, we now look into to its potential consequences. Most obviously, and following conventional wisdom, failure is clearly negatively connoted. It is therefore not surprising that the literature predominantly describes socially undesirable consequences. Some works, however, point to potentially productive functions of failure. Below, we first briefly discuss the negative consequences of failure, before turning our attention a

discussion of the productive potential of failure and the factors enabling or constraining its activation.

Negative consequences

Negative consequences of failure are well established in the literature. Arguably, the hardest consequences will be felt by the addressees of failing institutions and policies, which may lead to damage to their property or their social or material well-being (van der Steen et al. 2015; Ber 2013), particularly for those most dependent on the state (Gibb 2015; Schuck 2014). Failure can also have serious career implications for policy-makers and individuals within the political or administrative system (Griffin 1987; McConnell 2016; Howlett et al. 2015), whether as the result of fair and balanced evaluation or of blame games and the search for individual culprits (e.g. Bovens and Hart 2016).

These individual effects are often interrelated to negative developments that threaten well-being on the wider societal and economic level (Gibb 2015; Schuck 2014). Where individual actors pursue self-interested behaviour, such as (political) rent-seeking and outright corruption, this is often in direct contrast to wider societal interests, causing detrimental effects on a system-wide level. System-wide effects may become manifest in, e.g. the inefficient allocation and use of resources (e.g. Juhasz 1989; Wallis and Dollery 2002), the distortion of market prices, and increased levels of social cost to the economy (Venkatachalam 2004), potentially also resulting in the depletion of scarce resources (Acheson 2006) and environmental degradation (Juhasz 1989).

In the political system itself, failure and crisis often generate a sense of urgency, threat and uncertainty, thus revealing vulnerabilities in the system (Boin et al. 2008). If sufficiently strong, such events can severely undermine trust in the system (e.g. Saurugger and Terpan 2016; Farazmand 2012) and reduce electoral support (Howlett 2012; Schuck 2014), particularly as challenges become more frequent. Ultimately, fundamental threats to its core values can result in the destabilisation of the system as a whole (Saurugger and Terpan 2016; Hansen 1983), undermining the position of regime actors and encouraging the growth/success of challengers (May 2015; McConnell 2010).

Productive potential

Around half of publications in our sample discuss the consequences of failure, with only around a quarter addressing the ways in which these are associated with desirable implications of failure. Most publications remain relatively generic in their findings, simply arguing that failure can provide a window of opportunity for reform (e.g. Farazmand 2012) or learning (e.g. Gibb 2015), or may spur positive change (Marsh and McConnell 2010). While largely implicit, many of these publications hint at deeper-lying assumptions and understandings of these productive functions of failure. The "Productive potential" and "Factors conditioning the activation of productive potential" sections tease out this implicit understanding of productive potential on a policy, polity and political level in greater detail, as well as the conditions enabling or hindering its activation.

While the destabilisation of the political system was previously perceived as a major detrimental effect of failure, some contributors also stress its productive potential to open up windows of opportunity (e.g. Saurugger and Terpan 2016; Schwartz and McConnell 2009). As explicated in theories of the policy process, e.g. the Multiple Streams Framework (Kingdon 1984), events such as failure and crisis punctuate the normal rhythm of

Table 1 Productive functions of failure: Intervention types and instruments in the dimensions of the political system

	Individual policies (policy)	System structure (polity)	Political dynamics (politics)
Type of learning	Instrumental	Social	Political
Target of intervention	Tools and instruments	Beliefs and paradigms	Power structures and discourses
Impact on system	Low-level intervention, incremental change; system remains stable	Break-up inertia and path-dependency	Creates room for new ideas

policy-making (Schwartz and McConnell 2009). Failure may stimulate political momentum, helping to unfreeze institutional rigidity and inertia (Alink et al. 2001). In some cases, the complete dismantling or removal of institutions may even be required to unlock existing pathways and allow the creation of new ones (Giest 2017), an argument closely linked to Schumpeter's (1994) 'creative destruction'. Hence, these windows of opportunity present potential turning points for reform, institutional change (e.g. Kay and Boxall 2015; Grossman 2015), and learning (Hall 2011; Gibb 2015). Synthesising these diverse aspects, a deeper analysis of the collected literature reveals that the 'window of opportunity' takes on a distinct character in the different dimensions of the political system—policy, polity, and politics (see Table 1 for an overview), and with it alternative strategies for reform, learning, and lesson drawing are emphasised.

In the policy domain, given its focus on the policy tools and targets, failure may result in the fine-tuning of individual policies or instruments but they may also enable extensive reform of (individual) policies and lead to changes in the policy-making process. However, as the wider system remains essentially stable, reform and learning will most likely not take place beyond the relatively 'shallow' level. In this sense, the literature extensively refers to May's (1992) 'instrumental learning'.[1] Instrumental learning largely focuses on modifying policy tools or instruments to achieve programmatic roles. Thus, while it may lead to the adoption of new policy instruments and techniques, overarching policy goals remain unchanged.

In the polity domain, the consequences of failure may reach beyond the policy field and also trigger structural, institutional change in the political system, altering the systemic incentives and structures that led to institutional failure. Individual or low-level policy failures alone are unlikely to trigger change at this level. Rather, repeated failure and the erosion or even disappearance of institutions are required for system-wide changes to be able to take place (Kay 2017). While this inevitably comes with negative consequences for some, it also offers the opportunity to break with older patterns of inertia and path-dependency (Ball 2005; Boin et al. 2008), or for "rebirth and rethinking" (Dunlop 2017b, 9). Pressures that may potentially be able to stimulate a break with established patterns include: political pressures (e.g. a change in the way power is distributed), functional pressures (i.e. changing views about the instrumental value of institutionalised practices and procedures), and social pressures, or the loss of cultural consensus (Ball 2005). Hence, failure in this respect is likely to be accompanied by deeper 'social learning' (May 1992) and reforms,

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[1] Similar typologies of learning appear throughout the literature, all based on the depth of learning (see Dunlop 2017b).

involving changes in underlying policy beliefs and paradigms. There is little indication in the literature, however, that processes of destabilisation and reinstitutionalisation are *intentionally* used within a public policy framework, nor does it become clear whether or how these processes can be steered consciously with a particular alternative in mind.

In the realm of politics, windows of opportunity may involve the break-up of incumbent power structures and discourses. This may allow actors to form alternative coalitions or policy entrepreneurs to advance major, previously condemned changes (Grossman 2015; Saurugger and Terpan 2016; Walsh 2006). By putting the blame on one set of political actors—e.g. the government currently in power, or the proponents of a policy—opposing actors can seek a break with the status quo and push forward their preferred solutions. This strive for reformism may, however, face strong opposition from incumbent elites, who could use the failure as an opportunity to demonstrate the relevance and fundamental stability of the system, thus legitimising its very existence (Van Assche et al. 2012). Learning on this level, referred to as 'political learning' (May 1992), is thus concerned with advocating for preferred policy ideas and to enhance their political feasibility (Hall 2011).

As these potentials for change in all three domains highlight, learning may play a pivotal role for harnessing this change. Learning is defined in the literature as "improved understanding" (Newman and Bird 2017) or "the updating of beliefs" through own or witnessed experience, analysis or interaction (Dunlop 2017b). But sources of learning are not limited to own experiences: failure may also stimulate learning and reform with those who have not been direct subject to it. Referred to as 'policy transfer' in the literature (e.g. Giest 2017) experiences in other political settings in the past or present enable learning without the costs of negative experiences or an immediate need for action (Stern 1997; Marsh and Sharman 2009). In doing so, it is important to keep in mind the high context-specificity of policy environments, which can in some cases cause perceived lessons to be almost entirely opposed to another (Peters et al. 2011). Learning, especially in contexts of failure, also includes the 'unlearning' of certain routines to ensure openness to change, and 'negative lesson drawing', or learning what not to do (Stone 2017; c.f. Rose 1991).

Factors conditioning the activation of productive potential

Given the potentially productive functions of failure, the question remains how and under which conditions these can be effectively realised. Overall, the discussion of how to overcome negative events in the selected publications is relatively light-touch and little specific. While the literature frequently refers to the different ways in which failure can lead to productive consequences, it risks becoming a hollow statement if not sufficiently elaborated. The pertinent question is therefore which factors facilitate or hinder turning a negative consequence into a positive one, or how, and under which conditions the positive potentials of failure can be activated and reaped. While some of these factors are internal to the political system (e.g. institutional structures and actors, policy precedents, and information), others are external (e.g. economic markets, international politics) and thus more difficult or impossible to control. A comprehensive list of the enabling/hindering factors discussed in the literature is compiled in Table 2.

On the individual (micro-) level, ideological constraints and mental traits such as defensiveness and risk-averseness, as well as the tendency to reject negative lessons play an important role in actors' ability to turn experiences of failure into something more conducive. Ideological and psychological openness may enable individuals to activate the positive potential of failure. Dunlop (2017a), for example, refers to the 'absorptive capacity'

Table 2 Factors enabling and/or hindering productive functions

Level	Enabling factors	Source	Hindering factors	Source
Micro	Absorptive capacity of policy-makers to acquire knowledge from experts;	Dunlop (2017a)	Mental traits of policy-makers, e.g. defensiveness and risk-averseness;	Stern (1997) and Howlett et al. (2015)
			Bounded rationality;	Marsh and Sharman (2009)
			Tendency to accept positive and reject negative lessons of others;	Stern (1997)
Meso	Flexibility and redundancy in governance systems; ability of policies to learn and adapt under dynamic conditions;	Jessop (1998), Giest (2017) and Nair and Howlett (2017)	Path dependence and lock-in of existing institutions; deep institutionalisation of rules and practices;	Alink et al. (2001), Mol (2009) and Boin et al. (2008)
	Adequate resources (access to media, party strength and time allotted for speaking in parliament) for political elites;	Hinterleitner (2018)	Lack of institutional capacity, incl. administrative and financial capacity, lack of institutional memory;	Kay and Boxall (2015), Dunlop (2017a), Hulme and Hulme (2012) and Nair and Howlett (2017)
	Effective communication and coordination; institutional design supporting dialogue;	Howlett and Ramesh (2014) and Kay (2017)	Lack of communicative capacity or dialogue, lack of information;	Dunlop (2017a), Bovens and Hart (1995) and Hansen (1983)
	Understanding of the institutional and political context;	Hansen (1983) and Griffin (1987)	Lack of analytical capacity, incl. insufficient technical knowledge;	Walker (2014), Howlett and Ramesh (2014) and Dunlop (2017a)
	Good timing to exploit available windows of opportunity;	Alink et al. (2001)	'Political realities' incl. power imbalances, entrenched interests; high time-discount political actors;	Kay (2017), Schwartz and McConnell (2009) and Wallis and Dollery (2002)
	The cultivation of institutional memory; Interpersonal trust;	Stern (1997); Jessop (1998) and Kay (2017)	Blame avoidance by political actors;	Brändström and Kuipers (2003)
Macro	A political climate conducive to policy change;	Schwartz and Sulitzeanu-Kenan (2004)	Uncertainty;	Walsh (2006) and Wallis and Dollery (2002)

of policy-makers', the ability to distil key information when gathering information, whilst at the same time staying open to significant criticisms and assessing the appropriate speed and intensity with which to react.

Ample consideration is given to factors on the institutional (meso-) level. Here, factors such as the deep institutionalisation or lock-in of rules and practices, the lack of institutional capacity, communicative, and analytical capacity are considered to be important factors hindering or preventing the activation of productive potential. On a political level, 'political realities' such as power imbalances between actors and blame-avoidance strategies also appear to prevent negative consequences from becoming productive, with short-term action standing in the way of viable long-term solutions.

Consequences on the micro-level, such as the resignation or demotion of responsible officeholders (or scapegoats) may "serve as pressure valves that stymie attacks from opponents" (Hinterleitner 2018), preventing further action on a system level. On the other hand, enabling factors such as the presence of high levels of interpersonal trust, channels of effective communication and coordination, and institutional memory are considered to be conducive to activating this potential. Regardless of all these factors, good timing appears to be crucial if one is to exploit an available window of opportunity (Alink et al. 2001).

Finally, on a societal (macro-) level, uncertainty surrounding available policy options and their associated outcomes may be a significant barrier preventing factors, while a political climate conducive to policy change is considered to be an important enabling factor. How these factors "work" and how they might interact in practice remains unclear from the literature, offering interesting potential for future research.

Discussion and conclusions

Reviewing the literature in a systematic fashion revealed that while the negative consequences of failure and decline are discussed more widely in the literature, to date relatively little attention has been paid to the potentially productive consequences of failure. While failure plays an implicit role in many public policy frameworks (e.g. in punctuated equilibrium-theory), only scant attention is paid to a more explicit treatment of its productive consequences. Moreover, those publications that do discuss pathways of how failure may bring about positive change have largely remained generic and descriptive in their explanations, merely claiming that they may open a window of opportunity for reform and/or learning. It is our belief that such a coarse and simplistic view of failure inhibits meaningful change on the three dimensions of the political process. A more conscious appraisal of failure and a better understanding of its productive functions are thus required to further enrich studies of public policy and contribute to the advancement of some of the present frameworks.

The work presented here should be seen as a first step in this direction. We highlighted how failure can open up 'windows of opportunity' for reform, institutional change, and learning on different levels of the political system. By looking beyond the individual types in the literature, hitherto mostly treated separately, we have addressed different domains of the political system, notably the policy-level, the polity-level, and the politics-level. While failure of individual policies will mostly result in instrumental learning and the fine-tuning of policy instruments and techniques, on the polity and politics-level, the potentially productive effects of failure are much larger. Here, the destabilisation or removal of existing institutions, as well as deeper forms of (social and political) learning may provide important opportunities to overcome institutional lock-ins and break up dominant power

structures. While this literature thus clearly recognises the potential ways in which failure may lead to subsequent success, it presently fails to consider how such processes can consciously be initiated and directed so as to improve existing weaknesses or flaws in the system.

As a first step in this direction, we identified a wide range of factors that may enable or hinder the activation of the productive functions of failure, particularly deep-level structural changes. These include individual traits and constraints of decision-makers, institutional capacities, power relations, as well as the overall complexity of the wider system and tie in closely with the causes of failure, which can similarly be found on the micro, meso, and macro level. Particularly on the meso level, for which the most information is available, the identification of these enabling and hindering factors offers a great potential to help prevent, or better utilise, structural-level failures should they occur.

So how to move forward from here? More attention, through empirical and conceptual studies, will be needed to improve our understanding on how and through what mechanisms failure is likely to unfold its positive aspects or may even be activated intentionally and subsequently steered or guided in the desired direction. On a conceptual level, to further map and explore the positive potentials of failure, research should identify archetypical mechanisms of productive functions going beyond the windows of opportunity and reform, identified in our review. Special attention may be paid to the role of agency and ways to harness productive potentials. On a more empirical level, looking at cases of failure through the lens of enabling and hindering factors may enable us to better determine the relevance of individual factors and provide policy-makers with valuable clues as to where their intervention in the system may be required. A promising strategy forwards also lies in exploring the links between the concepts and productive functions of failure and established political theories and concepts of institutional change. Theories, such as the Social Construction Framework (Schneider et al. 2014), or the Narrative Policy Framework (Crow et al. 2018) may offer insights into the causes and construction of failure and the roles and strategies of actors to reap the productive potentials. Especially the tension between blame avoidance and learning and reform (Howlett 2012), as a major hurdle for the activation of productive potentials of failure on an individual and institutional level, may benefit from more attention and cross-fertilisation. Such an effort would be conducive to better anchoring the subject in broader policy and failure research and contribute towards fixing the "broken link" (Dunlop 2017b) between failure and learning.

Empirically, a next step may be to set the conceptual literature into dialogue with empirical findings; attention should be devoted to identifying relevant cases in which failure has been productive in practice, and where mechanisms identified here, such as negative lesson drawing, could be observed. Such an endeavour would help answer the question how and when failure can be put to use, and which actors play an important role, a question that cannot be answered from the conceptual literature alone. However, the empirical study of failure is facing particular challenges: issues of desirability bias and limited access to detailed information may prevail, especially in situations where actors report on their own experiences. Empirical research on failure and its productive functions may benefit further from innovative approaches for research design and methodology.

Finally, we strongly encourage more cross-disciplinary fertilisation to better understand how different fields deal with failure. The organisational literature, in particular, with obvious interfaces to the institutional literature, offers a strong potential to contribute to this debate (e.g. Mone et al. 1998; Frese and Keith 2015). Combined, these different research efforts may ultimately prove instrumental in coping with the real-life consequences of failure and developing adequate responses in practice.

References

Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., et al. (2017). Leverage points for sustainability transformation. *Ambio, 46*(1), 30–39.

Acheson, J. M. (2006). Institutional failure in resource management. *Annual Review of Anthropology, 35,* 117–134.

Alink, F., Boin, A., & Hart, P. T. (2001). Institutional crises and reforms in policy sectors: The case of asylum policy in Europe. *Journal of European Public Policy, 8*(2), 286–306.

Andrew, B. (2008). Market failure, government failure and externalities in climate change mitigation: The case for a carbon tax. *Public Administration and Development, 28*(5), 393–401.

Backhouse, R. E., & Medema, S. G. (2012). Economists and the analysis of government failure: Fallacies in the Chicago and Virginia interpretations of Cambridge welfare economics. *Cambridge Journal of Economics, 36*(4), 981–994.

Ball, A. (2005). Environmental accounting and change in UK local government. *Accounting, Auditing and Accountability Journal, 18*(3), 346–373.

Benitez, D., Estache, A., & Søreide, T. (2012). *Infrastructure policy and governance failures*. CMI Working Paper (Vol. 5). Bergen: Chr. Michelsen Institute (CMI).

Ber, I. (2013). Governmental strategies towards poorly-performing municipalities: From narrow perceptions to ineffective policies. *Lex Localis—Journal of Local Self-Government, 11*(1), 33–52.

Boin, A., McConnell, A., & Hart, P. T. (2008). *Governing after crisis. The politics of investigation, accountability and learning*. Cambridge: Cambridge University Press.

Bovens, M., & Hart, P. T. (1995). Frame multiplicity and policy fiascoes: Limits to explanation. *Knowledge and Policy, 8*(4), 61–82.

Bovens, M., & Hart, P. T. (2016). Revisiting the study of policy failures. *Journal of European Public Policy, 23*(5), 653–666.

Brändström, A., & Kuipers, S. (2003). From 'normal incidents' to political crises: Understanding the selective politicization of policy failures. *Government and Opposition, 38*(3), 279–305.

Bressers, N., van Twist, M., & ten Heuvelhof, E. (2013). Exploring the temporal dimension in policy evaluation studies. *Policy Sciences, 46*(1), 23–37.

Brummer, K. (2016). 'Fiasco prime ministers': Leaders' beliefs and personality traits as possible causes for policy fiascos. *Journal of European Public Policy, 23*(5), 702–717.

Crow, D. A., Albright, E. A., Ely, T., Koebele, E., & Lawhon, L. (2018). Do disasters lead to learning? Financial policy change in local government. *Review of Policy Research, 35,* 1–26.

Cullis, J. G., Jones, P. R., & Morrissey, O. (1993). The charge of the tax brigade. A case study of government failure and tax reforms. *European Journal of Political Economy, 9*(3), 407–425.

Dolfsma, W. (2011). Government failure—Four types. *Journal of Economic Issues, 45*(3), 593–604.

Dunlop, C. A. (2017a). Pathologies of policy learning: What are they and how do they contribute to policy failure? *Policy and Politics, 45*(1), 19–37.

Dunlop, C. A. (2017b). Policy learning and policy failure: Definitions, dimensions and intersections. *Policy and Politics, 45*(1), 3–18.

Farazmand, A. (2012). The future of public administration: Challenges and opportunities—A critical perspective. *Administration and Society, 44*(4), 487–517.

Fike, R., & Gwartney, J. (2015). Public choice, market failure, and government failure in principles textbooks. *Journal of Economic Education, 46*(2), 207–218.

Frese, M., & Keith, N. (2015). Action errors, error management, and learning in organizations. *Annual Review of Psychology, 66,* 661–687.

Gibb, K. (2015). The multiple policy failures of the UK bedroom tax. *International Journal of Housing Policy, 15*(2), 148–166.

Giest, S. (2017). Overcoming the failure of 'silicon somewheres': Learning in policy transfer processes. *Policy and Politics, 45*(1), 39–54.

Griffin, D. M. (1987). Implementation failure caused by institutional problems. *Mountain Research and Development, 7*(3), 250–253.

Grossman, P. Z. (2015). Energy shocks, crises and the policy process: A review of theory and application. *Energy Policy, 77*(1), 56–69.

Hajnal, G. (2010). Failing policies or failing politicians? Policy failures in Hungary. *World Political Science Review*. https://doi.org/10.2202/1935-6226.1089

Hall, C. M. (2011). Policy learning and policy failure in sustainable tourism governance: From first- and second-order to third-order change? *Journal of Sustainable Tourism, 19*(4–5), 649–671.

Hansen, S. B. (1983). Public policy analysis: Some recent developments and current problems. *Policy Studies Journal, 12*(1), 14–42.

Harris, E. (2007). Historical regulation of Victoria's water sector: A case of government failure? *Australian Journal of Agricultural and Resource Economics, 51*(3), 343–352.

Helm, D. (2010). Government failure, rent-seeking, and capture: The design of climate change policy. *Oxford Review of Economic Policy, 26*(2), 182–196.

Hinterleitner, M. (2018). Policy failures, blame games and changes to policy practice. *Journal of Public Policy, 38*(2), 221–242.

Howlett, M. (2012). The lessons of failure: Learning and blame avoidance in public policy-making. *International Political Science Review, 33*(5), 539–555.

Howlett, M. (2014). Why are policy innovations rare and so often negative? Blame avoidance and problem denial in climate change policy-making. *Global Environmental Change, 29,* 395–403.

Howlett, M., & Ramesh, M. (2014). The two orders of governance failure: Design mismatches and policy capacity issues in modern governance. *Policy and Society, 33*(4), 317–327.

Howlett, M., Ramesh, M., & Wu, X. (2015). Understanding the persistence of policy failures: The role of politics, governance and uncertainty. *Public Policy and Administration, 30*(3–4), 209–220.

Hulme, R., & Hulme, M. (2012). Policy learning? Crisis, evidence and reinvention in the making of public policy. *Policy and Politics, 40*(4), 473–489.

Jessop, B. (1998). The rise of governance and the risks of failure: The case of economic development. *International Social Science Journal, 50*(155), 29–45.

Juhasz, F. (1989). Water: Is there a crisis? *OECD Observer, 160,* 4–9.

Kay, A. (2017). Policy failures, policy learning and institutional change: The case of Australian health insurance policy change. *Policy and Politics, 45*(1), 87–101.

Kay, A., & Boxall, A.-M. (2015). Success and failure in public policy: Twin imposters or avenues for reform? Selected evidence from 40 years of health-care reform in Australia. *Australian Journal of Public Administration, 74*(1), 33–41.

Keech, W. R., & Munger, M. C. (2015). The anatomy of government failure. *Public Choice, 164*(1–2), 1–42.

King, A., & Crewe, I. (2013). *The lunders of our governments*. London: Oneworld.

Kingdon, J. W. (1984). *Agendas, alternatives, and public policies*. Harlow: Pearson.

Kirkpatrick, D. D. (2012). As Clashes Continue, Egypt Soccer Riot Becomes Metaphor for Government Failure. (2012, 03.02.2012). *The New York Times*.

Kortt, M. A., & Dollery, B. E. (2012). Australian government failure and the Green Loans Program. *International Journal of Public Administration, 35*(2), 150–158.

Kotrusová, M., & Výborná, K. (2015). A policy fiasco: The institutional (non-)reform of Czech public employment services in 2011. *Central European Journal of Public Policy, 9*(1), 148–168.

Leong, C., & House, S. R. (2012). Rethinking policy success: The normative basis for public action. *Journal of Asian Public Policy, 5*(1), 3–22.

Marsh, D., & McConnell, A. (2010). Towards a framework for establishing policy success. *Public Administration, 88*(2), 564–583.

Marsh, D., & Sharman, J. C. (2009). Policy diffusion and policy transfer. *Policy Studies, 30*(3), 269–288.

May, P. J. (1992). Policy learning and failure. *Journal of Public Policy, 12*(4), 331–354.

May, P. J. (2015). Implementation failures revisited: Policy regime perspectives. *Public Policy and Administration, 30*(3–4), 277–299.

May, P. J., & Jochim, A. E. (2013). Policy regime perspectives: Policies, politics, and governing. *Policy Studies Journal, 41*(3), 426–452.

McConnell, A. (2010). Policy success, policy failure and grey areas in-between. *Journal of Public Policy, 30*(3), 345–362.

McConnell, A. (2015). What is policy failure? A primer to help navigate the maze. *Public Policy and Administration, 30*(3–4), 221–242.

McConnell, A. (2016). A public policy approach to understanding the nature and causes of foreign policy failure. *Journal of European Public Policy, 23*(5), 667–684.

McConnell, A., Gauja, A., & Botterill, L. C. (2008). Policy fiascos, blame management and AWB limited: The Howard government's escape from the Iraq wheat scandal. *Australian Journal of Political Science, 43*(4), 599–616.

Meier, K. J., & Bohte, J. (2003). Not with a bang, but a whimper. Explaining organizational failures. *Administration and Society, 35*(1), 104–121.

Mitchell, W. C., & Simmons, R. T. (1995). Pathological politics: The anatomy of government failure. *Society, 32*(6), 30–38.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. J., & The PRISMA Group. (2009). Preferred reporting items for systematic reveiws and meta-analyses: The PRISMA Statement. *PLOS Medicine, 6*(7), e1000097.

Mol, A. P. J. (2009). Environmental deinstitutionalization in Russia. *Journal of Environmental Policy & Planning, 11*(3), 223–241.

Mone, M. A., McKinley, W., & Barker, V. L. (1998). Organizational decline and innovation: A contingency framework. *Academy of Management Review, 23*(1), 115–132.

Murray, D., & Dollery, B. (2005). Institutional breakdown? An exploratory taxonomy of Australian University failure. *Prometheus, 23*(4), 385–398.

Nair, S., & Howlett, M. (2017). Policy myopia as a source of policy failure: Adaptation and policy learning under deep uncertainty. *Policy and Politics, 45*(1), 103–118.

Newig, J. (2013). Produktive Funktionen von Kollaps und Zerstörung für gesellschaftliche Transformationsprozesse in Richtung Nachhaltigkeit. In J. Rückert-John (Ed.), *Soziale Innovation und Nachhaltigkeit. Perspektiven sozialen Wandels* (pp. 133–149). Wiesbaden: Springer.

Newman, J., & Bird, M. G. (2017). British Columbia's fast ferries and Sydney's Airport Link: Partisan barriers to learning from policy failure. *Policy and Politics, 45*(1), 71–85.

Oppermann, K., & Spencer, A. (2016a). Studying fiascos: Bringing public and foreign policy together. *Journal of European Public Policy, 23*(5), 643–652.

Oppermann, K., & Spencer, A. (2016b). Telling stories of failure: Narrative constructions of foreign policy fiascos. *Journal of European Public Policy, 23*(5), 685–701.

Peters, B. G. (2015). State failure, governance failure and policy failure: Exploring the linkages. *Public Policy and Administration, 30*(3–4), 261–276.

Peters, B. G., Pierre, J., & Randma-Liiv, T. (2011). Global financial crisis, public administration and governance: Do new problems require new solutions? *Public Organization Review, 11*(1), 13–27.

Prakash, A., & Potoski, M. (2016). Dysfunctional institutions? Toward a new agenda in governance studies. *Regulation and Governance, 10*(2), 115–125.

Richardson, W. (2007). Public policy failure and fiasco in education: Perspectives on the British examinations crises of 2000–2002 and other episodes since 1975. *Oxford Review of Education, 33*(2), 143–160.

Rose, R. (1991). What is lesson-drawing? *Journal of Public Policy, 11*(1), 3–30.

Saurugger, S., & Terpan, F. (2016). Do crises lead to policy change? The multiple streams framework and the European Union's economic governance instruments. *Policy Sciences, 49*(1), 35–53.

Schneider, A., Ingram, H., & Deleon, P. (2014). Democratic policy design: Social construction of target populations. *Theories of the Policy Process, 3,* 105–149.

Schuck, P. H. (2014). *Why government fails so often: And how it can do better*. Princeton: Princeton University Press.

Schumpeter, J. A. (1994). *Capitalism, socialism and democracy*. London: Routledge.

Schwartz, R., & McConnell, A. (2009). Do crises help remedy regulatory failure? A comparative study of the Walkerton water and Jerusalem banquet hall disasters. *Canadian Public Administration, 52*(1), 91–112.

Schwartz, R., & Sulitzeanu-Kenan, R. (2004). Managerial values and accountability pressures. Challenges of crisis and disaster. *Journal of Public Administration Research and Theory, 14*(1), 79–102.

Short, J. L. (2013). Self-regulation in the regulatory void: "Blue Moon"or "Bad Moon"? *Annals of the American Academy of Political and Social Science, 649*(1), 22–34.

Sparrow, A. (2008). Government condemned for failure to tackle bribery (2008, 17.10.2008). The Guardian.

Stern, E. (1997). Crisis and learning: A conceptual balance sheet. *Journal of Contingencies and Crisis Management, 5*(2), 69–86.

Stone, D. (2017). Understanding the transfer of policy failure: Bricolage, experimentalism and translation. *Policy and Politics, 45*(1), 55–70.

Ugyel, L., & O'Flynn, J. (2017). Measuring policy success: Evaluating public sector reform in Bhutan. *International Journal of Public Administration, 40*(2), 115–125.

Van Assche, K., Beunen, R., & Duineveld, M. (2012). Performing success and failure in governance: Dutch planning experiences. *Public Administration, 90*(3), 567–581.

van der Steen, M., Scherpenisse, J., van Twist, M., & Hart, P. T. (2015). How to see failure: Attempts by the Inspectorate of Education to detect and disarm failure in Dutch education policy. *Public Policy and Administration, 30*(3–4), 320–341.

Venkatachalam, L. (2004). Sources of government failure and the environmental externality: Analysis of groundwater pollution in Tamil Nadu, India. *Water Policy, 6*(5), 413–426.

Vince, J. (2015). Integrated policy approaches and policy failure: The case of Australia's Oceans Policy. *Policy Sciences, 48*(2), 159–180.

Vining, A. R., & Weimer, D. L. (1999). Inefficiency in public organizations. *International Public Management Journal, 2*(1), 1–24.

Walker, G. (2014). Water scarcity in England and Wales as a failure of (meta)governance. *Water Alternatives, 7*(2), 388–413.

Wallis, J., & Dollery, B. (2002). Wolf's model: Government failure and public sector reform in advanced industrial democracies. *Review of Policy Research, 19*(1), 177–203.

Walsh, J. I. (2006). Policy failure and policy change. British security policy after the cold war. *Comparative Political Studies, 39*(4), 490–518.

Wibe, S. (1992). Policy failures in managing forests. In R. K. Turner, S. Wibe (Eds.), *Market and government failures in environmental management* (pp. 45–82). Paris: OECD.

Young, D. R. (1977). Consumer problems in the public sector: A framework for research. *Journal of Consumer Policy, 1*(3), 205–226.

Zittoun, P. (2015). Analysing policy failure as an argumentative strategy in the policymaking process: A pragmatist perspective. *Public Policy and Administration, 30*(3–4), 243–260.

Sustainability through institutional failure and decline? Archetypes of productive pathways

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ABSTRACT. Although current literature on sustainability governance and institutions is preoccupied with innovation, novelty, success, and "best practice," there is an emergent tendency to consider decline and failure as opportunities and leverage points to work toward and to achieve sustainability. However, although failure, crisis, and decay have been treated extensively, the link toward their productive potential has remained underdeveloped in the literature. Using a systems perspective, we described five archetypical pathways through which crisis, failure, deliberate destabilization, and active management of decline may facilitate sustainability transformation through adaptation, learning, providing windows of opportunity, and informed choices regarding stability versus change. We sought to provide a basis for further conceptual and empirical inquiry by formulating archetypical pathways that link aspects of failure to productive functions in the sense of sustainability. We started out by describing five archetypical pathways and their conceptual underpinnings from a number of different literatures, including evolutionary economics, ecology, and institutional change. The pathways related to (1) crises triggering institutional adaptations toward sustainability, (2) systematic learning from failure and breakdown, (3) the purposeful destabilization of unsustainable institutions, (4) making a virtue of inevitable decline, and (5) active and reflective decision making in the face of decline instead of leaving it to chance. These archetypical pathways were illustrated by a number of sustainability-related empirical case studies. In developing these archetypes, we have sought to move forward the debate on sustainability transformation and harness the potential of hitherto overlooked institutional dynamics.

Key Words: *collapse; creative destruction; dismantling; experimentation; policy transfer; policy window; renewal; systems thinking*

INTRODUCTION

The recent sustainability discourse is dominated by a focus on innovation or the "new" (Shove 2012). These include technological or socio-technical innovations (Smith et al. 2010), business innovations (Schaltegger and Wagner 2011), social innovations (Jaeger-Erben et al. 2015), policy and governance innovations (Meadowcroft and Fiorino 2017), and democratic innovations (Mattijssen et al. 2015). There is hardly any reason to question the importance of this trend: There is a need for new ideas, technologies, governance structures, alternative economic structures, and business models. However, this domination of novelty may prevent us from recognizing alternative, or complementary, perspectives to achieve sustainability. For one thing, we should be reminded that innovation as such is often unsustainable (Røpke 2012) or may only sustain unsustainability (Blühdorn 2013). Quite recently, there has therefore been a growing unease with the noted bias on innovation, even from within innovation studies (Sveiby et al. 2012). Second, and more importantly, a focus on innovation and the creation of novelty may obscure the productive role of processes of failure and decline in achieving sustainability.

Our interest lies in institutions as the "stable, valued, recurring patterns of behavior whose most important function is to facilitate human collective action" (Fukuyama 2014:462). The institutional change literature, although traditionally focused on explaining the emergence of new institutions, has seen a recent boom in research on policy failure (McConnell 2015, Bovens and 't Hart 2016), governance failure (Howlett and Ramesh 2014, Peters 2015), institutional failure (Acheson 2006), and policy dismantling (Bauer and Knill 2014). These contributions add to our understanding of processes and causes of failure, as well as their circumstances, and partly also of consequences of failure (Derwort et al. 2018). However, few if any of these contributions address the potentially desirable function attached to failure and decline. Instead of propagating yet more innovations, we will turn to the productive side of destruction and failure.

The sparse treatment of productive elements of failure and decline in the recent literature is somewhat astonishing. Philosophers and writers of most different fields of study have long recognized, for example, the value of "creative destruction" for the functioning of market economies (Schumpeter 1950), of collapse for healthy renewal of ecosystems (Gunderson and Holling 2002), and of learning from the failure of past societies (Diamond 2005). All of these are strikingly absent in recent grand debates on institutional change, decline, and failure. Although, certainly, an integrated theory of productive elements of failure and decline in institutional change would be an alluring project, our aim is more modest. We formulate five archetypical pathways that encapsulate the ways in which institutional failure and decline is potentially related to productive, more sustainable outcomes.

To this end, we try to enrich the institutional change literature with considerations from various fields in which productive functions have been described, such as ecology, evolutionary economics, or anthropology. The common thread in these archetypical pathways is that they all refer to institutions' dysfunctionality. They either take dysfunctionality as an opportunity for productive change toward sustainability, or to deliberately make normatively undesirable institutions dysfunctional, or as an opportunity to reflect and decide on the desirability of a declining, i.e., increasingly dysfunctional, institution. To compare different pathways on a relatively abstract level, we use a systems lens, acknowledging that institutional systems are complex adaptive systems subject to "lock-in," path-dependent dynamics, and self-stabilization and are capable of adaptation, learning, and transformation from a more or less stable systems

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state to another (Bardach 2006). Considering how such productive pathways work in practice, we move toward a policy design perspective on institutional change, aiming to stimulate and facilitate further conceptual and empirical work on harnessing productive pathways of institutional failure and decline.

INSTITUTIONAL CHANGE ANALYSIS: A SYSTEMS APPROACH

Our logic is not to explain institutional change. We seek to identify opportunities related to dysfunction, i.e., institutional failure and decline, for productive change. By "productive," we mean changes toward more sustainable solutions that benefit the common good rather than particular interests, that help to protect the natural resources and life-support systems, and that embody lasting solutions rather than those undermining societal foundations. Ultimately, we consider the scope for agency within institutional regimes (see Fischer and Newig 2016).

Human societies organize themselves through institutions, i.e., the structures that make societal interaction predictable and guide human action toward collective goals (Scharpf 1997). We are principally concerned with formal institutions such as written rules (laws and regulations) and agreements (plans and contracts) that are collectively binding. Because institutions guide and constrain action, institutional change represents a crucial realm of leverage for sustainability transformations (Abson et al. 2017). In particular, we assume that although some institutions may suffer from dysfunctionality, others continue to strive (Fukuyama 2014). Our main focus lies on institutions as "regimes," acknowledging the close interaction of rules with the actors who, through their practices, reproduce and stabilize or erode and counteract them (Streeck and Thelen 2005).

Many recent contributions on institutional or policy change, explicitly or implicitly, employ a systems lens (Kingdon 1999, Streeck and Thelen 2005, Bardach 2006). We follow this path, drawing on the following systems concepts and approaches.

We assume institutions, understood as institutional regimes, to be complex adaptive systems (Pahl-Wostl 2009). That is, they are capable of learning and adapting to changing circumstances, while maintaining their identity. However, considering shorter time spans, institutions tend to be self-reinforcing and self-reproducing and thus oriented toward stability. Although stability is necessary for institutions to function in society, it may result in outright institutional inertia (North 1990). Stability versus change is thus one recurrent theme in our analysis (Leroy and Arts 2006). In addition, we consider whether institutions remain functional or become dysfunctional, and whether change occurs toward sustainability or whether it cements or even drives unsustainability. Finally, change in institutions can be quicker or slower, and we acknowledge that very different dynamics can be at play, such as "punctuated equilibria," in which long periods of stability are interrupted by periods of rapid change (Jones and Baumgartner 2012), as well as slow and gradual change of institutions, in which existing institutions interact with and may over time be replaced by new ones (Streeck and Thelen 2005, Mahoney and Thelen 2010).

Two systems concepts are of particular relevance because they are instrumental in delimiting and distinguishing processes of institutional change, including failure and decline. These are path dependency and the duality of structure and function.

First, path dependency has been described as a general feature of complex systems dynamics where small changes in initial conditions and positive feedbacks lead to self-reinforcement and "lock-in" of systems features (Arthur 1989). Acknowledging that institutions are never created nor changing in a void, path dependency has been a key concept in historical institutionalism (Thelen 1999) and has mostly flourished with regard to technology and economic developments. Path dependency, in our approach, constitutes an important element in institutional dynamics, because we perceive institutions as potentially interlinked, embedded, and locked in with technology, infrastructure, and the natural environment. For it is precisely the challenge to "unlock" locked-in institutional regimes in so far as they are judged unsustainable.

Second, while building on historical institutionalism as one major intellectual foundation, we also draw on structural functionalism, in the tradition of Merton, Parsons, and Luhmann, as "a framework for building theory that sees society as a complex system whose parts work together" (Macionis and Gerber 2010:14). Institutions, then, constitute social structures that serve particular functions in society.[1] Departing from a strong functionalist position, this is not to say, however, that institutions perform perfectly or even that all institutions still serve societal functions. Some may have become obsolete, with structures remaining, but dysfunctional or afunctional under changed circumstances, whereas others undergo fundamental structural change to keep up or improve functioning. Generally, structure and function are independent in that functions, such as the sustainable management of a commons, may be maintained by very different institutional structures, e.g., privatization or state-enforced limits to resource use.

These considerations help us define what we understand by institutional failure and decline. Assuming that institutional structure and function can both either remain stable or decline yields four different constellations of institutional change, or stability, as depicted in Table 1.

Table 1. Typology of institutional change with respect to preservation or collapse of structure and function (source: Newig 2013).

	Preservation of Structure	Decline or Radical Change of Structure
Preservation of function	(a) Stable institution	(b) Institutional transition/ adaptation
Dysfunction or radical change of function	(c) Path-dependent reorientation	(d) Institutional collapse

When both structure and function prevail, an institution stays stable (a). When both decline or change substantively, we find institutional collapse (d), in which the result of change is either an absence of the original institution or a change so dramatic that we need to speak of a new institution, similar to what Streeck and Thelen (2005) have termed "exhaustion" or "displacement," respectively. Quadrant (b) constitutes the prototype of

"successful" institutional change in that its basic function is preserved, or even enhanced, while, or because, its structure alters substantially or is replaced. This aligns with resilience thinking, according to which complex systems, put under pressure, are able to adapt their structure to maintain functioning (Folke et al. 2010). Quadrant (c), finally, constitutes a constellation similar to what Thelen and colleagues (Streeck and Thelen 2005:31) have termed "conversion," i.e., "redeployment of old institutions to new purposes." Acknowledging the crucial role of path dependency, of the "stickiness" of once established institutions, we call this constellation "path-dependent reorientation." Institutional structures prevail but have either become dysfunctional or have begun to serve new functions. The latter may occur either because circumstances have changed, rendering an existing institution dysfunctional, or because ambiguities in an institution's function allow for reinterpretation following shifts in power constellations (Streeck and Thelen 2005).

Summing up, institutional decline can relate to both function and structure. To define institutional failure, a normative element comes in, with institutional failure as a dysfunctionality of a normatively desirable institution. Next, we will identify and discuss archetypical pathways, through which these four types of institutional change may work productively toward sustainability.

THE PRODUCTIVE POTENTIAL OF INSTITUTIONAL FAILURE AND DECLINE: FIVE ARCHETYPICAL PATHWAYS

We took at multistep approach to identify five distinct, archetypical pathways of how to harness the productive potential of institutional dysfunction, depending on whether the system is still functioning and whether it appears desirable to preserve the system in its current state. Building on earlier work on "productive functions" of failure and decline (Newig 2013), we engaged in an iterative process of enriching, refining, and grounding them in scholarly debates (as summarized by Derwort et al. 2018) to arrive at the five archetypes we present. Although we do not suggest these to be definitive, the resulting archetypes may serve as diagnostic tools (Oberlack, Sietz, Bürgi Bonanomi, et al., *unpublished manuscript*) and support future empirical studies in diagnosing their systems of concern, anticipating potential problems, and assessing potential sustainability strategies. We delineated the archetypes as pathways that have distinct configurations of triggers of change and agents of change, as detailed in Table 2. The pathways are archetypes because a single case can be characterized by one or multiple archetypical pathways, as detailed in the *Discussion*. This notion of archetypes allows more fine-grained generalization than typologies of cases (Oberlack, Sietz, Bürgi Bonanomi, et al., *unpublished manuscript*). Subsequently, we describe each of the archetypical pathways, drawing on the relevant academic debates and origins behind them, discussing the constellations in which these occur and potential outcomes for sustainability, speculating on the role of institutional capacity and of agency required to harness each pathway, and highlighting current research questions. For illustrative purposes, we draw on one key empirical example for each archetype. A structured comparison of these empirical cases can be found in Table 3.

Institutional adaptation in the wake of crisis
Assuming that institutional systems are able to respond to pressure through reorganization, learning, and adaptation

without compromising, and rather even enhancing, key systems functions, crises have the potential to trigger institutional adaptations toward sustainability. Given prevailing institutional inertia and lock-in, such change is less likely under "normal" conditions (Stern 1997). Crises are defined as "periods of disorder in the seemingly 'normal' development of a system" (Boin et al 2005:2). Institutional crisis can be attributable to internal failure, for example, caused by excessive rigidity, as conceptualized in the literature on social-ecological systems (Gunderson and Holling 2002, also cf. Scott 1998), or caused by external events, such as natural disasters or technical accidents. In both cases, crises lay bare weaknesses and dysfunctionalities of an institution. For if an institution is properly working in the face of a severe disaster, there appears hardly any need for change. In this way, a crisis acts as a focusing event (Birkland 1997).

Crisis bears the potential to invoke a process of institutional adaptation and improvement in two distinct ways. The first is learning, or lesson drawing. A crisis presents an opportunity to learn if institutional malfunctions or dysfunctions were not known before. Hence, a crisis presents an ultimate test bed to the functioning of an institution, in a sense, an unwanted experiment with negative outcome.[2] In the simplest case, learning from crisis entails a mere "fix" of an institution, such as the level of a tax (first-order learning, or change, sensu Hall [1993]), but more often, it will also involve an element of innovation.

Institutional failure and subsequent change following environmental disasters such as the Sandoz incident, spilling chemicals into the Rhine river at Basel in 1986 (Wieriks and Schulte-Wülwer-Leidig 1997), may serve as a case in point. What was described as "western Europe's worst environmental disaster in decades" (Schwabach 1989:443) evidenced broad institutional dysfunctions on the part of the Rhine treaty regime, notably the International Commission for the Protection of the Rhine (ICPR), including incompatibility of national alarm systems and failure of Swiss authorities to comply with existing safety standards of the Rhine Chemical Convention, which, however, did not provide for incentives for compliance nor sanctions for noncompliance (Schwabach 1989). Following the disaster and its unmasking of the deficiencies of the existing institutional system, institutions were adapted and improved. Next to more technical fixes such as the installation of a disaster warning and prediction system, the crisis also sparked innovation. The Rhine Action Programme was launched by the ICPR member states, which led to a significant decrease of pollutants over the following 5 years (Wieriks and Schulte-Wülwer-Leidig 1997).

The case also evidences the second element of institutional adaptation and improvement: the creation of a window of opportunity for institutional change (Kingdon 1999). Different from the learning element, the point is that the focusing event directs public and political attention to the dysfunctional institution. The focusing event facilitates the adoption of institutional improvements that already exist as an idea but have not made it into the decision-making process. Hence, existing knowledge and existing solutions are not taken up by decision makers, or decision makers deliberately chose not to act on them. It is only as a result of crisis that they do act (Birkland 2009).[3] In a similar manner, windows of opportunities following crisis play an important role in the social-ecological systems literature, building on panarchy theory (Chapin et al. 2010, Gelcich et al.

Table 2. Archetypes of productive functions in comparison

	1. Adaptation in the Wake of Crisis	2. Systematic Learning from Failure	3. Purposeful Destabilization	4. Making a Virtue of Inevitable Decline	5. Active and Reflective Management of Decline
Focusing event or trigger	Sudden focusing event	No specific trigger needed	No specific trigger needed	Rather incremental shift	Critical institutional decline
Initial constellation	Crisis reveals dysfunctioning of institution	Openness to learn from failed experiences with parallels to current system	Stable, locked-in, but normatively undesirable system	Gradual decline that cannot be halted but redirected and turned into something new, useful, productive	Existing institutions decline; this gradual decline can either be halted or accelerated
Functionality of current system	Functioning, but weaknesses revealed by crisis	Good, but improvements possible	Stable and functioning but unsustainable	Fundamentally challenged or declining	Declining or about to decline
Action by institutional regime actors	Adapt, reorganize: respond to failure	Learn from failure	Destabilize, dismantle	Innovate, create	Reflect and decide: active decision making to speed up or halt decline
Harnessing failure or decline as …	An opportunity to improve and strengthen resilience of current system	Sources of knowledge and ultimately as opportunity to improve current system	Opportunity to abolish an unsustainable system and pave the way for a more sustainable alternative	Opportunity to move in different direction	Opportunity to reflect and make an informed decision on whether to accelerate or halt a declining institution
Outcome	Renewal and strengthening of existing system	Improvement of current system	Major reform	Innovations, path-dependent reorientation	Avoid loss of vital structure or avoid inefficient structure
Institutional capacity needed	Flexibility to adapt in the face of crisis; capacity for "intelligent" failure	Institutionalization of evidence-based approaches to policy making; reflective analysis of own situation	Political force to bring about major change; developed viable alternatives	Political structures fostering creativity	Structures for monitoring of decline; active and informed decision making; deliberative capacity; clarity on goals
Role of science	Thorough analysis of crisis pathways	Systematic aggregation of relevant evidence	Provision of scenarios of consequences of destabilization	Provision of innovative ideas to reuse obsolete institutional structures	Analysis of strengths and weaknesses of declining institution

2010), as well as in the literature on socio-technical transitions to sustainability (Frantzeskaki 2011).

The Sandoz accident indeed triggered massive attention within both the public and the political spheres of the riparian countries. This allowed breaking the gridlock in an existing, slow, multiparty process of chemical regulation, which had already produced considerable policy solutions, leading to the creation of the successful Rhine Action Programme (Wieriks and Schulte-Wülwer-Leidig 1997).

The question is, of course, how likely is it that institutions are in fact adapting in the wake of crisis? Institutional regimes may or may not learn from crisis (Boin et al. 2008). Lacking adaption bears the risk of an even greater crisis in the future, threatening the viability of the system at large. Disaster studies have shown moderate learning efforts in the wake of crisis; notably, opportunities for change toward sustainability have often gone unseized (Pelling and Dill 2010, Brundiers 2016). Stern (1997) reviews factors that may inhibit learning after crisis, including on the one hand an overgeneralization of crisis lessons and on the other hand too narrow a focus on the crisis event or hasty reforms, both of which involve overlooking important aspects in the functioning of the institution as a whole. Analyzing the aftermath of the 9/11 attacks, Birkland (2009:148-149) theorizes that decision makers are likely to engage in "superstitious learning – that is, learning without some sort of attempt to analyze the underlying problem," satisfying public demands with merely symbolic action and hence making instrumental learning relatively unlikely.

Given the purported benefits of crisis for institutional adaptation, one may ask whether crisis should in fact be deliberately introduced. One perspective calls for an institutional design that allows for crises to happen or even to deliberately introduce small elements of crisis. In fact, intentionally including crisis episodes and experimentation in institutional design may serve as a mechanism for "intelligent failure" (Sitkin 1996) and the opportunity to learn and develop innovative ideas, especially in complex systems faced with uncertainty. Presenting a broader view on crisis and renewal, panarchy theory, drawing on Schumpeter's idea of "creative destruction," assumes that perpetual crises allow for a system's healthy renewal (Carpenter et al. 2002). Homer-Dixon (2006:289) identifies "the fundamental challenge humankind faces: we need to allow for breakdown in the natural function of our societies in a way that doesn't produce catastrophic collapse but instead leads to healthy renewal."[4] Others assume small crises are not sufficient to induce change, but rather that very large crises are needed for pronounced institutional change (Drazen and Easterly 2001). However, it is important to point to the looming risks of introducing big crises, given the impossibility of predicting and controlling the outcome, particularly in complex systems.

What can we therefore conclude for institutional design? A key element lies in ensuring that institutions are designed to be open

Table 3. Illustrative cases of archetypes of productive functions

	Archetype 1: Sandoz Incident, Switzerland, and Rhine Basin	Archetype 2: Species at Risk Act, Canada	Archetype 3: Coal Phaseout, United Kingdom	Archetype 4: Reorientation of Military Conscription, Germany	Archetype 5: Active Abolishment of Military Conscription, Germany
Focusing event or trigger	Chemical spill into the Rhine River	None	None	Increasing contestation of compulsory military service	Legitimacy of compulsory service as a whole strongly contested
Initial constellation	Spill reveals incompatibility of national alarm systems, failure to comply with existing safety standards	Openness to learn from failed experiences (United States) with parallels to current system (Canada)	Technological system of electricity production stable and locked-in but incompatible with UK climate goals	Gradual decline of interest in military conscription	Loose application of draft examination rules leading to increasing injustice in drafting procedures and increasingly strong public opposition
Functionality of current system	Functioning but heavy institutional weaknesses revealed	System functioning well, improvements possible	Stable and functioning but environmentally unsustainable	Idea of military conscription challenged by society, functionality about to erode	Mandatory service (social and military) in serious decline
Action by institutional regime actors	Technical fixes, e.g., installation of disaster warning system, coupled with innovation (Rhine Action Programme)	Using failure from U.S. experiences to inform policy making in Canada	Introduction of new regulations and carbon pricing to phase out coal-fired electricity generation	Relaxation of draft rules coupled with the creation of new civil service functions to benefit German society	Fundamental reform, replacing mandatory conscription for men with a voluntary military service open to both men and women
Harnessing failure or decline as …	Opportunity to implement institutional improvements, which were partly already available	Source of knowledge, opportunity for learning	Opportunity to decarbonize electricity production	Opportunity to maintain support for conscription and strengthen civil service	Opportunity to abolish conscription following thorough public debate
Institutional change type (see Table 1)	Strengthening of existing institutional system	Improvement of existing system for ecosystem management	Major reform/ transformation of electricity system	Partial reorientation of existing draft structure	Accelerate collapse of an institutional structure

to the potentially transformational learning and adaptation opportunities invoked by crises (Eburn and Dovers 2015). Institutional systems need the capacity and flexibility to learn from, adapt to, and reorganize after crisis. This may also involve clear accountability and responsibility structures that secure democratic accountability of responsible agents while avoiding the blame game, and that establish a culture that, especially under conditions of complexity and uncertainty, regards failure as immanent to the system and actively encourages learning. Having said that, the extent to which failure can be allowed for in an institutional system depends crucially on what is at stake. If human security is at stake, the bar will be set considerably higher than when this is not the case.

Systematic learning from failure
Institutional improvement through learning and adaptation resulting from crisis experience happens in a rather ad hoc manner. It requires events to happen until deficiencies of institutions become apparent and until political momentum for change is built up. However, institutional improvements can also occur through more systematic learning from one's own experience or that of others (see, e.g., Howlett 2012) without the immediate trigger of crisis as a focusing event. In this form of learning, experiences come from various sources, such as evidence and lessons drawn from one's own and other jurisdictions, from predecessors within one's own jurisdiction, or from other policy fields, typically entailing some form of policy transfer and adaptation to the "domestic" context (Stone 2012). As Diamond (2005:24) has put

it: "For the first time in history, we face the risk of a global decline. But we also are the first to enjoy the opportunity of learning quickly from developments in societies anywhere else in the world today, and from what has unfolded in societies at any time in the past."

Learning from one's own experience ("endogenous learning"; Newig et al. 2016) has the advantage of being considered more adequate for one's own situation and, hence, superior to the experiences of others. However, learning from others ("exogenous learning"; Newig et al. 2016) may be equally powerful as learning from one's own experiences is often underestimated vis-à-vis internal adaptation. First and foremost, there are many more external experiences than internal ones. This is what Diamond, in his previous quote, refers to. At least in theory, the body of knowledge from cases of institutional design and implementation is vast. Hundreds, if not thousands, of assessments of how institutions work in the field of sustainability must be available in the published record; add to this ongoing or recent experiences in which involved decision makers or stakeholders are still available for direct exchange. Further, learning from one's own experiences, in particular if learning from failure is involved, often includes being confronted with political and emotional issues, and decision makers have to confess to mistakes they have committed. Learning from others allows for a more detached, less emotional analysis.

Learning from others, or policy transfer, has traditionally focused on learning from "successful" examples, implying it is "natural

for decision makers … to learn from abroad in order to find inexpensive and quick solutions to policy problems" (Coletti 2015:328). From a psychological point of view, it is understandable that decision makers prefer to focus on promising solutions rather than on failed experiences (Overman and Boyd 1994), especially if they are under pressure to find a solution to an urgent matter. Moreover, in academic research, studies with weak or null results are much less likely to be published or written up in the first place, leading to a publication bias toward strong positive effects (Franco et al. 2014).[5] In reality, however, while failure is common, success is rare. Several authors have voiced unease with the common preoccupation with learning from success in the sense of "best practice" examples, as advocated by Bardach (2004). For quite often, "best practice" means little more than "best guess." In the context of administrative reform, Overman and Boyd (1994) criticize that best practice research has neglected thorough learning from experience in that it focuses on short-term lessons; that best practice research is not cumulating evidence and experience and is hardly transferable because of mainly advocating context-insensitive blueprints; and that best practice research is rather biased by current, largely untested paradigms and fashions. The policy transfer literature has highlighted that learning from others by no means guarantees success, pointing to the dangers of uninformed, incomplete, or inappropriate policy transfer, all of which likely lead to failure (Dolowitz and Marsh 2000).

These considerations lead us to the study of failed experiences as a promising approach. The Canadian Species at Risk Act of 2002 (S.C. 2002, c. 29) constitutes an exemplary case in point. Its enactment drew on almost 30 years of observing the heavy regulatory controls on endangered species in the United States (see Illical and Harrison 2007). Despite the many similarities that Canada and the United States share regarding ecosystems and the endangered species therein, policy responses to this issue differ: The U.S. Endangered Species Act of 1973 relies strongly on regulation and coercion, imposing the costs of endangered species protection primarily on the private sector. By contrast, Canadian policy emphasizes subsidized voluntary stewardship, with the option of stricter regulation only to be enacted if needed and then requiring compensation to private interests, making the state bear the costs for protection of endangered species. Some of the dissimilarities between the two approaches may be attributable to certain institutional differences. However, clearly, "negative lesson drawing" (Stone 2017) from the U.S. experience played an explicit role in drafting the Canadian policy. These negative lessons stipulated by the United States' coercive approach mainly included the following: negative economic consequences for landowners and the business community; creating perverse incentives to "shoot, shovel, and shut up" to avoid restrictions on land use; and the approach leading to many instances of litigation and even to the diversion of funds from species protection programs to cover judicial conflict resolution. In the Canadian policy-making process, landowners and business interests mobilized a strong opposition force, directly referring to the U.S. experience and requiring a balance between environmental and business concerns.

Using failure as a source of knowledge for improving current institutional systems suggests two conclusions for institutional design: First, knowledge about the failed experiences of others has to be made available or somehow introduced into one's own institutional system. This requires the kind of science that produces unbiased and reliable accounts of failed institutions and attempts, a desideratum that addresses as much the sphere of policy, which may occur through funding programs, as the sphere of academia, which needs to be more engaged with failure and the related learning potential than it has in the past. One way to foster the availability of this knowledge to policy makers may be through strengthening cross-jurisdictional exchange, either through direct communication among public administrators or via intermediary brokers. Literature on governance networks points to similar conclusions (Newig et al. 2010). Second, as the case of the Canadian Species at Risk Act illustrates, decision makers must be willing and capable of learning from systematic assessments of failed institutions, and this presupposes a better integration of scientific advice (Howlett 2012). In this vein, Volden (2016) found learning from failed institutions to be more likely in states with professional rather than less professional legislatures.

Purposeful destabilization of unsustainable institutions

The first two archetypes describe how existing institutions can be improved by adapting to or learning from failure. This presupposes that these institutions are generally functioning and also normatively desirable in the sense of sustainability. At times, however, more fundamental institutional change toward sustainability is required, beyond the mere improvement of existing systems (e.g., Westley et al. 2011). Depending on the nature of the required change, this may relate to both the structure, e.g., coal-based electricity provision, and the function, e.g., electricity provision as such, of an institution. Although a focus on innovation, which is dominating the current discourse, is and will remain important, there is the risk of neglecting the potentially important and productive role of destabilizing unsustainable institutions.

To implement more sustainable institutions, existing ones need to be replaced for institutional inertia to be overcome (Geva-May 2004). Put differently, the destabilization of existing institutions can help pave the way for alternatives (Turnheim and Geels 2013). In addition, the mere abolition of an unsustainable institution may be an end in itself. Although institutions may destabilize "spontaneously," i.e., without deliberate political intervention, through a variety of means and processes (see Streeck and Thelen 2005), we are concerned with how to unlock and purposefully destabilize through deliberate political steering. We thus depart from the Schumpeterian notion of "creative destruction," which indicates the inevitable and necessary destruction as a side effect of the creation of the new in a market economy. The academic literature has introduced a variety of terms, such as elimination, termination (Geva-May 2004), or dismantling (Bauer and Knill 2014), but active termination and dismantling appear to be relatively rare in practice (Geva-May 2004).

Subsequently, we discuss two important aspects related to the active destabilization of institutions, which we may term (1) the "problem of unlocking" and (2) the "problem of restabilization." Each bears different implications for governance.

With regard to the first problem, institutions, having coevolved with their broader societal environment in a path-dependent way, are stabilized, i.e., locked in, through multiple interactions with

the societal environment in which they are embedded. In the context of sustainability, such interactions concern industrial practices, technology and infrastructure, cultural codes, consumer practices, administrative routines (cf. Turnheim and Geels 2013), and the biophysical environment (Chapin et al. 2010). This raises the crucial issue of how to "unlock" or "deinstitutionalize" institutional regimes. For such processes, the term "exnovation" has recently become popular in the context of sustainability transitions (David 2017). Strategies to unlock may include (cf. Seto et al. 2016) attacking an institution's vulnerable parts, e.g., unpopular subsidies for incumbent industry; exerting aligned pressure onto an existing regime (Geels and Schot 2007); coherent policy mixes (Oliver 1992, Kivimaa and Kern 2016, David 2017); actively "unlearning" administrative practices (Fiol and O'Connor 2017); or changing discourses (McGuire and Hardy 2009).

Regarding the destabilization of existing institutional regimes, the notion of a "window of opportunity" or "policy window" (Kingdon 1999) is relevant in the sense that either a policy window is required for institutional destabilization to take place (Geva-May 2004) or institutional destabilization creates a window to enable further policy change, e.g., allowing niche innovations to replace a dominant regime (Geels and Schot 2007). A case in point for this latter constellation from a sustainability perspective can be found in the UK government's proposals to end unabated coal generation in Great Britain by 2025. Although not affecting the function of the electricity market, i.e., the provision of electricity, the reform seeks to fundamentally transform the structure of electricity production by decarbonizing it. The closure of power plants is to be achieved through a combination of activities, including requirements under the Industrial Emissions Directive (Directive 2010/75/EU), setting a 1500-hour/year limit on operations for the majority of coal units, and carbon pricing, affecting the profitability of coal generation (Department for Business, Energy and Industrial Strategy 2018). By informing the energy industry of its decision 10 years before the actual closure, the British government aims to minimize the impact on the electricity system by providing investors with certainty to enable low-carbon alternatives at a time when old coal-fired power plants are due to either undergo upgrades and retrofits or be taken off-line.

Concerning the second problem, the establishment of an institutional alternative is contingent on whether the opportunity is actively harnessed for institutional change, or whether destabilization merely leads to an institutional void that can be filled by random forces. What we term the "restabilization problem" has been aptly expressed by Fukuyama (2014:462): "Political decay is therefore in many ways a condition of political development: the old has to break down in order to make way for the new. But the transitions can be extremely chaotic and violent; there is no guarantee that political institutions will continuously, peacefully and adequately adapt to new conditions." The Arab Spring revolutions are a sobering, albeit extreme, case in point, sadly proving the difficulty of restabilization and of putting in place alternative regimes following the destabilization of existing ones (Geddes et al. 2014). In the less extreme example of the UK coal phaseout, the UK government has repeatedly emphasized that the technological replacement will be chosen based on market conditions. However, despite the strongly improved performance

of renewable energy technologies such as solar and wind power, the government strongly promotes the expansion of nuclear technologies, most noticeably in the construction of the controversial Hinkley Point C nuclear power station. Taken together, institutional destabilization bears considerable danger and must be approached with great care and understanding of the institutions under consideration. These cases demonstrate that a precondition for effective restabilization is the existence of viable alternatives that can be activated once a window of opportunity opens through regime destabilization.

Institutional destabilization for sustainability need not be followed by an alternative replacement. For example, the recent European Union (EU) decision to ban three neonicotinoid pesticides from all field crops serves as a case in point. In the face of growing evidence that the use of those pesticides poses a threat to pollinators, such as honey bees, the EU commission passed the ban in April 2018 (Carrington 2018). In this light, the decision can be seen as a case of dismantling of harmful institutions and practices to contribute to the sustainability of European ecosystems.

Making a virtue of inevitable decline
The previous archetypes addressed either the strengthening of existing institutions through crisis or failure or the deliberate removal of existing institutions for the better. Our fourth archetype, by contrast, is concerned with situations in which decline is inevitable, because of external or internal factors. Decision makers are then faced with having to either give in to this decline or collapse or use the opportunities generated through this decline. These opportunities can arise either through a new and innovative redeployment of existing structures or through a full institutional redesign in the face of inevitable decline.

Institutions decline for a variety of reasons. One is that they simply wear out over time. What Streeck and Thelen (2005:29) term "exhaustion" refers to a dynamic that makes institutions increasingly vulnerable and self-undermining over time. Institutions may simply age and become obsolete as circumstances change, or they become too complex in their process of adaptation, turning impractical or illegitimate over time (Streeck and Thelen 2005), thus equaling a dynamic of loss of resilience and subsequent breakdown as described in panarchy theory's "conservation" and subsequent "release" phases (Gunderson and Holling 2002). Second, institutions may slowly decline but formally remain intact, called "drift" by Streeck and Thelen (2005). This typically happens as institutions are no longer updated to changing circumstances, as in the nonadaptation of pollution standards to increasing traffic.[6] Third, as new institutions are introduced, existing ones may invariably erode, simply because only a limited number of rules may be adhered to by addressees. What Streeck and Thelen (2005) have termed "displacement" typically happens slowly and subtly, such as by new institutions competing with and gradually replacing old ones. More rarely, displacement may occur in the course of "catastrophes" such as lost wars or revolutions. Whole institutional systems may be overthrown and replaced by new ones, e.g., by invaders, in the course of such major events.[7]

Given inevitable institutional decline, productive potentials arise, first, by reusing institutional structures, whose function has become obsolete, for novel purposes. This is a case of path-

dependent reorientation, as introduced in the section *Institutional change analysis: a systems approach*. Existing but functionally devoid institutional structures, i.e., institutional "ruins," which often bear ambiguity, are reinterpreted in an innovative way. Existing institutional "material" is worked with to produce something new and more sustainable.[8] A case in point is the German civilian service, which emerged out of and partly replaced the military conscription system (the latter is discussed in more detail in *Active and reflective management of decline—instead of leaving it to chance*). For decades in the Cold War period, West German law mandated military service for adult men. Only under strict circumstances could draftees object to military service for reasons of conscience and perform a civilian service instead. With the Cold War ending, the draft system was increasingly contested in public and political debates, leading to a stepwise relaxation of the criteria for objecting to military service, up to a point where the majority of draftees "chose" the civilian service. This allowed supporting, for example, elderly care but also created innovative tasks in environmental services, such as work in national parks or in sustainability education. Hence, the institutional structure of the draft system remained intact, but its original function to support and maintain a sufficiently large army in Cold War times gradually eroded, paving the way in part for a substantial redeployment for civil and ecological purposes. The importance of these "new" functions can be judged by the fierce debates on the abolishment of the conscription (see *Active and reflective management of decline—instead of leaving it to chance*), in which some argued in favor of keeping the conscription system to maintain the civilian functions.

Second, decline or collapse can be used as an opportunity for a fundamental institutional redesign, instead of more incremental adjustments, as described in archetypes 1 and 2. A case in point is the U.S. town Greensburg, Kansas, which after being hit by a tornado, was completely rebuilt as a green and sustainable city (Brundiers 2016). The physical or built environment was destroyed, which triggered not only a physical but also an institutional rebuild. The notion of a "blank slate" has been introduced to describe such situations (Agrawal 2011). This may occur even with essentially well-functioning systems, which are destroyed by accident, as in the mentioned case, but provide opportunities for change and reorientation, e.g., toward sustainability. So this does not mainly strengthen the immediate functioning of the system, but it provides opportunities for reorientation toward more lasting, sustainable institutional setups. In a similar vein, the notion of a "reset button" has been introduced to characterize disasters, as "what happens in their wake is shaped by historical forces, to be sure, but they also enable greater leveraging power to new resources, fresh endeavors and innovative institutions, because older structures and processes lose at least part of their historical force" (Agrawal 2011:291). Different from a blank slate, however, the reset button is more appropriate to constellations of a somewhat dysfunctional institutional system, grown old and having become too rigid over time, an argument also made in panarchy theory (Carpenter et al. 2002). This refers mostly to the internal functioning of a system.

Active and reflective management of decline—instead of leaving it to chance

In what we describe as our final archetypical pathway, we turn to the constellation in which an existing institution has started to

decline, but where, different from archetype 4, decline can still be halted, and what opportunities and challenges this poses for governance. We argue that the main productive function in such constellations is harnessing the opportunity to reflect and decide on the desirability of a declining, i.e., increasingly dysfunctional, institution. We term this active and reflective decision making, as opposed to letting things happen. Slightly different from the previous archetypes, there is as strong an emphasis on the preservation of institutions as there is on their decline and destabilization. The unregulated decline of existing institutions, as opposed to active and reflective management, is not unproblematic but may give rise to two fundamental, but mutually exclusive challenges. We discuss these, along with potential productive governance responses, by drawing on the case of German conscription, in which the institution of mandatory military service, and connected to it the alternative civil service, was ultimately abolished in the face of a number of growing pressures.

First, if existing but declining institutions are generally still functional and normatively desirable, there is the danger of potentially irreversible loss of institutional elements such as knowledge, networks, or actor capacity (Newig 2013). An active and reflective management of decline could prevent such losses. In cases of beginning institutional exhaustion, decision makers could engage in active reform to halt decline and to prevent an eventual institutional breakdown. In cases of displacement through new institutions, decision makers could engage in preserving or transferring useful elements of the old institution. In cases of drift, decision makers could actively adapt the institution to changing circumstances.

Second, if, on the other hand, the decline of institutions is desirable, but it takes too long for the institution to be fully removed, there is the problem of "cleanup." This occurs if novelty is introduced, but old institutions remain or are at least not fully abolished or replaced. To our knowledge, this has not been treated systematically in the literature. In some cases, this will be inevitable. For example, institutions linked to technologies such as coal-based electricity generation need to be maintained so long as the technology itself still exists. In other cases, transition periods occur to allow for a smooth transition from the old to the new. However, the longer the remnants of old institutions stay, the greater the persisting institutional complexity, associated with greater inefficiencies. A possible response, therefore, is to engage more actively in fully abolishing existing institutions. A policy instrument to prevent the cleanup problem in the first place is sunset legislation. This refers to laws that demand revision or removal after a given time, thus periodically providing for windows of opportunity for institutional change or termination (Geva-May 2004).

The essential point is that active decision making is required on whether a declining institution is still normatively desirable and should be preserved, or elements thereof, or whether it should be abandoned and eliminated sooner rather than later. A case in point is military conscription in Germany. German law stipulated a general conscription of male adults, with those unwilling to perform military service (Wehrdienst) instead allowed to perform alternative civilian service (Zivildienst) in social services such as hospitals and retirement homes. In post–Cold War Germany, the size of the federal army was reduced dramatically, greatly

reducing the number of required draftees. Among other things, this led to an increasingly loose application of examination rules to the effect that only a minority of physically highly capable candidates were drafted, thus leading to increasing injustice in the drafting procedure. Hence, over time, public opposition to compulsory service increased, with important questions arising around its sustainability for the future. The legitimacy of the Wehrdienst was therefore in serious decline, and a decision needed to be made about how to proceed in the future. In 2010, the federal defense minister commissioned a report providing recommendations for the modernization of the German military. It acknowledged that in its current state, the German military was "out of balance, too big, wrongly composed and increasingly old-fashioned" (Strukturkommission der Bundeswehr 2010). Despite initial doubts, in March 2011, the German government replaced mandatory conscription with a voluntary military service of between 6 and 23 months, open to both men and women.

This case can be described as one of "drift" in the sense of Streeck and Thelen (2005), in which the institution of conscription was initially not adapted to the changing circumstances dictated by a smaller army size. With growing opposition, the German government was faced with a decision to either re-establish drafting justice through drafting more men, e.g., at the expense of professional soldiers, or, alternatively, abolish conscription altogether, which is what happened. This decision was in no way inevitable, however, as illustrated by the example of Sweden, which has recently introduced conscription for both men and women. The case exemplifies how active and reflective decision making, involving an expert commission and public and parliamentary debate, successfully halted the unregulated and unsustainable decline of an institution.

Gathering from the evidence of the case, and going beyond, suggests to us the importance of reasoned and reflective societal dialogue to inform active decision making on whether or not to halt decline. This may involve techniques of scenario building or deliberative assessment (Adger and Jordan 2009, Loorbach et al. 2017).

DISCUSSION

As this tour d'horizon of productive functions has shown, there is no single body of literature that captures them all. Many of the pathways we describe have been mentioned in writings on ecology, organizational studies, economics, political science, anthropology, or sociology. Our purpose, therefore, was not to reinvent the wheel, nor to add another dimension of decay. Rather, we sought to identify and discuss some intricacies of the basic pathways, which are summarized in Table 2. In concluding our analysis, we point to some overarching issues for further discussion and reflection.

First, although described as distinct archetypes, the five productive pathways are, of course, not unrelated. On the one hand, they may serve as building blocks for typical sequences. For example, a major institutional change through purposeful destabilization may follow a crisis that reveals deficiencies of existing institutions that are so devastating that incremental adaptation and adjustment are deemed no longer sufficient. On the other hand, whether something is viewed as, for example, crisis response or as active dismantling may depend on the level of abstraction. Similarly, purposeful destabilization may happen in situations of already beginning decline. The notion of the reset

button, discussed in the fourth archetype, bears some similarities to adaptation in the wake of crisis: In both constellations, inevitable institutional degradation is occurring, but in the latter, this appears through a focusing event, i.e., crisis, and typically relates to specific weaknesses revealed, whereas in the former, a gradual but thorough decline may suggest a rethinking to institutional regime actors. The cleanup mechanism, discussed in the final archetype, may also be relevant to purposeful destabilization. However, in the latter, the main focus is on how to achieve the destabilization as such, whereas in the former, decline is happening anyhow.

Second, a few metatopics emerge across the archetypical pathways. One concerns the issue of stability versus change, as indicated previously (e.g., see Table 2). Although we are mostly concerned with change as a feature of decline and destabilization, this cannot be conceptualized without considering stability as the other side of the coin. Thus, in the first two archetypes, there is a normative aspiration toward functioning, i.e., functionally stable, institutions; restabilization is an issue in archetypes 3 and 5 and most explicitly discusses the desirability of institutional decline versus stability. A second metatopic relates to innovation. Although we started from the observation of a biased preoccupation with innovation, the archetypes we presented are nevertheless interspersed with references to innovation. We find innovation in the course of adaptation after crisis, as innovation adoption in the course of learning from failure, as alternatives to a destabilized institution, and, most notably, as innovating in the face of inevitable decline. However, we highlighted that, at the same time, decline may be an inevitable, yet often neglected component of innovation as well: Innovating existing institutions will go hand in hand with overcoming or dismantling of those institutions, or at least part of them. Learning constitutes another metatopic, most notably in archetypes 1 and 2. Whereas the latter builds on the record of existing experiences, the former requires crisis as a focusing event to enable effective learning. Although learning in the wake of crisis is merely reactive, systematic learning in the second archetype requires a more active search for relevant experiences. However, we have deliberately left out a learning mechanism that is yet more proactive in targeting effective learning on the effectiveness and improvability of an institution: policy experimentation, potentially as part of an adaptive governance strategy (Koontz et al. 2015). Policy experiments, in the best case, succeed and then do not involve failure. However, arguably much of the literature on policy experimentation is too much concerned with how local "experiments" can be "upscaled" and mainstreamed, implicitly assuming their success. In this literature, including that on experimentation in adaptive governance, there is currently too little recognition that experiments may also fail. Only if the potential negative outcome of experiments is fully recognized will they serve an effective learning function, rather than one of merely piloting (see Sanderson 2002).

Both of these aspects, relations among and metatopics across the archetypical pathways, demonstrate how the individual pathways hang together. This reinforces our view that the productive functions of institutional failure and decline ought to be discussed in conjunction, as we propose.

Third, despite relying on a structural functionalist perspective, we acknowledge that politics, bargaining, and societal conflicts play

important roles in the archetypical pathways we present. None of the archetypes unfolds in a natural manner but can be interpreted as the instance or outcome of a process of societal bargaining. This may be most obvious in the archetype on purposeful destabilization or reflective management in the face of decline, which entails almost by definition conflict and societal struggle, but holds also for the other archetypes. Productive outcomes realized through learning from failure and adaptation in the wake of crises also require the introduction and negotiation of alternative ideas, knowledge, and perspectives and, hence, can be interpreted as the product of conflictive societal processes. Exploring the proposed archetypes through the perspectives of conflict theories may provide a means to bring closer together functionalist ideas strongly embedded in social-ecological and socio-technical systems thinking with core ideas of the social sciences (see Olsson et al. 2015, Hahn and Nykvist 2017).

Finally, we see that failure and decline cannot be discussed without explicit reference to normativity. Some failure is bad, other failures are desirable and intelligent. Our focus has been on the role of productive pathways for enhancing sustainability. Although sustainability outcomes are by no means automatic, we assume sustainability goals to be given (see Brundiers 2016). This is not unproblematic in the context of failure and decline. The sustainability of subsystems may come at the expense of higher order systems stability/sustainability: "Sustainability or increased longevity of components, be they cultural or ecological, may be limiting for the adaptation and sustainability of the whole" (Voinov and Farley 2007:105).

CONCLUSION

To conclude, we highlight two considerations, one conceptual and one empirical, that we deem important for future work. On a conceptual level, we have approached productive functions of failure and decline mostly from a governance perspective. In that we assume decision makers to be generally interested in sustainability and the common good, our approach is thus prone to the "problem-solving bias of governance" identified by Mayntz (2004). Others, such as Bovens and 't Hart (1996), Boin et al. (2008), Galaz et al. (2011), or Bauer and Knill (2014), have discussed the politics around failure, crisis, and dismantling, turning attention to the strategic motives of decision makers. Such considerations are essential for understanding how the potential of productive functions can be harnessed under real conditions. We would encourage fellow researchers to continue on this road of linking analytical strands of institutional change literature to the more intervention-oriented governance literature. In this context, it will be important for future work, as outlined previously, to more closely scrutinize the role of conflict, agency, and particular actors in the institutional change processes. Where our treatment of archetypical mechanisms has admittedly remained on a relatively abstract level, further research will have to disentangle institutional regimes, taking a microperspective on individual and collective actors and their potentially productive roles in institutional failure and decline.

Earlier work has found surprisingly little empirical evidence on the productive aspects of failure and decline (Derwort et al. 2018). We presented what to us appear the most promising archetypical pathways to harness the productive potential of institutional failure and decline. We hope that the conceptual distinctions made in this contribution will spark, facilitate, and structure further conceptual and empirical research. On a conceptual level, further refinement, expansion and/or simplification of the set of five archetypical pathways may further strengthen the framework. As regards empirical challenges, there is a clear need to understand under what circumstances the pathways will hold. How can institutions be built in a way that systematic learning from failure and institutional adaptation after crises happen? How and when are unsustainable institutions likely to be destabilized, paving the way for more sustainable solutions? As a research agenda, we suggest testing the propositions we have made by identifying empirical accounts on productive functions in the literature and the boundary conditions under which they have worked or not, respectively. In particular, we propose a large-N comparative (meta-)study of institutional dynamics along the outlined five productive functions, potentially across different countries and decades. This should allow us to gain a clearer understanding of the pathways at work and of the conditions under which institutional decline does indeed prove productive and where it does not.

[1] We define social structure as "stable patterns within society on a supra-individual (emergent) level" (Newig et al. 2010). Not all social structures are institutions; social structure also comprises the "relational structure," e.g., networks of actors.

[2] When we talk of adaptation, we should beware not to confuse this with the concept of adaptive management or governance. This draws on explicit experimentation to learn from policy interventions, i.e., trial and error learning, whereas we are concerned with unintended experimentation through crisis.

[3] In Kingdon's (1999) terms, this is where the stream of policy solutions meets a redirected politics stream and thus generates the momentum necessary for reform.

[4] From a different theoretical tradition, but to the same effect, social systems theorist Luhmann (1995) described social systems as systems with "temporalized complexity," in which regular disintegration paves the way for novel elements, such that a constant renewal of systems elements is ensured in a process of dynamic rather than static stability. In this sense, crises are seen as a constituent part of a functioning societal "immune system."

[5] A notable exception constitutes works on case selection that explicitly contrast successes with failures (see, e.g., Eisenhardt 1989, Kimmich and Villamayor Tomas 2018).

[6] Such forms of gradual institutional decline through non–decision making are similar to what Bauer and Knill (2014) term "policy dismantling by default," although they presuppose deliberate inaction by policy makers.

[7] Although seemingly similar to archetype 1, there is an important difference, namely, that in archetype 1, crisis does not jeopardize or outright replace the institution as such but merely reveals deficiencies that can be attended to.

[8] This parallels debates on "green drift," in which existing institutions are converted to more sustainable ones (Sousa and McGrory Klyza 2017).

Responses to this article can be read online at:
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LITERATURE CITED

Abson, D. J., J. Fischer, J. Leventon, J. Newig, T. Schomerus, U. Vilsmaier, H. von Wehrden, P. Abernethy, C. D. Ives, N. W. Jager, and D. J. Lang. 2017. Leverage points for sustainability transformation. *Ambio: A Journal of the Human Environment* 46:30-39. http://dx.doi.org/10.1007/s13280-016-0800-y

Acheson, J. M. 2006. Institutional failure in resource management. *Annual Review of Anthropology* 35:117-134. http://dx.doi.org/10.1146/annurev.anthro.35.081705.123238

Adger, W. N., and A. Jordan. 2009. Sustainability: exploring the processes and outcomes of governance. Pages 3-31 *in* N. W. Adger and A. Jordan, editors. *Governing sustainability*. Cambridge University Press, Cambridge, UK. http://dx.doi.org/10.1017/CBO9780511807756.003

Agrawal, A. 2011. Economics: a positive side of disaster. *Nature* 473(7347):291-292. http://dx.doi.org/10.1038/473291a

Arthur, W. B. 1989. Competing technologies, increasing returns, and lock-in by historical events. *Economic Journal* 99:116-131. http://dx.doi.org/10.2307/2234208

Bardach, E. 2004. Presidential address—the extrapolation problem: how can we learn from the experience of others? *Journal of Policy Analysis and Management* 23:205-220. http://dx.doi.org/10.1002/pam.20000

Bardach, E. 2006. Policy dynamics. Pages 336-366 *in* M. Moran, M. Rein, and R. E. Goodin, editors. *The Oxford handbook of public policy*. Oxford University Press, New York, New York, USA.

Bauer, M. W., and C. Knill. 2014. A conceptual framework for the comparative analysis of policy change: measurement, explanation and strategies of policy dismantling. *Journal of Comparative Policy Analysis: Research and Practice* 16:28-44. http://dx.doi.org/10.1080/13876988.2014.885186

Birkland, T. A. 1997. *After disaster: agenda setting, public policy, and focusing events.* Georgetown University Press, Washington, D.C., USA.

Birkland, T. A. 2009. Disasters, lessons learned, and fantasy documents. *Journal of Contingencies and Crisis Management* 17:146-156. http://dx.doi.org/10.1111/j.1468-5973.2009.00575.x

Blühdorn, I. 2013. The governance of unsustainability: ecology and democracy after the post-democratic turn. *Environmental Politics* 22:16-36. http://dx.doi.org/10.1080/09644016.2013.755005

Boin, A., A. McConnell, and P. 't Hart, editors. 2008. *Governing after crisis: the politics of investigation, accountability and learning*. Cambridge University Press, Cambridge, UK. http://dx.doi.org/10.1017/CBO9780511756122

Boin, A., P. 't Hart, E. Stern, and B. Sundelius. 2005. *The politics of crisis management: public leadership under pressure*. Cambridge University Press, Cambridge, UK. http://dx.doi.org/10.1017/CBO9780511490880

Bovens, M. A. P., and P. 't Hart. 1996. *Understanding policy fiascoes.* Transaction, New Brunswick, New Jersey, USA.

Bovens, M., and P. 't Hart. 2016. Revisiting the study of policy failures. *Journal of European Public Policy* 23(5):653-666. http://dx.doi.org/10.1080/13501763.2015.1127273

Brundiers, K. 2016. *Disasters as opportunities for change towards sustainability*. Dissertation. Arizona State University, Tempe, Arizona, USA.

Carpenter, R. A., W. A. Brock, and D. Ludwig. 2002. Collapse, learning, and renewal. Pages 173-193 *in* L. H. Gunderson and C. S. Holling, editors. *Panarchy: understanding transformations in human and natural systems*. Island, Washington, D.C., USA.

Carrington, D. 2018. EU agrees total ban on bee-harming pesticides. *Guardian*. 27 April. [online] URL: https://www.theguardian.com/environment/2018/apr/27/eu-agrees-total-ban-on-bee-harming-pesticides

Chapin, F. S., III, S. R. Carpenter, G. P. Kofinas, C. Folke, N. Abel, W. C. Clark, P. Olsson, D. M. Stafford Smith, B. Walker, O. R. Young, F. Berkes, R. Biggs, J. M. Grove, R. L. Naylor, E. Pinkerton, W. Steffen, and F. J. Swanson. 2010. Ecosystem stewardship: sustainability strategies for a rapidly changing planet. *Trends in Ecology & Evolution* 25(4):241-249. http://dx.doi.org/10.1016/j.tree.2009.10.008

Coletti, P. 2015. Public policy design: how to learn from failures. *World Political Science* 11:325-345. http://dx.doi.org/10.1515/wps-2015-0008

David, M. 2017. Moving beyond the heuristic of creative destruction: targeting exnovation with policy mixes for energy transitions. *Energy Research and Social Science* 33:138-146. http://dx.doi.org/10.1016/j.erss.2017.09.023

Department for Business, Energy and Industrial Strategy. 2018. *Implementing the end of unabated coal by 2025: government response to unabated coal closure consultation*. Department for Business, Energy and Industrial Strategy, UK Government, London, UK.

Derwort, P., N. Jager, and J. Newig. 2018. Towards productive functions? A systematic review of institutional failure, its causes and consequences. *Policy Sciences, in press*. http://dx.doi.org/10.1007/s11077-018-9339-z

Diamond, J. 2005. *Collapse: how societies choose to fail or succeed.* Viking, New York, New York, USA.

Dolowitz, D. P., and D. Marsh. 2000. Learning from abroad: the role of policy transfer in contemporary policy-making. *Governance* 13:5-23. http://dx.doi.org/10.1111/0952-1895.00121

Drazen, A., and W. Easterly. 2001. Do crises induce reform? Simple empirical tests of conventional wisdom. *Economics and Politics* 13:129-157. http://dx.doi.org/10.1111/1468-0343.00087

Eburn, M., and S. Dovers. 2015. Learning lessons from disasters: alternatives to royal commissions and other quasi-judicial

inquiries. *Australian Journal of Public Administration* 74 (4):495-508. http://dx.doi.org/10.1111/1467-8500.12115

Eisenhardt, K. M. 1989. Building theories from case study research. *Academy of Management Review* 14(4):532-550. https://doi.org/10.5465/amr.1989.4308385

Fiol, M., and E. O'Connor. 2017. Unlearning established organizational routines – part I. *Learning Organization* 24:13-29. http://dx.doi.org/10.1108/TLO-09-2016-0056

Fischer, L.-B., and J. Newig. 2016. Importance of actors and agency in sustainability transitions: a systematic exploration of the literature. *Sustainability* 8(5):476. http://dx.doi.org/10.3390/su8050476

Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. 2010. Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society* 15(4):20. http://dx.doi.org/10.5751/ES-03610-150420

Franco, A., N. Malhotra, and G. Simonovits. 2014. Publication bias in the social sciences: unlocking the file drawer. *Science* 345 (6203):1502-1505. http://dx.doi.org/10.1126/science.1255484

Frantzeskaki, N. 2011. *Dynamics of societal transitions: driving forces and feedback loops*. Dissertation. Delft University of Technology, Delft, The Netherlands.

Fukuyama, F. 2014. *Political order and political decay*. Profile Books, London, UK.

Galaz, V., F. Moberg, E. K. Olsson, E. Paglia, and C. Parker. 2011. Institutional and political leadership dimensions of cascading ecological crises. *Public Administration* 89(2):361-380. http://dx.doi.org/10.1111/j.1467-9299.2010.01883.x

Geddes, B., J. Wright, and E. Frantz. 2014. Autocratic breakdown and regime transitions: a new data set. *Perspectives on Politics* 12 (2):313-331. http://dx.doi.org/10.1017/S1537592714000851

Geels, F. W., and J. Schot. 2007. Typology of sociotechnical transition pathways. *Research Policy* 36:399-417. http://dx.doi.org/10.1016/j.respol.2007.01.003

Gelcich, S., T. P. Hughes, P. Olsson, C. Folke, O. Defeo, M. Fernández, S. Foale, L. H. Gunderson, C. Rodríguez-Sickert, M. Scheffer, R. S. Steneck, and J. C. Castilla. 2010. Navigating transformations in governance of Chilean marine coastal resources. *Proceedings of the National Academy of Sciences of the United States of America* 107:16794-16799. http://dx.doi.org/10.1073/pnas.1012021107

Geva-May, I. 2004. Riding the wave of opportunity: termination in public policy. *Journal of Public Administration Research and Theory* 14:309-333. http://dx.doi.org/10.1093/jopart/muh020

Gunderson, L. H., and C. S. Holling, editors. 2002. *Panarchy: understanding transformations in human and natural systems*. Island, Washington, D.C., USA.

Hahn, T., and B. Nykvist. 2017. Are adaptations self-organized, autonomous, and harmonious? Assessing the social–ecological resilience literature. *Ecology and Society* 22(1):12. http://dx.doi.org/10.5751/ES-09026-220112

Hall, P. A. 1993. Policy paradigms, social learning, and the state: the case of economic policymaking in Britain. *Comparative Politics* 25:275-296. http://dx.doi.org/10.2307/422246

Homer-Dixon, T. F. 2006. *The upside of down: catastrophe, creativity and the renewal of civilization*. Island, Washington, D. C., USA.

Howlett, M. 2012. The lessons of failure: learning and blame avoidance in public policy-making. *International Political Science Review* 33:539-555. http://dx.doi.org/10.1177/0192512112453603

Howlett, M., and M. Ramesh. 2014. The two orders of governance failure: design mismatches and policy capacity issues in modern governance. *Policy and Society* 33(4):317-327. http://dx.doi.org/10.1016/j.polsoc.2014.10.002

Illical, M., and K. Harrison. 2007. Protecting endangered species in the US and Canada: the role of negative lesson drawing. *Canadian Journal of Political Science* 40(2):367-394. http://dx.doi.org/10.1017/S0008423907070175

Jaeger-Erben, M., J. Rückert-John, and M. Schäfer. 2015. Sustainable consumption through social innovation: a typology of innovations for sustainable consumption practices. *Journal of Cleaner Production* 108A:784-798. http://dx.doi.org/10.1016/j.jclepro.2015.07.042

Jones, B. D., and F. R. Baumgartner. 2012. From there to here: punctuated equilibrium to the general punctuation thesis to a theory of government information processing. *Policy Studies Journal* 40(1):1-20. http://dx.doi.org/10.1111/j.1541-0072.2011.00431.x

Kimmich, C., and S. Villamayor Tomas. 2018. Assessing action situation networks: a configurational perspective on water and energy governance in irrigation systems. *Water Economics and Policy, in press*. http://dx.doi.org/10.1142/S2382624X18500054

Kingdon, J. W. 1999. *Agendas, alternatives, and public policies*. [Original work published in 1984.] Longman, New York, New York, USA.

Kivimaa, P., and F. Kern. 2016. Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. *Research Policy* 45(1):205-217. http://dx.doi.org/10.1016/j.respol.2015.09.008

Koontz, T. M., D. Gupta, P. Mudliar, and P. Ranjan. 2015. Adaptive institutions in social-ecological systems governance: a synthesis framework. *Environmental Science & Policy* 53B:139-151. http://dx.doi.org/10.1016/j.envsci.2015.01.003

Leroy, P., and B. Arts. 2006. *Institutional dynamics in environmental governance*. Springer, Dordrecht, The Netherlands.

Loorbach, D., N. Frantzeskaki, and F. Avelino. 2017. Sustainability transitions research: transforming science and practice for societal change. *Annual Review of Environment and Resources* 42:599-626. http://dx.doi.org/10.1146/annurev-environ-102014-021340

Luhmann, N. 1995. *Social systems*. [Original work published in 1984.] Stanford University Press, Stanford, California, USA.

Macionis, J. H., and L. M. Gerber. 2010. *Sociology*. Seventh Canadian edition. Pearson Canada, Toronto, Ontario, Canada.

Mahoney, J., and K. Thelen. 2010. A theory of gradual institutional change. Pages 1-37 *in* J. Mahoney and K. Thelen, editors. *Explaining institutional change: ambiguity, agency, and power*. Cambridge University Press, New York, New York, USA.

Mattijssen, T. J. M., J. H. Behagel, and A. E. Buijs. 2015. How democratic innovations realise democratic goods. Two case studies of area committees in the Netherlands. *Journal of Environmental Planning and Management* 58:997-1014. http://dx. doi.org/10.1080/09640568.2014.905460

Mayntz, R. 2004. *Governance Theory als fortentwickelte Steuerungstheorie?* MPIfG Working Paper 04/1. Max-Planck-Institut für Gesellschaftsforschung, Köln, Germany.

McConnell, A. 2015. What is policy failure? A primer to help navigate the maze. *Public Policy and Administration* 30 (3-4):221-242. http://dx.doi.org/10.1177/0952076714565416

McGuire, S., and C. Hardy. 2009. Discourse and deinstitutionalization: the decline of DDT. *Academy of Management Journal* 52(1):148-178. http://dx.doi.org/10.5465/amj.2009.36461993

Meadowcroft, J., and D. J. Fioriono. 2017. *Conceptual innovation in environmental policy*. MIT Press, Cambridge, Massachusetts, USA. http://dx.doi.org/10.7551/mitpress/9780262036580.001.0001

Newig, J. 2013. Produktive Funktionen von Kollaps und Zerstörung für gesellschaftliche Transformationsprozesse in Richtung Nachhaltigkeit. Pages 133-149 *in* J. Rückert-John, editor. *Soziale Innovation und Nachhaltigkeit*. Springer VS, Wiesbaden, Germany. http://dx.doi.org/10.1007/978-3-531-18974-1_8

Newig, J., D. Günther, and C. Pahl-Wostl. 2010. Synapses in the network: learning in governance networks in the context of environmental management. *Ecology and Society* 15(4):24. http://dx.doi.org/10.5751/ES-03713-150424

Newig, J., E. Kochskämper, E. Challies, and N. W. Jager. 2016. Exploring governance learning: how policymakers draw on evidence, experience and intuition in designing participatory flood risk planning. *Environmental Science & Policy* 55:353-360. http://dx.doi.org/10.1016/j.envsci.2015.07.020

North, D. C. 1990. *Institutions, institutional change and economic performance*. Cambridge University Press, Cambridge, UK. http://dx.doi.org/10.1017/CBO9780511808678

Oliver, C. 1992. The antecedents of deinstitutionalization. *Organization Studies* 13(4):563-588. http://dx.doi.org/10.1177/017084069201300403

Olsson, L., A. Jerneck, H. Thoren, J. Persson, and D. O'Byrne. 2015. Why resilience is unappealing to social science: theoretical and empirical investigations of the scientific use of resilience. *Science Advances* 1(4):e1400217. http://dx.doi.org/10.1126/sciadv.1400217

Overman, E. S., and K. J. Boyd. 1994. Best practice research and postbureaucratic reform. *Journal of Public Administration Research and Theory* 4:67-83.

Pahl-Wostl, C. 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change* 19:354-365. http://dx.doi.org/10.1016/j.gloenvcha.2009.06.001

Pelling, M., and K. Dill. 2010. Disaster politics: tipping points for change in the adaptation of sociopolitical regimes. *Progress in Human Geography* 34:21-37. http://dx.doi.org/10.1177/0309132509105004

Peters, B. G. 2015. State failure, governance failure and policy failure: exploring the linkages. *Public Policy and Administration* 30(3-4):261-276. http://dx.doi.org/10.1177/0952076715581540

Røpke, I. 2012. The unsustainable directionality of innovation – the example of the broadband transition. *Research Policy* 41:1631-1642. http://dx.doi.org/10.1016/j.respol.2012.04.002

Sanderson, I. 2002. Evaluation, policy learning and evidence-based policy making. *Public Administration* 80:1-22. http://dx.doi.org/10.1111/1467-9299.00292

Schaltegger, S., and M. Wagner. 2011. Sustainable entrepreneurship and sustainability innovation: categories and interactions. *Business Strategy and the Environment* 20:222-237. http://dx.doi.org/10.1002/bse.682

Scharpf, F. W. 1997. *Games real actors play: actor-centered institutionalism in policy research*. Westview Press, Boulder, Colorado, USA.

Schumpeter, J. A. 1950. Der Prozess der schöpferischen Zerstörung. Pages 134-142 *in* J. A. Schumpeter, editor. *Kapitalismus, Sozialismus und Demokratie*. A. Francke Verlag, Tübingen, Germany.

Schwabach, A. 1989. The Sandoz spill: the failure of international law to protect the Rhine from pollution. *Ecology Law Quarterly* 16:443-480.

Scott, J. C. 1998. *Seeing like a state: how certain schemes to improve the human condition have failed*. Yale University Press, New Haven, Connecticut, USA.

Seto, K. C., S. J. Davis, R. B. Mitchell, E. C. Stokes, G. Unruh, and D. Ürge-Vorsatz. 2016. Carbon lock-in: types, causes, and policy implications. *Annual Review of Environment and Resources* 41:425-452. http://dx.doi.org/10.1146/annurev-environ-110615-085934

Shove, E. 2012. The shadowy side of innovation: unmaking and sustainability. *Technology Analysis and Strategic Management* 24:363-375. http://dx.doi.org/10.1080/09537325.2012.663961

Sitkin, S. B. 1996. Learning through failure: the strategy of small losses. Pages 541-578 *in* M. D. Cohen and L. S. Sproull, editors. *Organizational learning*. Sage, Thousand Oaks, California, USA.

Smith, A., J.-P. Voß, and J. Grin. 2010. Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges. *Research Policy* 39:435-448. http://dx.doi.org/10.1016/j.respol.2010.01.023

Sousa, D. J., and C. McGrory Klyza. 2017. "Whither we are tending": interrogating the retrenchment narrative in U.S. environmental policy. *Political Science Quarterly* 132(3):467-494. https://doi.org/10.1002/polq.12659

Stern, E. 1997. Crisis and learning: a conceptual balance sheet. *Journal of Contingencies and Crisis Management* 5:69-86. http://dx.doi.org/10.1111/1468-5973.00039

Stone, D. 2012. Agents of knowledge. Pages 339-352 *in* D. Levi-Faur, editor. *The Oxford handbook of governance.* Oxford University Press, New York, New York, USA. http://dx.doi.org/10.1093/oxfordhb/9780199560530.013.0024

Stone, D. 2017. Understanding the transfer of policy failure: bricolage, experimentalism and translation. *Policy and Politics* 45:55-70. http://dx.doi.org/10.1332/030557316X14748914098041

Streeck, W., and K. Thelen. 2005. Introduction: institutional change in advanced political economies. Pages 1-39 *in* W. Streeck and K. Thelen, editors. *Beyond continuity: institutional change in advanced political economies*. Oxford University Press, Oxford, UK.

Strukturkommission der Bundeswehr. 2010. *Vom Einsatz Her Denken: Konzentration, Flexibilität, Effizienz*. Strukturkommission der Bundeswehr, Berlin, Germany.

Sveiby, K.-E., P. Gripenberg, and B. Segercrantz, editors. 2012. *Challenging the innovation paradigm*. Routledge, New York, New York, USA.

Thelen, K. 1999. Historical institutionalism in comparative politics. *Annual Review of Political Science* 2:369-404. http://dx.doi.org/10.1146/annurev.polisci.2.1.369

Turnheim, B., and F. W. Geels. 2013. The destabilisation of existing regimes: confronting a multi-dimensional framework with a case study of the British coal industry (1913–1967). *Research Policy* 42:1749-1767. http://dx.doi.org/10.1016/j.respol.2013.04.009

Voinov, A., and J. Farley. 2007. Reconciling sustainability, systems theory and discounting. *Ecological Economics* 63(1):104-113. http://dx.doi.org/10.1016/j.ecolecon.2006.10.005

Volden, C. 2016. Failures: diffusion, learning, and policy abandonment. *State Politics & Policy Quarterly* 16:44-77. http://dx.doi.org/10.1177/1532440015588910

Westley, F., P. Olsson, C. Folke, T. Homer-Dixon, H. Vredenburg, D. Loorbach, J. Thompson, M. Nilsson, E. Lambin, J. Sendzimir, B. Banerjee, V. Galaz, and S. van der Leeuw. 2011. Tipping toward sustainability: emerging pathways of transformation. *Ambio: A Journal of the Human Environment* 40:762-780. http://dx.doi.org/10.1007/s13280-011-0186-9

Wieriks, K., and A. Schulte-Wülwer-Leidig. 1997. Integrated water management for the Rhine river basin, from pollution prevention to ecosystem improvement. *Natural Resources Forum: A United Nations Sustainable Development Journal* 21:147-156. http://dx.doi.org/10.1111/j.1477-8947.1997.tb00686.x

How to explain major policy change towards sustainability? Applying the Multiple Streams Framework and the Multi-Level Perspective on Socio-Technical Transitions to the German 'Energiewende'

1 Introduction

Explaining major policy change still is one of the great challenges to the policy sciences. While a number of theories and frameworks are available, the explanation of any given major policy change remains difficult (John 2003; Heikkila et al. 2014). This is especially the case with issues where policy change involves the change of technology and large infrastructure – as it applies to many sustainability-related issues that humanity is currently facing (Kanie et al. 2012; Meadowcroft 2009; Dryzek 2016). One instance of a fundamental, policy-guided shift towards sustainability is currently under way with the German energy transition, aiming to replace nuclear and fossil-fuel electricity generation with a renewables-based one. While changes of policy tools and instruments are common in policymaking, a major institutional change such as the German Energiewende – constituting a massive deviance from the politics-as-usual – is very particular and asks for close scrutiny.

Explaining such major shifts in policy and societal change more generally will be of great value for all those engaging in the governance of such transformation (Westley et al. 2012, Meadowcroft 2009, Patterson et al. 2017). Identifying and understanding the crucial dynamics and processes that drive the key decisions and developments that initiate, guide and maintain such transformations will be essential for policy-makers in different parts of the globe. Hence, we seek to analyse the case of the German Energiewende to gather such insights on the governance of societal transformations.

Recent contributions (see e.g. van der Heijden 2013; Cairney 2013) have called for a more plural use of theories to produce new perspectives and research agendas. To this end, we draw on two theoretical frameworks with complementary foci that help structure and guide the analysis: Lending from policy sciences, John Kingdon's (1999) Multiple Streams Framework (MSF) focuses on political factors including the role of public opinion to explain why some policy alternatives come about. Second, we draw on the socio-technical transitions literature that

explicitly considers the role of technological innovations and industry dynamics for explaining fundamental regime shifts towards sustainability. Building on innovation studies and evolutionary economics, the Multi-Level Perspective (MLP) on transitions (Kemp 1994; Geels 2002; Geels and Schot 2007), explains regime shifts through an interplay of dynamics in socio-technical regimes, technological niches, and contextual conditions (landscape). While generalization from one single case is always challenging, applying the two conceptual frameworks helps to identify factors and actor constellations in a more abstract sense, thus increasing the possibility to learn from this case and more systematically compare with others.

As argued by Ostrom (2005), it is necessary to draw on the foundations of many different theories and disciplines to adequately explain changes in complex systems. Energy systems, consisting of a wide range of actors and technologies and governed through institutional and political structures, are a good example of such complex systems (Bale et al. 2015). The application of multiple theoretical frameworks in energy transitions processes allows scholars to deal with this complexity (Turnheim et al. 2015; Geels et al. 2016a; Kern and Rogge 2018). Meadowcroft (2009, 2011) stressed the relevance of political science in understanding sustainability transitions, calling for the inclusion of interests, institutions and ideas in studies of energy transitions. In applying different lenses to the case of the German Energiewende, this article joins past attempts at the cross-fertilization of theories. A number of recent publications have applied the MSF and transition management lenses to British climate change and energy policy (Carter and Jacobs 2014), to the case of local transportation Phoenix, Arizona (Harlow et al. 2018) and the development of low-carbon energy scenarios in illiberal democracies in Latin America (Noboa and Upham 2018). Transitions research on Germany's energy transition has also been combined with other frameworks, such as discursive approaches (e.g. Leipprand and Flachsland 2018). Others argue in favour of the integration of existing theoretical frameworks, with Cherp et al. (2018) developing a meta-theoretical framework of techno-economic, socio-technical and political perspectives, using a brief discussion of the transition of Germany's electricity system as an illustrative application.

The remainder of the article proceeds as follows. In the subsequent section (2), we briefly introduce the selected frameworks and their *explanans* for institutional change through the 'policy window' and 'window of opportunity'. We will then (3) briefly discusses the research methodology. The main section of the article (4) introduces the case and applies the two frameworks to Germany's Energiewende, setting out in detail how a series of key developments paved the way for the country's current energy transition. In the penultimate section (5), we compare the two frameworks in terms of their analytical strength, discuss to what extent the

narratives presented complement each other, and identify gaps in the approaches. We close by offering the conclusions of our research and outlining avenues for further research (6).

2 Two complementary lenses to explain major policy change

We argue in this paper that the two theoretical approaches of the Multiple Streams Framework (MSF) and the Multi-Level Perspective on socio-technical transitions (MLP) can help explain the transformational change that is the 'Energiewende'. We start in this section by outlining how each of the frameworks understands change to take place, with the MSF strongly focusing on the political factors behind policy change, and the MLP looking at the intertwined role of technological and societal factors in bringing about regime shifts. Table 1 below outlines both the phenomenon explained by each framework (the explanandum), as well as the mechanisms through which it explains it (the explanans).

Table 1: Description of selected theoretical frameworks

Name of the Framework	Original Source	Explanandum of the framework	Explanans of the framework
Multiple-Streams Framework (MSF)	Kingdon (1984)	Explaining agenda-setting dynamics: Why do some issues move up on the agenda of decision-makers, while others do not?	Policy process consists of three largely independent streams (problem, policy, politics) which may be coupled by policy entrepreneurs at the right time ('policy windows'), resulting in policy change
Multi-level Perspective (MLP)	Geels (2002)	Explaining socio-technical transitions: In particular, how do niche-innovations break through on mainstream markets ('socio-technical regimes')?	Regime shifts come about through interacting processes on three levels (niche, regime, landscape): radical innovations emerge in niches which may break through on markets if landscape developments create pressures on the regime and create a 'window of opportunity' for change.

Although formally independent, we argue here that the *explanandums* of both frameworks overlap or even coincide to a considerable degree. Consistent with the overall assumption that fundamental societal transformation such as the Energiewende entails change in many societal 'subsystems', we presuppose that both policy change *and* technological innovation are required for an effective energy transition. We furthermore conjecture that these two, while analytically separate, are largely (inter-) dependent processes, which we will elaborate in our empirical analysis. Lastly, the two frameworks touch on many common themes with respect to processes and barriers to major shifts in policy direction (MacRae and Winfield 2016) and in their

explanans both rely on the idea of a 'window' in which change can take place. Hence, it is the overall aim of this paper to compare these two theories, using a case study of the German Energiewende, to explain in a more nuanced and complete way how major societal and policy change can take place.
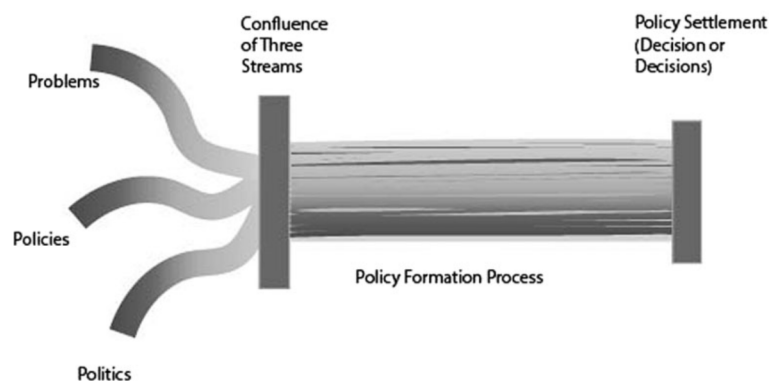
2.1 MSF: Explaining policy change through the convergence of multiple streams

The MSF (Kingdon 1984) is one of the most well-known approaches to study the policy process for those who aim to understand how specific policy decisions may come about (Jones et al. 2016). The framework emphasizes the complexity of policy-making, including the ambiguity of individual behaviour, the importance of situational configurations, and of chance events (Carter & Jacobs 2014; Zahariadis 2014; Bandelow et al. 2019; Capano 2009) – features essential to any analysis of energy policy and its transitions. In broad terms, the approach asks why some issues become prominent on the policy agenda, while others are ignored, and why some policy alternatives are seriously considered, while others are not (Kingdon's (1984)). While increased attention does not generate substantive policy change automatically, agenda-setting literature provides abundant evidence that heightened political attention can result in such change (Carter & Jacobs 2014). In this vein, it has been widely employed to assess instances of major policy change the field of energy policy, but also many others (e.g. Harlow et al 2018; Carter & Jacobs 2014; Bandelow et al. 2019; Kagan 2018; Kammermann 2018).

The MSF argues that major policy shifts occur when the three 'streams' of problems, policy and politics converge and open a policy window for change. The 'problem stream' refers to problems in society that are considered to require attention (Howlett et al. 2015). They usually come to political attention through indicators, feedback from existing programs, or through focusing events like crises or disasters that draw critical attention (Herweg et al. 2017; Birkland & Warnement 2015). The 'policy stream', or 'solution stream' contains a variety of potential policy proposals developed by policy makers, specialists, academics and lobby groups sharing a common concern. Kingdon (2011, 116) originally perceives these ideas to float around in a policy "primeval soup". To be considered seriously as a policy option, an idea must meet certain 'survival criteria', such as technical feasibility, value acceptability, public acquiescence, and financial viability (Herweg et al. 2017, 23). Finally, 'politics stream' comprises factors such as national mood and public opinion, interest group campaigns, election results, changes in the administration, and legislative turnover (Whiteford et al. 2016; Béland and Howlett 2016). In this stream majorities for proposals are sought by means of bargaining and power (Herweg et al. 2017).

While these streams are perceived to operate largely independent of each other, there are rare moments where these converge, opening up a policy window (see Fig.1): That is, a problem is recognised, a viable solution is available, *and* political developments and the national mood make it the right time for policy change (Kingdon, 1999). These windows are exploited by policy entrepreneurs, who can influence the policy process by coupling the three streams together (Mintrom and Norman 2009; Weible and Schlager 2016), in order "to push their pet solutions, or to push attention to their special problem" (Kingdon 2011, 165) and foster policy change in their desired direction.

Policy entrepreneurs work either in or around policymaking venues – in elected or appointed positions, interest groups or research organisations (Kingdon, 1984). In order to be successful, they must act swiftly to focus political attention to specific problems and indicate an acceptable policy solution (Whiteford et al. 2016). The process of coupling itself is a 'search for fit' (Carter & Jacobs 2014, 127). The MSF literature (Zahariadis 2003) distinguishes between consequential coupling, where the policy window opens from the problem stream through the emergence of a problem building political pressure and stimulating policy action by decision-makers; and doctrinal coupling, where the window opens from the political stream triggering a search for the problem that matches the pre-existing solution.

Fig. 1: Three-Stream Framework (Source: Howlett et al. 2015)

2.2 MLP: Explaining socio-technical regime change through niche-regime-landscape interactions

Rather than being designed to explain individual instances of policy change, the MLP (Geels 2005; Geels et al. 2017) seeks to explain how innovations emerge and may lead over a longer period of time to multi-dimensional socio-technical transitions, i.e. shifts in socio-technical regimes (Dóci et al. 2015). The perspective has gained considerable attention in the study of fundamental, systemic societal change, especially in areas that contain a strong technological

aspect, such as energy (e.g. Geels et al. 2016), but also in others, e.g. agriculture (e.g. Hörisch 2018) or the field of transportation and mobility (e.g. Goyal & Howlett 2018).

Regime shifts are explained as outcomes of alignments between developments on three levels: niche, regime, and landscape (Geels and Schot 2007). "Socio-technical regimes are relatively stable configurations of institutions, techniques and artefacts, as well as rules, practices and networks" (Smith et al. 2005, 1493) that dominate the functioning of a system (Kemp et al. 1998; de Haan and Rotmans 2011; Geels 2002). Understood in this way, the regime determines the logic and direction for incremental socio-technical change along established lines of development (Markard et al. 2012). New ideas and technologies, as basis for larger changes, develop in technological niches. These act as 'incubation rooms' or 'safe havens' without the strong selection pressure of the established regime for radical novelties or innovations to develop (Geels 2002). The socio-technical landscape constitutes the wider environment made up of deep structural economic, cultural and macro-political factors beyond the direct influence of regime and niche actors. Interactions between these three levels are the determining feature of the MLP in that regimes are embedded within landscapes and niches within regimes (Geels 2005).

Major socio-technical change, i.e. the success of a new innovation, is determined both by processes within the niche, but also by developments at the higher regime and landscape-level. As Kemp et al. (2012) argue it is the alignment of developments on all three levels which determines if a regime shift will occur. Radical innovations in niches may break through on the market and contribute to fundamental change if exogenous landscape developments create sufficient pressure on the regime, thus creating a 'window of opportunity' for a transition to take place (Shove and Walker 2010) (see Fig 2). Depending on the nature and timing of the interaction in this window of opportunity, these innovations may have a competitive or disruptive effect on the incumbent regime – creating impulses for change and allowing niche-innovations to challenge the regime – or help improve its performance and thus strengthen its foundations (Geels and Schot 2007; Adrian Smith et al. 2005).

While the levels do not themselves have agency (Fischer and Newig 2016), agency can be associated with particular levels. On the niche-level, agency is exerted by small actor networks who aim to push forward their innovation (Smith and Raven 2012; Leipprand and Flachsland 2018); on the regime-level, actors tend to oppose change (Rock et al. 2009); and on the landscape level – while less clearly defined – agency largely occurs in the form of political coalitions (Leipprand and Flachsland 2018).
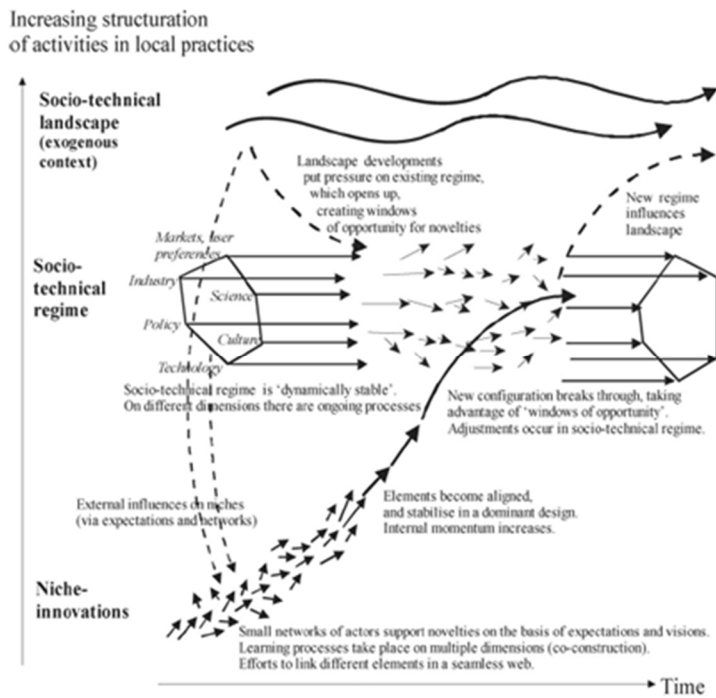
Fig. 2: Multi-level perspective on transitions (source: Geels & Schot, 2007)

2.3 Comparing the two approaches

We chose the two approaches because both are applicable to explaining large-scale energy transitions. Both approaches adopt a co-evolutionary perspective focussing on "complex adaptive systems" (Kingdon 1995: 224; Loorbach 2010). In that, they are 'universal' as they are not restricted to any particular sector, region, or time. In this sense, they share important similarities. However, they also differ in important respects, making them in several instances complementary approaches, compensating for the respective other's shortcomings.

First, while both approaches seek to explain major societal change, and as such observe longer time frames and chains of events, their particular focus is somewhat different. The MSF conceptualizes changes as discrete event, i.e. happening at a specific moment in time, which makes it particularly apt to analyse specific stages of policy development, especially agenda setting and decision-making, but which makes it more difficult to apply at the implementation stage (Capano 2009; but see e.g. Howlett 2018). The MLP, on the other hand, strives to explain socio-technical 'regime change' (*inter alia* dominant technologies, practices, policies), and as such has a more evolutionary perspective (Geels & Schot 2007). This means that the approach looks rather at long-term, co-evolutionary dynamics involving also aspects of change of practices, infrastructures, technologies and institutions (Markard et al. 2012). Hence, path-dependency and structural lock-ins play a pivotal role in the MLP, while those feature in the MLP rather indirectly, e.g. though the survival criteria in the policy stream (Herweg et al. 2017).

Second, both approaches conceptualise windows of opportunity as preceding major change, and explain under which conditions such windows are likely to open. For the actual promotion of change, both are not blind to agency (political entrepreneurs; change-agents) (see e.g. Avelino 2017; Mintron & Norman 2009). Whereas the MLP places emphasis on technological innovations developed through niche innovations, the MSF studies policy innovations developed by political actors and the ways in which policy entrepreneurs try to bring to the political centre stage.

Finally, and related to issues of agency, both approaches see change as a result of competition: Ideas compete to get on the agenda (Mintrom 1997); niche innovations compete to replace the dominant regime (Geels 2018). Both deal with innovation in a certain sense (ideas whose time has come in the MSF, socio-technical innovation in the MLP). Also, the origin and survival of these innovations is subject to specific filtering and selection mechanisms, however following different logics. Policy ideas, somehow pre-existent in the "primeval soup", are very fluid and get filtered and substantiated in policy communities in an arguing process called 'softening up' (Kingdon 2011, 127) Their actual survival is dependent on various criteria, such as technical feasibility, value acceptability, public acquiescence, and financial viability (Herweg et al. 2017). Technological innovation, on the other hand, may develop in technological or market niches as 'hopeful monstrosities' (Schot & Geels 2008, 537) and may substantiate through processes of social learning across multiple experiments, articulation of promising expectations and heterogeneous networking among actors (Markard et al. 2012).

Despite these differences, we argue that for the kind of change we are looking here – sustainability transformation – and for which the German Energiewende is one important case in point, a socio-technical change from one electricity regime to another will naturally involve important changes in the institutional and policy system and – vice versa – policy change almost invariably involves technological change.

3 Case selection and data sources

Given the long-term nature of this study, together with the well-described study object, we rely on a mix of secondary and complimentary primary sources to reconstruct the narrative of Germany's energy transition (for a similar approach see e.g. Geels et al. 2016b). Hence, we drew from a vast collection of academic books, articles and reports (e.g. Renn et al. 2016; Wedel 2016; Kaiser et al. 2016; Quitzow 2016; Hager & Stefes 2016; Mez 2016; Hostenkamp & Radtke 2018), quantitative energy statistics (e.g. AG Energiebilanzen 2017), and official documents (e.g. BMWi 2010; Deutscher Bundestag 2011; Vattenfall 2012). The synthesis of this material was led by the chosen theories and aimed at tracing the relevant chains of events.

The temporal period discussed in the case study primarily covers events between the 1980s and 2012, matching the timeline adopted by similar studies discussing Germany's energy transition (e.g. Geels et al. 2016b; Hake et al. 2015). Because transitions are long-term processes, adopting such a long time-perspective is crucial to fully appreciate how solutions and/or innovations could become 'strong' enough to be considered viable alternatives or challenge the regime.

4 The German Energiewende

While today, the term 'Energiewende' is widely associated with the political project of fundamentally transforming the German energy system following the 2011 Fukushima disaster (e.g. Renn and Marshall 2016; Wedel 2016), it has in fact been a much longer process, with the origins of the term dating back more than 30 years (Kaiser et al. 2016). Consisting of two parts, the Energiewende relates, on the one hand, to the phase-out of nuclear energy and, on the other hand, the replacement of fossil fuels with renewable resources (Quitzow et al. 2016). While the following section does not aim to provide an exhaustive description of Germany's long trajectory towards an energy transition (see e.g. Hager & Stefes 2016; Hake et al. 2015 for more detailed accounts on this subject), here we provide a brief overview of the key aspects of the case study context that relate to our analysis.

As in many European countries, the oil crisis of 1973 constituted an important external shock for Germany (Hake et al. 2015), fundamentally transforming the way the country approached its energy policy. Strongly dependent on fossil fuels, the threat of resource scarcity made energy security one of the dominant topics on the political agenda (Berlo et al. 2017). While, on a political level, nuclear energy was seen as an important technology to guarantee energy supplies (Renn and Marshall 2016), on a societal level, Germany witnessed a growing anti-nuclear movement, particularly following nuclear incidents at Three Mile Island in 1979 and Chernobyl in 1986 (Mez 2012). Similarly, opposition to coal-fired energy increased in intensity, particularly as the effects of greenhouse gas emissions and acid rain on the global climate became better known (Quitzow et al. 2016; Matthes 2017). It was in this political environment that first policies to stimulate the development of renewable energy technologies were developed (Hake et al. 2015). Despite strong opposition from the German government and large utilities, a number of small support programmes for the development of wind and solar-PV were introduced (Lauber and Mez 2004) and innovative technologies and business-models (e.g. community-led energy initiatives) were developed in protest to state-sponsored industrial projects (Hager 2016).

The first major policy change discussed in this article occurred in 1990, when Germany introduced its first Renewable Electricity Feed-In Law, or *Stromeinspeisegesetz*.[1] This law required electricity providers to (1) connect small-scale renewable energy of up to 5MW to the grid and (2) to purchase the energy produced at a fixed rate to these small producers. In effect, the Feed-In Law served to create a protected environment for renewable technologies by making them economically viable (Mez 2012). Nevertheless, throughout this period, the energy system continues to be dominated by monopolistic energy structures and vertical integration of the energy market, with large utilities forming the "backbone" of the electricity regime (Geels et al. 2016b). During this phase of the Energiewende, electricity production continued to predominantly rely on lignite, hard coal and nuclear power (see Fig.3), with the share of renewables increasing only slowly.
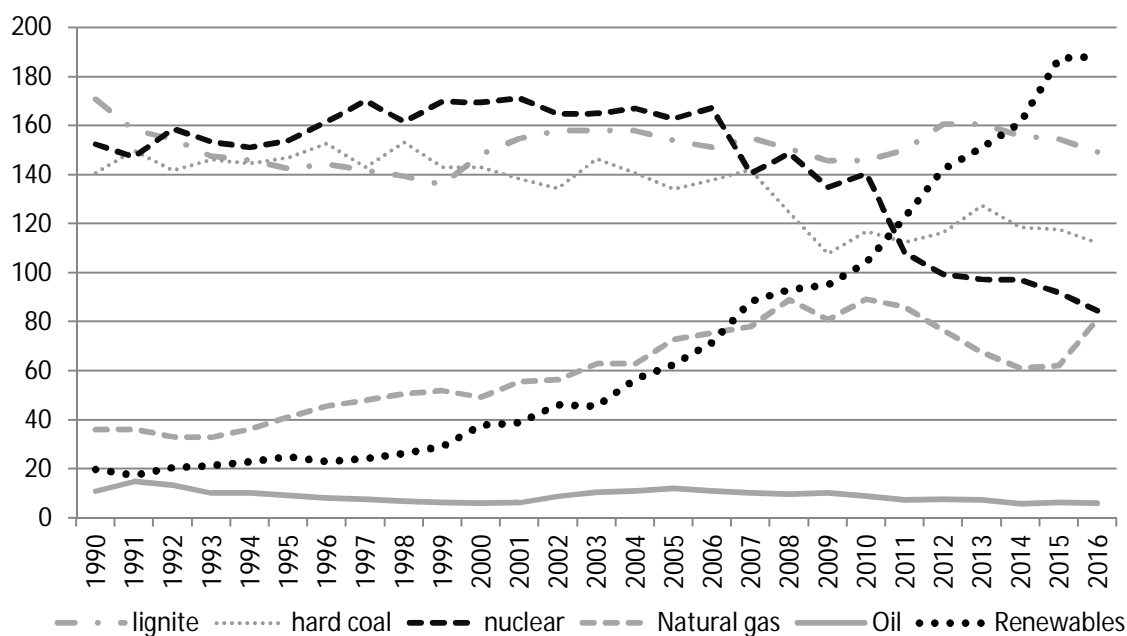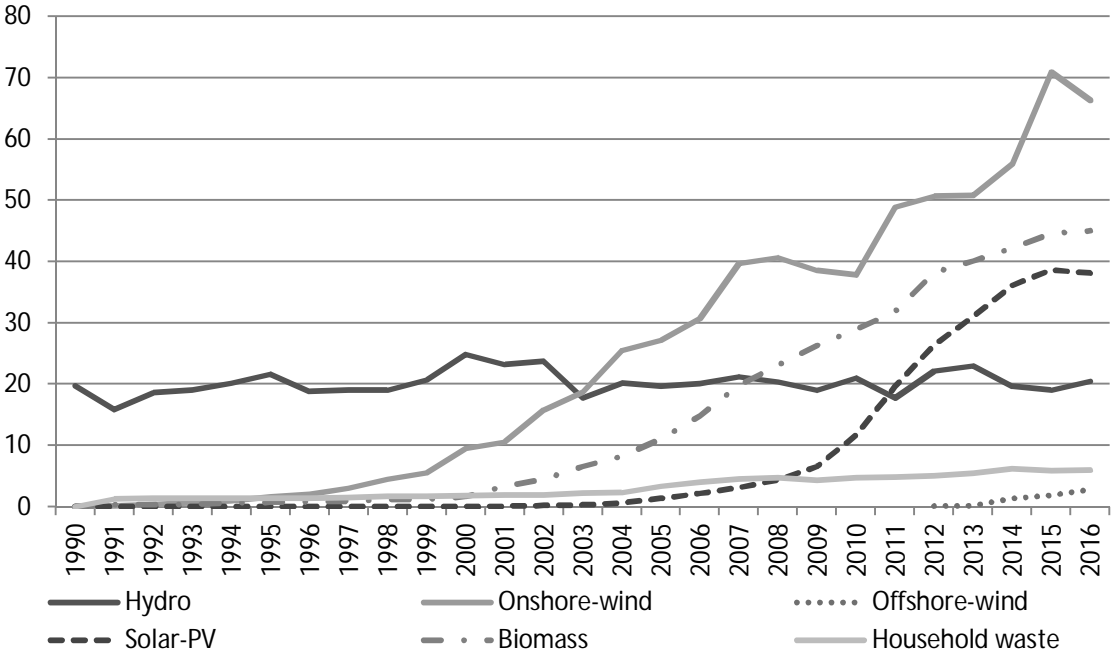

Fig. 3: Gross electricity production by fuel type, 1990-2016 in TWh (source: AG Energiebilanzen, 2017)

However, by the year 2000, the Electricity Feed-In Law was no longer considered to be able to accommodate the expansion of renewable energies (see e.g. Hirschl 2008) and replaced by the first Renewable Energy Act (EEG).[2] Under the EEG, electricity produced from renewables significantly increased, with onshore-wind, solar-PV and biomass, in particular, experiencing strong growth rates (see Fig.4). In 2000, the German government also announced its decision to gradually phase out existing nuclear power plants in its Nuclear Energy Phase-Out Act, banning

[1] Bundesgesetzblatt, 1990 Teil I, Nr.67, Seite 2633
[2] Bundesgesetzblatt, 2000 Teil I, Nr.13, Seite 305

the future construction of new nuclear power plants and limiting the lifespan of existing nuclear power plants to 32 years. Faced with considerable public and political opposition to nuclear energy, investments strongly concentrated on coal and gas-fired power plants, with the share of electricity produced by nuclear power stations dropped from its height at 30.8 percent of gross electricity production in 1997 to 22.2 per cent in 2010. Furthermore, this change was accompanied by a strong shift in ownership structures and a professionalization of the renewable energy sector (Kungl 2015; Geels et al. 2016b). Despite controlling over 80 percent of electricity production capacity in 2004 (Kungl 2015), large energy companies only possessed around 6.5 percent of the growing renewable production capacity (Strunz 2014). By 2009, the share of renewable energies had increased to 15.9 per cent (AG Energiebilanzen 2017), owned and operated by more plural and diversified structures such as energy cooperatives (see e.g. Holstenkamp and Müller 2013).

Fig. 4: Gross electricity production from renewables, 1990-2016, in TWh (source: AG Energiebilanzen 2017)

As the final step in our analysis, in 2010, as part of its wider Energy Concept, the new centre-right German government announced a long-term energy strategy, gradually increasing the share of renewables in electricity generation to 55-60 percent in 2035, and 80 percent by 2050 ((BMWi) 2010). As part of this energy strategy, the government delayed the previous nuclear phase-out decision, arguing that nuclear energy would be required to make this transition to a renewable energy system technically and economically feasible (Hermwille 2016). At the time, there was little to suggest Germany would embark on its path of transformational change only a few months

later. However, in June 2011 – in the wake of the nuclear catastrophe in Fukushima, Japan – German Parliament voted in favour of a series of laws that would come to transform the country's energy system, phasing out nuclear power by 2022 and decommissioning the seven oldest reactors per immediately (Hermwille 2016). That same year, renewables – for the first time in modern German history – overtook nuclear as an energy source for electricity production. By 2017, the share of renewable energy in electricity production had increased to just under 30 percent of gross electricity production in 2016 (see Fig.3), more than nuclear (at 13%) and only surpassed by hard coal and lignite combined.

Taken together, these changes constitute a fundamental shift away from fossil and nuclear fuels, and towards renewable energies. In the following sections, we apply the MSF (4.1) and MLP (4.2) to the case at hand, explaining how the interconnectedness between policy changes and technological changes enabled the Energiewende to take place.

4.1 Explaining the Energiewende using the MSF

In the previous section, we identified the three key instances of policy change that together paved the way for the current transformation of Germany's energy system. In the following section, we will apply the Multiple Streams Framework as an analytical lens to study the energy reforms.

1990: Supporting small-scale renewables

Over the course of the 1970s and 1980s, a number of indicators and events, described in Section 3, brought the issue of energy security and environmental sustainability to the attention within the *problem stream*. While the 1973 oil crisis raised important concerns over energy security and increased demand for alternative energy sources, nuclear incidents and a growing environmental awareness resulted in growing social opposition to nuclear and coal technologies. Feedback from first pilot programmes with renewable energy technologies offered potentially viable alternatives.

In the *policy stream*, first policies to stimulate the development of renewable energies were developed, mostly for onshore-wind and solar-PV (Hake et al. 2015; Lauber and Mez). Proposals for feed-in tariffs were first brought up in the late 1980s but were facing strong opposition by the government majority and large utilities (Stefes 2016b; Hirschl 2008) and, hence, did not figure very successful on the agenda. In the late 1980s, however, two politicians – Matthias Engelberger (a CDU-politician in his final year in German parliament) and Wolfgang Daniels (Green Party) (Stefes 2016b; Hirschl 2008; Berchem 2006) – acted as policy entrepreneurs, bringing together a small policy community from different parties. Their proposal required electricity providers by law to connect renewable energy generators to the grid and to purchase the renewable energy

produced at a set price, with rates varying from 65 to 90 per cent of the average tariff for final customers (Lipp 2007; Mez 2012).

A number of developments can be observed in the *political stream* around the same time, with some elements of the political stream opposed to policy change and others in favour. As the Green Party entered the German *Bundestag* in 1983, changes in the administration and legislative turnover meant that environmental concerns featured strongly on the political agenda (Stefes 2016b). Nevertheless, interest group campaigns by large utilities – seeking to protect their business models – strongly lobbied the government against support for renewables (Stefes 2016b; Hirschl 2008).

These three streams converged and opened a *policy window* for change around the time of German Reunification (see Fig. 5). Although only indirectly connected to energy policy, this big political project caught up and bound most attention of political and economic actors. With the framing of the proposal as being about technical infrastructure development and market access rather than about direct political intervention in the means of energy generation – and the attention of the opposition absorbed by grid expansion into former East-Germany – the policy entrepreneurs managed to push a proposal that was estimated as only a minor change with little impact and, thus, deemed acceptable to a parliament majority (Lauber and Mez 2004; Stefes 2016b). The *Stromeinspeisegesetz* was therefore passed into law on December 7, 1990, and came into effect on January 1, 1991.
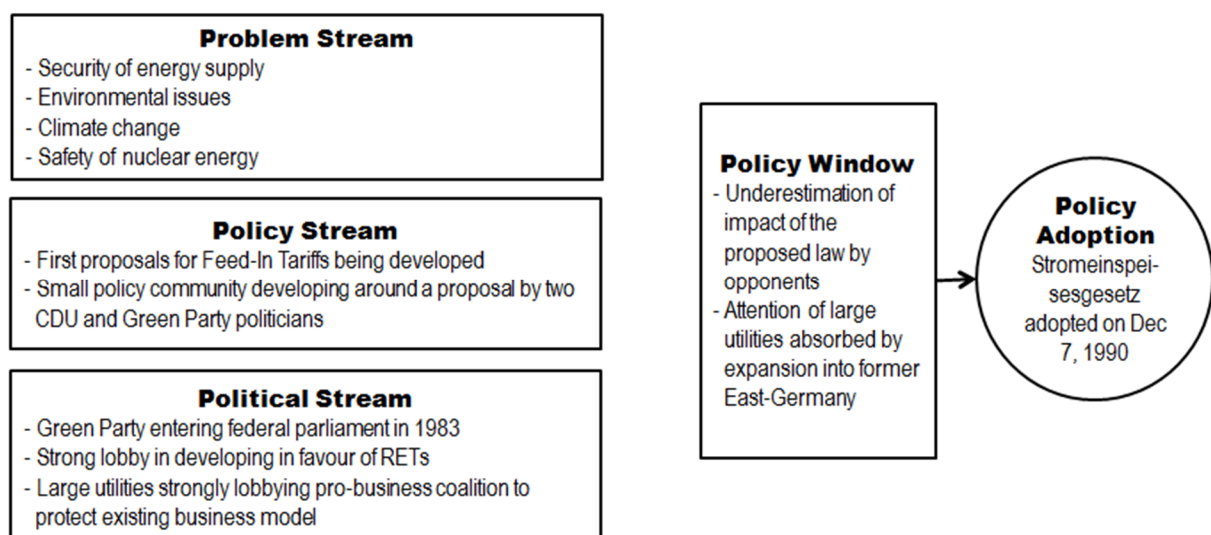
Fig. 5: Explaining the adoption of the 1990 Feed-in tariff Law

### 2000: Expansion of renewable energies and nuclear phase-out

Around the turn of the century, concerns about the climate and the environment continue to play an important role in the *problem stream*. The subject of climate change continues to be a salient issue during the 1990s, and following reunification, Germans were suddenly confronted with the pollution and other negative effects of coal mining in the former East-German areas (Renn and Marshall 2016). The Green Party, now in government, appeared to be an important problem broker, bringing to political attention issues such as ecological modernisation and climate change policy, the phasing-out of nuclear power, and the promotion of renewable energy sources (e.g. Hirschl 2008; Mez 2012). Feedback from the Stromeinspeisegesetz, however, indicates that the law is no longer able to accommodate the rate of expansion of renewable energies.

In the *policy stream*, a handful of Green Party representatives at this time act as policy entrepreneurs by single-handedly rewriting the existing law. Under their proposal rates were determined for each technology in relation to its costs and fixed for a period of 20 years, aiming to at least double the share of renewable energies by 2010. Solar-PV and biomass technologies, in particular, receive increased support under this proposal, with wind-technology increasingly considered to already be economically and financially viable (Hirschl 2008; Stefes 2016b).

In the *political stream*, the most important development in favour of policy comes from following the 1998 elections. With a new coalition of social democrats (SPD) and Greens coming into office, a major re-shuffling of the policy agenda occurred and environmental policies rose on the political agenda (Schiffer 2002; Renn and Marshall 2016). With both parties elected on an anti-nuclear platform, the future construction of nuclear power plants is to be banned, and existing nuclear power stations are to be gradually phased out by limiting their lifespan (Mez 2012). With coal under increasing pressure and existing climate commitments under the Kyoto Protocol, the new government made the expansion of renewable energy a priority (Stefes 2006). With the incumbent energy players (e.g. large utilities) unable to see a threat to existing business models, lobbying activities were limited to "the defence of the status quo" (Kungl 2015).

In this particular case, a *policy window* came about through changes in the political stream, with the election of a new political coalition against nuclear energy. With the Green Party in government, the policy entrepreneurs were in a strong position to push their preferred solution, with renewable energy sources framed as an acceptable policy solution for the problems posed by nuclear energy and polluting coal-fired power. The new EEG was unanimously approved by both governing parties on December 13, 1999 and passed into law the next year (see Fig. 6).
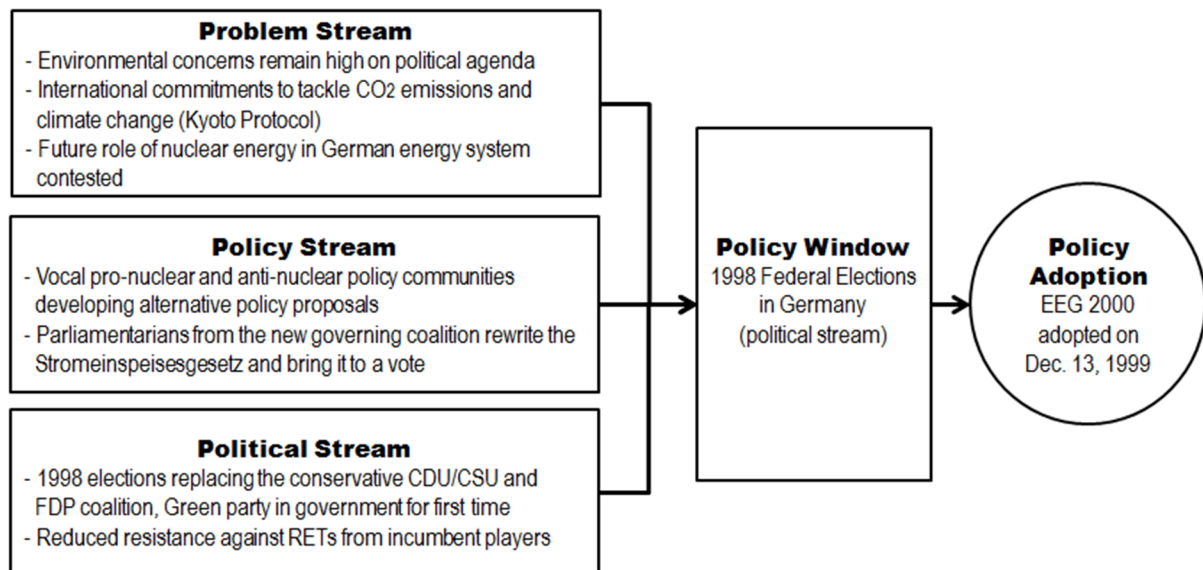
Fig.6: Explaining the adoption of the Renewable Energy Act 2000

2011: Break-through in the Energiewende

Throughout the 2000s, the *problem stream* continues to be dominated by sustainability-related indicators, with the publication of influential climate change reports and popular documentaries ensuring that the topic remains in the spotlight. However, events in the political stream (explained in more detail below) at the time effectively block any meaningful movement on the issue of nuclear power in Germany's energy system. The 2011 earthquake off the Japanese coast and subsequent nuclear disaster in Fukushima, however, radically changed the political landscape, serving as a focusing event in the sense of Birkland (1997).

In the *policy stream*, a variety of potential policy proposals exist with two opposing policy communities around the topic of nuclear energy. On the one hand, the SPD, Greens and Left party, wished to maintain the nuclear phase-out agreement of 2000. On the other hand, CDU/CSU and FDP aimed for extending the operating period of nuclear power plants to keep in check the costs of the transition and secure a sufficient supply of energy (Huß 2014). Between 2005 and 2009, the CDU/CSU and SPD government fundamentally disagreed on the future role of nuclear power in Germany's energy system, effectively blocking movement on this issue.

Developments in the *political stream* initially favoured the pro-nuclear coalition. A change in the political administration following the 2009 elections put in power a CDU/CSU and FDP government, which subsequently announced the extension of the lifetime for existing nuclear power plants to ensure continued security of supply and economic affordability during the transition to a clean and renewable energy future (ibid.). The decision was greeted by interest group campaigns from the fossil-nuclear regime, which used their political influence to stress the threat of a nuclear phase-out to the security of supply in the short to medium term (Strunz 2014).

However, the events in Fukushima led to a strong shift in the national mood and fundamentally undermined support for nuclear energy in Germany.

The nuclear disaster at Fukushima opened a *policy window* in the problem stream. In line with Kingdon's argument, the Fukushima disaster can be considered an important mobilising event, combining a new appreciation of the problem to be combined with ideas already in circulation, but lacking a receptive audience (see Fig. 7). Public approval of nuclear energy further diminished into overt opposition to the extent that political parties could no longer mobilise core voters in favour of the subject (Huß 2014). Faced with electoral losses in key state elections (see Renn et al. 2016), policy entrepreneurs from CDU/CSU and FDP proposed to phase out nuclear power by 2022 and decommission the seven oldest reactors per immediately, a proposal that was immediately supported by all main political parties. It is important to note here that none of the post-Fukushima measures were actually new, but had in fact been around for a while, with various policy proposals floating around when the nuclear disaster occurred. Existing plans for the nuclear phase-out were accelerated, with renewable energies – in the long-term – expected to generate most of the electricity supplied.
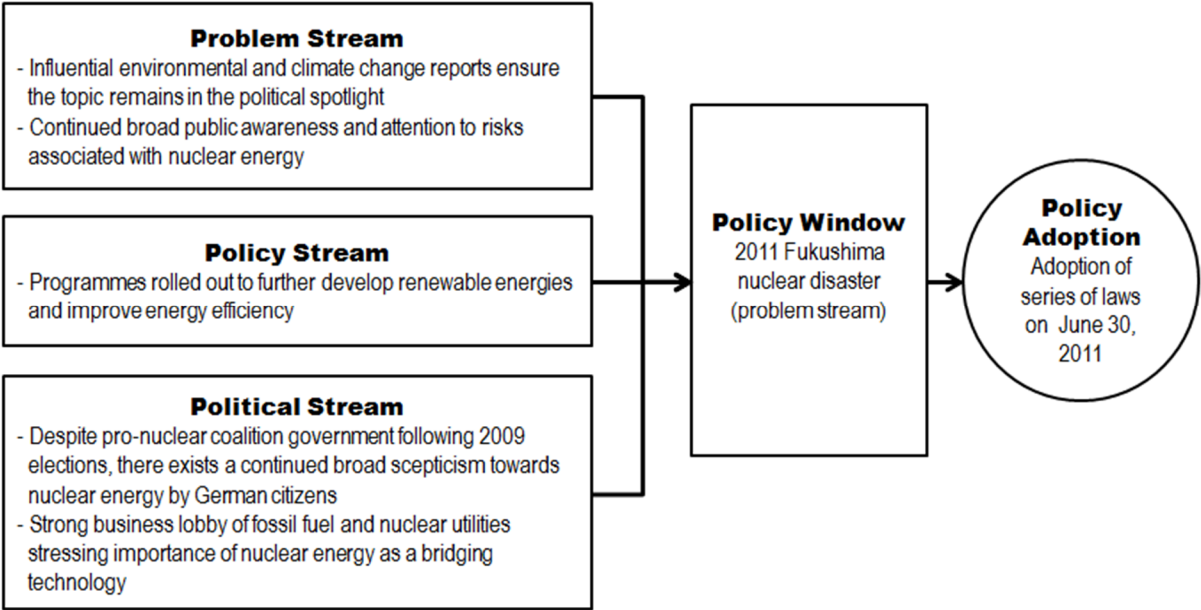
Fig. 7: Explaining the nuclear phase-out decision in June 2011

4.2 Explaining the Energiewende using the MLP

Applying the MLP lens to the German Energiewende, in this section we highlight how, ultimately, niche-level innovations, coupled with pressures on the landscape level, including incremental changes in the institutional context, were – over time – able to destabilise the conventional electricity production regime and open a window of opportunity for an energy

transition to take place. Distinguishing several typical phases in transitions (see e.g. Geels 2005), we identified three distinct stages in the development of the energy transformation; First, before the 1990s, early renewable energy innovations emerged in niches, posing little threat to the regime; second, in the phase between 1990 and 2011, the new technologies rapidly developed but could not seriously threaten the existing regime; and third, following the nuclear disaster in 2011, renewable energy technologies have been entering the center stage and are now in the course of replacing the nuclear part of the established regime.

Phase 1: Emergence of RETs in niche (pre-1990)

During this phase, the socio-technical regime (or energy market) was characterised by monopolistic energy structures and vertical integration, in which grid utilities controlled the electricity grid. The energy regime consists almost exclusively of fossil fuel technologies, particularly hard-coal and lignite. In the 1970s, several new nuclear power plants were constructed, with long technological lifespans.

On the landscape level, a number of factors beyond the direct influence of regime- and nice-level actors can be identified, such as the 1973 oil crisis, the anti-nuclear movement following nuclear incidents, and growing environmental awareness. At this point, however, they do not yet create sufficient pressure on the regime to affect fundamental change.

On the niche-level, small-scale experimentation took place with renewable energy technologies. While renewable energy has always played a small role in energy production – in 1950 renewables accounted for around 10 per cent of electricity production, largely in the form of hydropower (Hirschl 2008) – frontrunners increasingly experimented with new technologies such as wind or solar-PV and business models (e.g. community-led citizen initiatives). Niche actors were largely motivated by anti-nuclear or pro-environmental beliefs and acting in protest to state-sponsored industrial projects such as nuclear power plants (Hager 2016).

Phase 2: Parallel developments in niche and regime (1990 – March 2011)

During this phase, the regime-level continues to be characterised by a reliance on fossil-fuel technologies and large utilities. With nuclear power facing considerable public and political opposition, investments concentrated on coal and gas-fired power plants. Perceived as a threat to existing business models, incumbent regime actors strongly opposed the expansion of renewables through courts, political pressure, and efforts to delegitimise renewable technologies (see e.g. Hake et al. 2015) and declined to invest in renewables due to the comparatively lower return-on-investment offered compared to fossil fuels (Kungl 2015; Strunz 2014), and the belief that

centralised large-scale energy production would continue to dominate the energy regime in the future (Wassermann et al. 2015).

The landscape level is characterised by a number of major national and international developments. On the macro-political level, utilities were confronted with a number of challenges, including the EU-wide deregulation and liberalisation of the electricity (1996) and gas markets (1998), the German nuclear consensus banning the construction of new nuclear power plants and gradually phasing-out existing facilities, and legislation levelling the playing field for renewable energy technologies. Culturally, environmental concerns became increasingly mainstream. Finally, by the end of this period, structural economic factors further threatened the dominant position of utilities, with a reduction in the electricity demand following the financial and economic crisis, leading to an oversupply on the electricity market.

Following the EEG in 2000, niche technologies can rely on a more stable policy framework and increased support for more expensive energy sources, particularly solar PV and biomass (Quitzow et al. 2016; Matthes 2017), giving these technologies the opportunity to develop as a viable alternative to established energy sources. The largest share of renewable capacity was owned by actors without ties to the conventional energy sector, such as individuals (35%), project developers (14%) and farmers (11%) (Wassermann et al. 2015; Matthes 2017), with onshore-wind, biomass and solar PV making up the highest share of renewable energy production (see Fig. 3). During this phase, small-scale experimentation is increasingly replaced by a growing professionalization by niche-level actors.

Phase 3: Competition between RETs and established regime (post-March 2011)

In the third phase, the established regime increasingly has to compete with renewable energies. While initially given a boost by the lifespan extension of existing nuclear power plants, the incumbent energy regime was put further under intensive pressure, taking away their most profitable technology and leaving utility providers with "stranded assets" (Geels et al. 2016b). During this phase, the Big Four were forced to admit that traditional business models were under serious – even existential – threat (Vattenfall 2012; AG 2013), and responded by, on the one hand, adopting cost-cutting strategies (see e.g. Kungl 2015), selling off divisions and reducing its staff and, on the other, developed new business strategies that specifically included renewables.

On the niche-level, thanks to the subsequent policies that allowed innovative technologies to develop in a relatively 'safe haven' in the 1990s and 2000s, renewable technologies (particularly onshore-wind, biomass and solar-PV) were now sufficiently advanced technologically and in terms of market share to be considered a viable alternative to nuclear energy.

In this case, the March 2011 nuclear disaster resulted in sufficient pressure from the socio-technical landscape to finally open the window of opportunity needed for a (lasting) lasting transformation of the German energy system. Fostering a sudden regime shift (Strunz 2014), it led the German government to decide to reverse its decision to extend the lifespan of nuclear energy in Germany and shut the last nuclear power plant by 2022. While in the short term, this decision resulted in an increase in the use of hard coal and lignite, these sources of fuel too have increasingly come under pressure from renewable energy technologies in recent years (see Fig. 3). It is highly doubtful that the Fukushima nuclear disaster would have led to a regime shift had it not been for the large investment and stimulation programmes for renewable technologies. When disruptive change occurred, a fully developed niche innovations were readily available, allowing them to substitute the incumbent regime. Fig. 8 below represents the developments described previously for during each of the three phases.
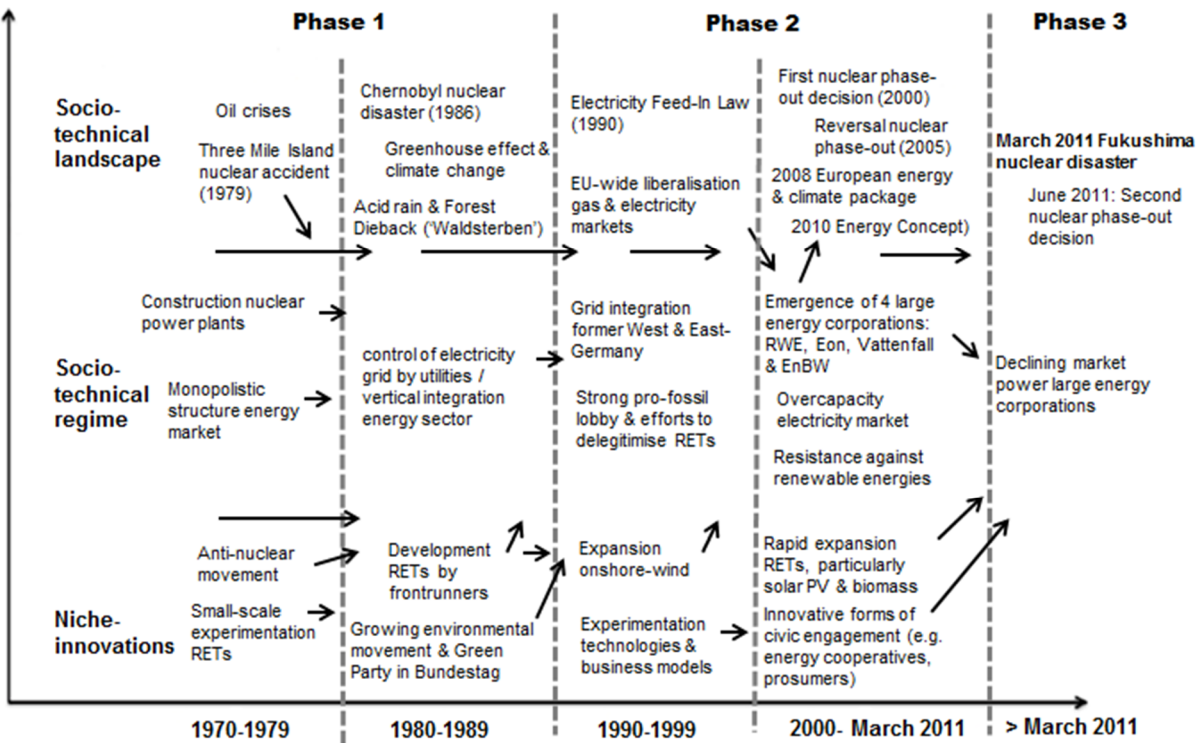
Fig. 8: The energy transition presented through the Multi-Level Perspective. Based on Geels (2002) and Berlo et al. (2017)

5 Discussion

By applying the Multiple Streams Framework as well as the Multi-Level Perspective on sustainability transitions to the German Energiewende, we were able to present a richer and more complex explanation than would have been the case by singularly applying either one of the frameworks. The analysis highlights the complementarity of the two approaches, tying together

political and socio-technical aspects in the explanation of Germany's energy transition. Applying the two lenses to the same case study demonstrates how political and technological developments went hand in hand and, in fact, reinforced each other in the case at hand. In doing so, it provides a more holistic picture of the Energiewende.

For example, the MSF strongly emphasized the role of policy entrepreneurs who played a key role in formulating and advocating for (politically) viable alternatives to the energy system dominated by fossil fuels and nuclear. Particularly in the first two policy changes, a small number of likeminded political representatives were able to develop and successfully push forward proposals that gradually allowed nuclear and fossil-fuel electricity generation to be replaced by renewables, sometimes in the face of strong opposition. In the final instance of policy change, the national mood and public opinion shifted strongly shifted away from nuclear energy so that those solutions that were already available could readily be applied. Furthermore, by providing a detailed narrative of the political factors behind policy transformation, the MSF provided important insights into which niche developments were fostered and structured over time. The technological feasibility of policy options, however, is largely static at those given points in time.

Using the MSF alone, however, it would have been difficult to explain why strong provisions for the expansion of renewable energies provided by the Feed-In Act and Renewable Energy Law did not result in immediate shifts in the energy mix. Looking at developments through this lens, there appears to be a paradox between the shift in the political mood in favour of renewable energy and the low share of renewable energy technologies. Describing the case through the MLP lens largely obfuscates the issue of agency or how socio-political agency brings about change on the landscape-level (see e.g. Levidow and Upham 2017), at least in part due to the fact that political developments are treated as exogenous contextual factors. However, applying the MLP lens provides valuable insights on the role of technological infrastructure and developments, which demonstrates how niche technologies, supported by developments on the landscape level, are increasingly able to compete with the technological regime as they are further advanced and developed. In fact, Fig. 4 shows that these developments took off at times when specific technologies were commercially ready, first in the case of on-shore wind, followed by biomass, and solar-PV in the second half of the 2000s. By looking at technical feasibility of niche-technologies as a decisive factor for transitions, the MLP therefore internalizes one important external factor of the MSF.

While both frameworks adopt a long timeframe in explaining how the Energiewende occurred, analytically the two frameworks differ in how they explain this societal transformation. Viewed through the MSF lens, the energy transition was the result of three distinct instances of policy

change that cannot simply be conflated, with three separate 'policy windows' identified in 1990, 2000 and 2011. Yet, the ultimate case of institutional change – the 2011 decision to quickly phase out nuclear energy and massively expand renewables – would not have been possible without the two instances that preceded it. Viewed from the MLP perspective, however, the three phases distinguished are all part of a single, long-term process of regime shift that took decades to unfold. Strictly applying the phases identified by (Geels 2005) to the case proved difficult. The second phase in particular – covering the extended period between 1990 and 2011 – could be further broken down into different analytical stages if we consider the dynamics of expansion and commercial viability of individual renewable technologies. Nevertheless, in March 2011, the Fukushima nuclear disaster ultimately opened a 'window of opportunity' for regime change, sufficiently destabilising the regime to allow a shift to take place.

6 Conclusions

Taking the German Energiewende as an illustrative case, in this article we have shown how societal transformation works according to two different theoretical frameworks. These frameworks offer clear 'lenses' through which developments can be explained. As each contains its own cluster of assumptions and limitations, the application of multiple, complementary, lenses offers important insights into why transitions may follow a certain pathway. Our combined analysis points to an interplay between mandated, directed change through policy (nuclear phase out: government decides to shut down nuclear power plants) and enabling policy decisions, fostering niche development (feed-in tariff). Niche development does not, however, happen without technological innovation by market actors, and as an evolutionary process of mutation (innovation) and selection (gaining market share), takes time, in this case decades, which cannot be simply mandated by government. Viewing societal transformation towards sustainability as either a political *or* a socio-technical process will cut short of how change develops – and can actively be steered – in reality.

Policy change not only involves the political system, at least in those sectors where technology and infrastructure are part of the game – which applies to many if not most issues of relevance to sustainability. As the example of the German Energiewende shows, policy creates the conditions for its own change. This is not simply path dependency. In fact, policies can actively create change through enabling and fostering new technology, while disincentivising – and even abolishing – old technology. As such, it can be argued that the purposeful termination of existing infrastructure, technology and policies can be just as important as the role of innovations in bringing about this shift towards a sustainable energy system.

What does all this mean for the policy sciences? The embeddedness of policy into other aspects of society is clearly recognised by the scholarly community. Anderies et al. (2013), for example, look at the system-wide outcomes of the policy process in coupled social-ecological systems. However, to date, none of the major frameworks of policy change have made real progress in dealing with the technological or infrastructural aspects of sustainability transitions.

Reflecting on this study, we should like to point to two considerations for future research. First, more reflection and engagement are required on the system-wide outcomes of policy change in socio-technical systems. Research presented here would benefit from the application of further institutional change or transitions frameworks that shed light on aspects of this case that have not yet been reviewed. Theories from a socio-psychological perspective could be applied, for example, to analyse why the nuclear disaster in Fukushima received a much stronger response in Germany than it did in other European countries that are dependent on nuclear energy for a large share of electricity production, such as France. Second, understanding societal transformation towards sustainability is as much a conceptual as it is an empirical mission. What we have learned on the conceptual level from this single case study needs to be applied to further case studies, aiming to achieve empirically generalizable results which will, in turn, inform conceptual development. Given the mounting sustainability challenges ahead of humanity, a lot more systematic inquiry that is not narrowly limited to the application of one particular framework is urgently needed. Ultimately, these efforts could lead to the better integration of policy sciences and socio-technical transitions.

References

(BMWi), B. f. W. u. T. (2010). Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. Berlin: Bundesministerium für Wirtschaft und Technologie (BMWi).

AG, E. E. B.-W. (2013). Bericht 2012 Werte schaffen - gemeinsam und nachhaltig. Kurzfassung. Karlsruhe: EnBW Energie Baden-Württemberg AG.

AG Energiebilanzen (2017). Bruttostromerzeugung in Deutschland ab 1990 nach Energieträgern. In A. Energiebilanzen (Ed.).

Allison, G. T., & Zelikow, P. (1999). *Essence of Decision: Explaining the Cuban Missile Crisis* (2nd ed.). New York: Longman.

Anderies, J. M., & Janssen, M. A. (2013). Robustness of social-ecological systems: Implications for public policy. *Policy Studies Journal, 41*(3), 513-536.

Avelino, F. (2017). Power in Sustainability Transitions: Analysing power and (dis)empowerment in transformative change towards sustainability. *Environmental Policy and Governance*.

Bale, C. S. E., Varga, L., & Foxon, T. J. (2015). Energy and complexity: New ways forward. *Applied Energy, 138*, 150-159.

Bandelow N C, Vogeler C S, Hornung J, Kuhlmann J, Heidrich S. (2017). Learning as a Necessary but Not Sufficient Condition for Major Health Policy Change: A Qualitative Comparative Analysis Combining ACF and MSF. *Journal of Comparative Policy Analysis: Research and Practice* 21(2) 1–16

Béland, D., & Howlett, M. (2016). The Role and Impact of the Multiple-Streams Approach in Comparative Policy Analysis. *Journal of Comparative Policy Analysis: Research and Practice, 18*(3), 221-227.

Berlo, K., Wagner, O., & Heenen, M. (2017). The incumbents' conservation strategies in the german energy regime as an impediment to re-municipalization - An analysis guided by the multi-level perspective. *Sustainability (Switzerland), 9*(1), 53.

Birkland, T.A. & Warnement, M.K. (2015). Refining the Idea of Focusing Events in the Multiple-Streams Framework. In: Zohlnhöfer Reimut & Rüb, Friedbert W., Decisionmaking under Ambiguity and Time Constraints. Assessing the Multiple-Streams Framework. Colchester: ECPR Press, pp. 91-107.

Cairney, P. (2007). A 'multiple lenses' approach to policy change: The case of tobacco policy in the UK. *British Politics, 2*(1), 45-68.

Cairney, P. (2013). Policy Concepts in 1000 Words: Multiple Streams Analysis. *Paul Cairney: Politics & Public Policy*.

Cairney, P., & Heikkila, T. (2014). A Comparison of Theories of the Policy Process. In P. A. Sabatier, & C. M. Weible (Eds.), *Theories of the Policy Process* (3rd ed., pp. 363-389). Chicago: Westview Press.

Cairney, P., & Jones, M. D. (2016). Kingdon's multiple streams approach: What is the empirical impact of this universal theory? *Policy Studies Journal, 44*(1), 37-58.

Capano, G. (2009). Understanding Policy Change as an Epistemological and Theoretical Problem. *Journal of Comparative Policy Analysis: Research and Practice 11*(1) 7–31

Carter, N. and M. Jacobs (2014) 'Explaining radical policy change: The case of climate change and energy policy under the British labour government 2006-10.' *Public Administration* 92 (1): 125-41.

Cherp, A., Vinichenko, V., Jewell, J., Brutschin, E., & Sovacool, B. (2018). Integrating techno-economic, socio-technical and political perspectives on national energy transitions: A meta-theoretical framework. *Energy Research and Social Science, 37*, 175-190.

Cohen, M. D., March, J. G., & Olsen, J. P. (1972). A Garbage Can Model of Organizational Choice. *Administrative Science Quarterly, 17*(1), 1-25.

Das unterschätzte Gesetz. (2006, September 22). *Zeit Online*.

de Haan, J. H., & Rotmans, J. (2011). Patterns in transitions: Understanding complex chains of change. *Technological Forecasting and Social Change, 78*(1), 90-102.

Dehmer, D. (2013). The German *Energiewende*: The First Year. *Electricity Journal, 26*(1), 71-78.

Deutscher Bundestag (2011). Gesetzentwurf der Fraktionen der CDU/CSU und FDP. Entwurf eines Gesetzes zur Neuregelung des Rechtsrahmens für die Förderung der Stromerzeugung aus erneuerbaren Energien. Berlin: Deutscher Bundestag,.

Dóci, G., Vasileiadou, E., & Petersen, A. C. (2015). Exploring the transition potential of renewable energy communities. *Futures, 66*, 85-95.

Dryzek, J.S. (2016) 'Institutions for the Anthropocene: Governance in a Changing Earth System.' British Journal of Political Science 46 (4): 937-56.

Fischer, L.-B., & Newig, J. (2016). Importance of Actors and Agency in Sustainability Transitions: A Systematic Exploration of the Literature. *Sustainability, 8*(5).

Geels, F., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy, 36*, 399-417.

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy, 31*(8-9), 1257-1274.

Geels, F. W. (2005). The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860-1930). *Technology Analysis and Strategic Management, 17*(4), 445-476.

Geels, F. W. (2018). Disruption and low-carbon system transformation: Progress and new challenges in socio-technical transitions research and the Multi-Level Perspective. *Energy Research and Social Science, 37,* 224–231.

Geels, F. W., Berkhout, F., & Van Vuuren, D. P. (2016a). Bridging analytical approaches for low-carbon transitions. *Nature Climate Change, 6*(6), 576-583.

Geels, F. W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., et al. (2016b). The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990-2014). *Research Policy, 45*(4), 896-913.

Geels, F. W., Sovacool, B.K., Schwanen, T. & Sorrell, S. (2017). Sociotechnical transitions for deep decarbonization. Accelerating innovation is as important as climate policy. *Science 357*(6357) 1242–1244.

Goyal, N.; Howlett, M. (2018). Technology and Instrument Constituencies as Agents of Innovation: Sustainability Transitions and the Governance of Urban Transport. *Energies*, 11, 1198.

Hager, C. (2016). The Grassroots Origin of the German Energy Transition. In C. Hager, & C. H. Stefes (Eds.), *Germany's Energy Transition: A Comparative Perspective* (pp. 1-26). New York: Palgrave Macmillan US.

Hager, C. & Stefes, C.H. (Eds.) (2016). *Germany's Energy Transition: A Comparative Perspective*. New York: Palgrave Macmillan US.

Hake, J.-F., Fischer, W., Venghaus, S., & Weckenbrock, C. (2015). The German Energiewende - History and status quo. *Energy, 92*(3), 532-546.

Harlow, J., Johnston, E., Hekler, E., & Yeh, Z. (2018). Fostering sustainability transitions by designing for the convergence of policy windows and transition arenas. *Sustainability (Switzerland), 10*(9), 2975.

Heikkila T, Pierce J J, Gallaher S, Crow D A, Weible C M, 2014, "Understanding a Period of Policy Change: The Case of Hydraulic Fracturing Disclosure Policy in Colorado" *Review of Policy Research* 31(2) 65–87

Hermwille, L. (2016). The role of narratives in socio-technical transitions - Fukushima and the energy regimes of Japan, Germany, and the United Kingdom. *Energy Research and Social Science, 11*, 237-246.

Herweg, N., Zahariadis, N., Zohlnhöfer, R. (2017). The Multiple Streams Framework: Foundations, Refinements, and Empirical Applications, in: Theories of the Policy Process. Routledge, Fourth edition. Boulder, CO : Westview Press, 2017., pp. 17–54.

Hirschl, B. (2008). *Erneuerbare Energien-Politik: Eine Multi-Level Policy-Analyse mit Fokus auf den deutschen Strommarkt*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Holstenkamp, L., & Müller, J. R. (2013). Zum Stand von Energiegenossenschaften in Deutschland: Ein statistischer Überblick zum 31.12.2012. Arbeitspapierreihe Wirtschaft & Recht (Vol. 14). Lüneburg: Leuphana Universität Lüneburg.

Holstenkamp, L. & Radtke, J. (2018) *Handbuch Energiewende und Partizipation.* Eds: Holstenkamp, L. & Radtke, J. Springer VS, Wiesbaden.

Hörisch, Jacob (2018), How business actors can contribute to sustainability transitions: A case study on the ongoing animal welfare transition in the German egg industry, *Journal of Cleaner Production*, 201, 1155-1165.

Howlett, M. (2018). Moving policy implementation theory forward: A multiple streams/critical juncture approach. *Public Policy and Administration,* 1–26.

Howlett, M., McConnell, A., & Perl, A. (2015). Streams and stages: Reconciling Kingdon and policy process theory. *European Journal of Political Research, 54*(3), 419-434.

Huß, C. (2014). Energy transition by conviction or by surprise? Environmental policy from 2009 to 2013. *German Politics, 23*(4), 430-445.

John, P. (2003). Is there life after policy streams, advocacy coalitions, and punctuations: Using evolutionary theory to explain policy change? Policy Studies Journal, 31, 481–498.

Jones, M. D., Peterson, H. L., Pierce, J. J., Herweg, N., Bernal, A., Lamberta Raney, H., et al. (2016). A River Runs Through It: A Multiple Streams Meta-Review. *Policy Studies Journal, 44*(1), 13-36.

Kagan, J. A. (2018). Multiple Streams in Hawaii: How the Aloha State Adopted a 100% Renewable Portfolio Standard. *Review of Policy Research 36*(2) 217–241.

Kaiser, J., Rhomberg, M., Maireder, A., & Schlögl, S. (2016). Energiewende's Lone Warriors: A Hyperlink Network Analysis of the German Energy Transition Discourse. *Media and Communication, 4*(4), 18-29.

Kammermann, L. (2018). Factors Driving the Promotion of Hydroelectricity: A Qualitative Comparative Analysis. *Review of Policy Research 35*(2) 213–237.

Kanie, N., M.M. Betsill, R. Zondervan, F. Biermann and O.R. Young (2012) 'A charter moment: Restructuring governance for sustainability.' Public Administration and Development 32 (3): 292-304.

Kemp, R. (1994). Technology and the transition to environmental sustainability. The problem of technological regime shifts. *Futures, 26*(10), 1023-1046.

Kemp, R., Rip, A., & Schot, J. (2012). Constructing Transition Paths Through the Management of Niches. In R. Garud, & P. Karnøe (Eds.), *Path Dependence and Creation* (pp. 269-299). Mahwah, NJ: Lawrence Erlbaum.

Kemp, R., Schot, J., & Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management, 10*(2), 175-195.

Kern, F. and K.S. Rogge (2018) 'Harnessing theories of the policy process for analysing the politics of sustainability transitions: A critical survey.' Environmental Innovation and Societal Transitions 27: 102-17.

Kingdon, J. W. (1984). *Agendas, alternatives, and public policies*. Harlow; Essex: Pearson.

Kingdon, J. W. (1999). *Agendas, alternatives, and public policies*. New York: Longman.

Kungl, G. (2015). Stewards or sticklers for change? Incumbent energy providers and the politics of the German energy transition. *Energy Research and Social Science, 8*, 13-23.

Lauber, V., & Mez, L. (2004). Three decades of renewable electricity policies in Germany. *Energy and Environment, 15*(4), 599-623.

Leipprand, A., & Flachsland, C. (2018). Regime destabilization in energy transitions: The German debate on the future of coal. *Energy Research and Social Science, 40*, 190-204.

Levidow, L., & Upham, P. (2017). Linking the multi-level perspective with social representations theory: Gasifiers as a niche innovation reinforcing the energy-from-waste (EfW) regime. *Technological Forecasting and Social Change, 120*, 1-13.

Lindblom, C. E. (1990). *Inquiry and Change. The Troubled Attempt to Understand and Shape Society.* New Haven [u.a.]: Yale University Press.

Lipp, J. (2007). Lessons for effective renewable electricity policy from Denmark, Germany and the United Kingdom. *Energy Policy, 35*(11), 5481-5495.

Loorbach, D. (2010). Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework. *Governance 23*(1) 161–183.

MacRae, R., & Winfield, M. (2016). A little regulatory pluralism with your counter-hegemonic advocacy? Blending analytical frames to construct joined-up food policy in Canada. *Canadian Food Studies, 3*(1), 140-194.

Markard, J., Raven, R. & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy 41*(6) 955–967

Matthes, F. C. (2017). Energy transition in Germany: a case study on a policy-driven structural change of the energy system. *Evolutionary and Institutional Economics Review, 14*(1), 141-169.

Meadowcroft, J. (2009). What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences, 42*(4), 323-340.

Meadowcroft, J. (2011). Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions, 1*(1), 70-75.

Mez, L. (2012). Germany's merger of energy and climate change policy. *Bulletin of the Atomic Scientists, 68*(6), 22-29.

Mintrom, M. (1997). Policy Entrepreneurs and the Diffusion of Innovation- *American Journal of Political Science, 41*(3), 738–770.

Mintrom, M., & Norman, P. (2009). Policy Entrepreneurship and Policy Change. *Policy Studies Journal, 37*(4), 649-667.

Noboa, E., & Upham, P. (2018). Energy policy and transdisciplinary transition management arenas in illiberal democracies: A conceptual framework. *Energy Research and Social Science, 46*, 114-124.

Orach, K., & Schlüter, M. (2016). Uncovering the political dimension of social-ecological systems: Contributions from policy process frameworks. *Global Environmental Change, 40*, 13-25.

Ostrom, E. (2005). Doing Institutional Analysis: Digging Deeper than Markets and Hierarchies. In C. Ménard, & M. M. Shirley (Eds.), *Handbook of New Institutional Economics* (pp. 819-848). Berlin & Heidelberg: Springer.

Patterson, J., Schulz, K., Vervoort, J., van der Hel, S., Widerberg, O., Adler, C., Hurlbert, M., Anderton, K., Sethi, M. & Barau, A. (2017). Exploring the governance and politics of transformations towards sustainability. *Environmental Innovation and Societal Transitions 24*: 1-16.

Quitzow, L., Canzler, W., Grundmann, P., Leibenath, M., Moss, T., & Rave, T. (2016). The German *Energiewende* – What's happening? Introducing the Special Issue. *Utilities Policy, 41*, 163-171.

Renn, O., & Marshall, J. P. (2016). Coal, nuclear and renewable energy policies in Germany: From the 1950s to the "Energiewende". *Energy Policy, 99*, 224-232.

Rock, M., Murphy, J. T., Rasiah, R., van Seters, P., & Managi, S. (2009). A hard slog, not a leap frog: Globalization and sustainability transitions in developing Asia. *Technological Forecasting and Social Change, 76*(2), 241-254.

Schiffer, H.-W. (1991). *Energiemarkt Bundesrepublik Deutschland* (2nd ed.). Köln: TÜV Rheinland.

Schiffer, H.-W. (2002). *Energiemarkt Deutschland* (8th ed.). Köln: TÜV-Verlag.

Schot, J. & Geels, F. W. (2008). Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management 20*(5), 537–554.

Shove, E., & Walker, G. (2010). Governing transitions in the sustainability of everyday life. *Research Policy, 39*(4), 471-476.

Smith, A., & Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy, 41*(6), 1025-1036.

Smith, A., Stirling, A., & Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research Policy, 34*(10), 1491-1510.

Stefes, C. H. (2016a). Conclusion: Lessons from the German *Energiewende*. In C. Hager, & C. H. Stefes (Eds.), *Germany's Energy Transition: A Comparative Perspective* (pp. 185-193). New York: Palgrave Macmillan US.

Stefes, C. H. (2016b). Critical Junctures and the German *Energiewende*. In C. Hager, & C. H. Stefes (Eds.), *Germany's Energy Transition: A Comparative Perspective* (pp. 63-89). New York: Palgrave Macmillan US.

Strunz, S. (2014). The German energy transition as a regime shift. *Ecological Economics, 100*, 150-158.

Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B., et al. (2015). Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change, 35*, 239-253.

van der Heijden, J. (2013). Different but equally plausible narratives of policy transformation: A plea for theoretical pluralism. *International Political Science Review, 34*(1), 57-73.

Vattenfall (2012). A New Energy Landscape: Annual Report 2012 including Sustainability Report. Solna: Vattenfall.

Wassermann, S., Reeg, M., & Nienhaus, K. (2015). Current challenges of Germany's energy transition project and competing strategies of challengers and incumbents: The case of direct marketing of electricity from renewable energy sources. *Energy Policy, 76*, 66-75.

Wedel, M. (2016). *The European Integration of RES-E Promotion: The Case of Germany and Poland*. Wiesbaden: Springer VS.

Weible, C. M., & Schlager, E. (2016). The Multiple Streams Approach at the Theoretical and Empirical Crossroads: An Introduction to a Special Issue. *Policy Studies Journal, 44*(1), 5-12.

Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., Thompson, J., Nilsson, M., Lambin, E., Sendzimir, J., Banerjee, B., Galaz, V. and van der Leeuw, S. (2011). 'Tipping Toward Sustainability: Emerging Pathways of Transformation.' Ambio 40 (7): 762-80.

Whiteford, H. A., Meurk, C., Carstensen, G., Hall, W., Hill, P., & Head, B. W. (2016). How Did Youth Mental Health Make It Onto Australia's 2011 Federal Policy Agenda? *SAGE Open, 6*(4), 1-12.

Zahariadis, N. (2003). Ambiguity and Choice in Public Policy. Washington, DC: Georgetown University Press.

Zahariadis, N. (2014). Ambiguity and Multiple Streams. In P. Sabatier, & C. M. Weible (Eds.), *Theories of the Policy Process* (3 ed., pp. 25-59). Boulder: Westview Press.

Phasing out not in: Exnovation Governance for Sustainability and the Powering Past Coal Alliance

1 Introduction

In December 2015, signatories to the Paris Agreement committed to taking action to spur clean growth and reduce the risks and impacts of climate change, keeping global average temperature rise well below 2 degrees Celsius above pre-industrial levels (United Nations, 2015). With energy production and use accounting for around two-thirds of anthropogenic greenhouse-gas emissions (International Energy Agency, 2015), the energy sector plays an important role in achieving this target (Rogge and Johnstone, 2017). A fundamental transformation of the energy system through energy decarbonisation and low- or zero-carbon investments is thus required to keep the rise in global temperatures below 2°C (Agency, 2017, McCollum et al., 2018). To date, attention has focused strongly on the role of technological innovations in bringing about a shift away from the current fossil-fuel based energy regime towards a sustainable energy system (Geels and Schot, 2007, Kern and Smith, 2008), ranging from mobility (e.g. Geels 2002, Upham et al., 2016), to housing (Faber and Hoppe, 2013) and energy (Verbong and Geels, 2007). However, despite an "innovation-driven improvement of resource efficiency" (Kropp, 2015), and despite renewable energy accounting for 70 per cent of net additions to global generating capacity in 2017 (REN21, 2018), indicators for sustainable development continue to point in the wrong direction, with carbon-related CO_2 emissions rising 1.4 per cent in 2017 (International Energy Agency, 2018) and progress on the Sustainable Development Goal for energy considered "too slow to be on track to meet the global energy targets for 2030" (United Nations, 2018).

A growing unease with this bias on innovation has been detected in recent years, even from within innovation studies (Sveiby et al., 2012). In response, recent literature has argued that a focus on innovation alone is no longer sufficient to achieve the required transformation and replace established non-sustainable structures (Heyen et al., 2017, Heyen, 2016, David, 2017, Arnold et al., 2015). Instead, society will need to "eliminate existing unsustainable modes of energy utilization" (Gross and Mautz, 2015). Drawing on earlier literature on organisational exnovation (Kimberly, 1981), this emerging body of literature argues that existing research should be complemented by a stronger focus on the other side of the coin: the "exnovation", or the purposive termination of unsustainable technologies, products, structures or practices (e.g. Rogge and Johnstone, 2017, Johnstone and Hielscher, 2017, Leipprand and Flachsland, 2018).

This raises the following question: How can we deliberately and purposively steer the governance of exnovation in the desired direction? One such conceptual framework was recently proposed by Heyen et al. (2017), whose framework aims to evaluate the governance processes behind the

phase-out of fossil fuels and associated technologies, by focusing on the 'political dimension', 'policy dimension' and 'time-horizon' of the exnovation process. By combining different possible characteristics within these categories, the authors argue that different governance approaches can be identified. To date, however, little empirical research has been undertaken to determine how this conceptual frame holds up in a real-world context.

The aim of this article is twofold. First, it seeks to apply the framework to the exnovation of coal-fired electricity generation by the Powering Past Coal Alliance (PPCA). The PPCA is a coalition of national and sub-national governments, businesses and organisations agreeing to phase-out traditional coal power and place a moratorium on any new coal power stations without operational carbon capture and storage in their jurisdictions (United Nations Framework Convention on Climate Change, 2017). With partners free in their choice of strategies and governance mechanisms, this study of an observable case of a coal phase-out contributes to a better understanding of the different approaches to exnovation governance followed in practice. Lessons learned from this particular case may be applied in the study of future exnovation processes in energy systems, such as a natural gas or nuclear phase-out. Secondly, this article examines the value of Heyen et al.'s framework of exnovation governance and includes recommendations on how to further adjust this framework to better account for the empirical observations.

The remainder of the article is organised as follows. Section 2 introduces the concept of exnovation, its connection to sustainability, and governance mechanisms for exnovation discussed in the literature. Section 3 offers a brief introduction of the case study. Section 4 describes the research method applied. The main research findings are presented in Section 5, followed by a number of concluding remarks and an outline of potentials for future research in Section 6.

2 Conceptual framework

Section 2 reviews the exnovation literature and identifies important categories of analysis which form the basis for the empirical analysis presented in this article. The following subsections focus on the concept of exnovation (2.1), its relevance to the sustainability debate (2.2), and the governance mechanisms identified in the literature (2.3).

2.1 Exnovation

The term "exnovation" can be traced back to the organisational management literature of the 1980s. Discussing the life cycle of managerial innovation, Kimberly (1981) defines exnovation as "the removal of an innovation from an organization … in which it had previously invested" (ibid: 92), either because they have been superseded by new innovations, because they do not perform well enough to justify continued use, or due to a change in executive priorities. Suggesting that

innovations may eventually be "discontinued, abandoned, rejected or demoted" (Frost and McHann, 2015), exnovation is seen as the final stage in a sequence of stages in the diffusion and adoption of innovation. Since then, use of the term has spread to a number of fields, including public sector organisations (Hartley, 2005), product innovation studies (Yan, 2001), and health sciences, where it can refer to the *reduced use* or scaling back of harmful or outdated technologies and practices (Frank, 2004, Skinner and Chandra, 2016, Bekelis et al., 2017) or the *complete removal* of innovations (Ogbolu et al., 2013, Rodriguez et al., 2016). In the last few years, the concept of exnovation has increasingly made its ways into the literature on sustainability and environmental innovations.

2.2 Exnovation and sustainability

In their efforts to transition to a sustainable society, work on transitions and system changes have strongly focused on a "technological fix" (Leach et al., 2012). With respect to energy systems, this was largely driven by the belief that even though the challenge is immense, so are the technological possibilities (Raskin et al., 2002). However, with only a few years left to make unprecedented changes to global energy infrastructure and limit climate change (Intergovernmental Panel on Climate Change, 2018), it is clear that a focus on innovation alone is no longer sufficient to meet these goals (Robiou du Pont and Meinshausen, 2018). Furthermore, as argued by David (2018a; 2018b), unsustainable practices will prevail even under changed institutions unless the structures that enable them are removed. Alongside adding the new energy sources to the mix, sustainability-oriented management should thus also "identify that which should be replaced and thus avoided or reduced in the future" (Paech, 2012). In this context, the concept of exnovation is understood as "the purposive termination of existing (infra)structures, technologies, products and practices" (Heyen et al., 2017), or *deliberate* and forced removal of physical infrastructure (David, 2017), where "previous technologies or practices that are not suitable for climate protection and/or climatic conditions are discontinued or withdrawn from circulation" (Fichter, 2009, Fichter et al., 2010, Clausen et al., 2011). Going beyond one-time closing processes, the exnovation of unsustainable trajectories constitute "multi-layered and contested restructuring and transformation processes" (Kropp 2018). In some cases, the persistence of the existing can significantly "affect, delay or completely fail the emergence and the spread of the new" (Antes et al., 2012). Antes et al. (2012: 37) thus argue that "for sustainable path options to become path dynamics, the active dissolution of the existing non-sustainable is also required". This is particularly relevant for energy systems, where the long investment period associated with physical infrastructures create high degrees of path dependency and infrastructural, institutional and technological lock-in (Unruh, 2000, Fouquet, 2016). This high degree of lock-in ensures that the active dissolution of energy systems is unlikely to take place

overnight. For example, while Germany decided to terminate its nuclear energy production shortly after Fukushima, this decision will not come into effect until 2022. This is why, in practice, we often speak of a phase-out of certain energy technologies, which better captures the process of termination.

2.3 Governance of exnovation

In some cases, exnovation occurs without active intervention by actors. Within the context of innovation processes, this type of exnovation is strongly linked to Schumpeter's (1950) concept of 'creative destruction' and later literature on 'disruptive innovation' (Christensen, 1997, Markides, 2006), with established technologies being substituted by new alternatives (Markard and Truffer, 2008). Here, the introduction of new technologies or business models can lead to regime destabilisation (Turnheim and Geels, 2013, Turnheim and Geels, 2012, Johnstone and Hielscher, 2017) and ultimately result in product elimination (Avlonitis, 1983). With these processes considered too slow to meet the climate targets, this leaves the question: How can these processes of purposive termination be governed? Rather than a technological or economic by-product, the governance of exnovation thus treats this as a conscious political choice, thus closely linking to the literatures on policy termination (deLeon, 1978, Geva-May, 2004) and policy dismantling (Bauer and Knill, 2014). In their work on the productive functions of failure, Newig et al. (2018) describe the potentially important and productive role of actively destabilising unsustainable institutions, discussing the problems of 'unlocking' institutional regimes and subsequent re-stabilisation by technological substitution.

While the sociotechnical transitions literature has extensively studied technological exnovation through the process of creative destruction, the active governance of exnovation has received much less attention to date. Nevertheless, the literature has begun to identify important categories to indicate a spectrum of governance approaches and design principles, looking at both the policy- and politics dimension (David, 2014, Heyen et al., 2017, David, 2017). This article puts forward an analytical framework consisting of three categories derived from Heyen et al. (2017), namely actor interaction (hereafter referred to as the political dimension), policy instruments and the time-horizon of the exnovation process. By combining different possible characteristics within these categories, different governance approaches can be identified.

Firstly, from a **political dimension**, governance approaches focus on the role of actors and authority, with possible approaches including coalition, coercion or consensus. Under a *coalition approach*, exnovation approaches are based on a broad coalition of actors from within and outside the political system sharing certain goals and/or motives. Actors within such a coalition coordinate with each other in order to develop and implement their preferred ideas into

government programmes (Weible 2005). A *coercive approach*, on the other hand, focuses on a unilateral government decision in which the government imposes its wishes on other actors. While such an approach risks creating conflict with those opposing the decision, governments can exercise their power to achieve intended goals (Day, 1986). Under a *consensual approach*, government can negotiate the terms of exnovation with relevant stakeholders, and by getting supporters and opponents together for a negotiated compromise can create a sense of "ownership" of the outcome (Schneider et al., 2003).

Secondly, from a **policy dimension**, governance approaches focus on a range of instruments for termination, including positive and negative *incentives*, *bans* or *standards* to achieve exnovation. While economic instruments, for example, seek to effect change or influence behaviour by impacting on market signals (World Health Organisation, n.d.), thus removing the business case for unsustainable technologies, bans can be considered as a more direct instrument to enact environmental policy (Owen, 2004). Standards, finally, constitute a more indirect instrument (e.g. establishing more ambitious standards such as efficiency requirements) to influence business cases or effectively ban certain technologies or practices.

Thirdly and finally, exnovation processes take place over a certain **time-horizon**, either in the short term – with an almost immediate ban where alternatives are easily available – or through an extended transition period, often in the form of a phase-out (Heyen et al. 2017). A transition period may in some cases be required to reduce resistance to proposed changes, giving companies, employees and affected communities time to adjust (Bardach, 1976, deLeon, 1978). These categories are applied to the empirical case study of the PPCA in Section 4.

3. Case Study: The Powering Past Coal Alliance

The Powering Past Coal Alliance was founded during the COP23 in Bonn, Germany, by Canada and the UK in November 2017 and made up of 28 countries, 8 sub-national governments, and 28 business and organisations by April 2018 (see Table 1). Bringing together national and sub-national governments, as well as businesses and organisations, the explicit goal of the alliance is to "help accelerate clean growth and climate protection through the rapid phase-out of traditional coal-fired electricity" (Powering Past Coal Alliance, 2017). Since this article looks specifically at the public governance of exnovation, the analysis focuses exclusively on national and sub-national government partners of the PPCA.[1] In this article, exnovation refers to the process of

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[1] Local governments are excluded from the analysis due to their limited authority to design and implement phase-out decisions of state-wide or national generating capacity. Some of these jurisdictions are covered by higher-level authorities, such as Los Angeles (State of California), the city and county of Honolulu (State of Hawaii), and the city of Vancouver (British Columbia).

removing coal-fired electricity generating capacity. In order move away from coal, government partners agree to phase out existing traditional coal power and ban any new traditional coal-fired power stations without carbon-capture and storage within their jurisdictions. The partners further agree to work together to "share real world examples and best practices" (ibid.). The Declaration thus explicitly leaves open the choice of instruments and governance approaches to achieve its goals. Despite a bias to the global North, the PPCA provides a valuable case of conscious exnovation by a range of different governments, at different levels of governance, from different parts of the world, constituting one of the few examples of exnovation at this scale.

Table 1: List of partners in the Powering Past Coal Alliance

Countries (30)		Sub-national governments (17)
Austria (AT)	Liechtenstein (LI)	Australian Capital Territory (ACT)
Angola (AO)	Lithuania (LT)	**Government of the Balearic**
Belgium (BE)	Luxembourg (LU)	**Islands, Spain (IB)**
Canada (CA)	Marshall Islands (MH)	**Province of Alberta (AB)**
Costa Rica (CR)	**Mexico (MX)**	Province of British Columbia (BC)
Denmark (DK)	**Netherlands (NL)**	**Province of Ontario (ON)**
El Salvador (SV)	**New Zealand (NZ)**	Province of Quebec (QC)
Ethiopia (ET)	Niue (NU)	South Chungcheong Province, South
Fiji (FJ)	**Portugal (PT)**	Korea (SCP)
Finland (FI)	Senegal	**State of California (US-CA)**
France (FR)	**Sweden (SE)**	**State of Connecticut (CT)**
Ireland (IE)	Switzerland (CH)	**State of Hawaii (HI)**
Israel (IL)	Tuvalu (TV)	**State of Minnesota (MN)**
Italy (IT)	**United Kingdom (UK)**	**State of New York (NY)**
Latvia (LV)	Vanuatu (VU)	**State of Oregon (OR)**
		State of Washington (WA)
		Scottish Government (SCT)
		Welsh Government (WLS)

Note: The list includes all national and sub-national governments who signed up to the PPCA by January 2019. (Source: Powering Past Coal Alliance, n.d., last accessed March 19, 2019.)

A number of national and sub-national governments were excluded from the analysis for a variety of reasons. First, of the 47 national and sub-national governments, 16 countries and regions have never used coal to meet their electricity needs.[2] Without clear policies or governance approaches to phase out coal, there appears to be little we can learn from these cases in terms of exnovation pathways. Second, the Australian Capital Territory is excluded from this analysis as it has no coal-fired generating capacity of its own, instead importing about 99 per cent of its electricity from neighbouring New South Wales and the broader National Energy Market (Australian Capital Territory Government 2011). Finally, South Chungcheong Province in South Korea is excluded

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[2] These include: Angola, Costa Rica, El Salvador, Ethiopia, Fiji, Latvia, Liechtenstein, Lithuania, Marshall Islands, Niue, Senegal, Switzerland, Tuvalu, Vanuatu, the Provinces of British Columbia and Quebec.

due to language issues, which meant that insufficient reliable and detailed information could be retrieved beyond media reports.

A further three countries have recently phased out coal from electricity production, notably Luxembourg in 1997, Ontario in 2014 and most recently Belgium, in 2016. However, with the phase-out in Luxembourg seen as the result of a strategic decision by industry to introduce electric furnaces (International Energy Agency, 2014) rather than government policy, this country is excluded from this analysis. A closer examination of the exnovation pathways followed by Ontario and Belgium, however, may provide more valuable information in terms of the followed governance approaches. Scotland and Wales are included in the analysis of the United Kingdom as energy policy is reserved specifically for UK Parliament under the terms of devolution.

The remaining 23 countries and regions have made explicit their intention to phase out the unabated use of coal in electricity generation at some point in the future[3], ranging from 2021 in the case of France (White, 2018), to 2035 for the State of Oregon (Oregon Senate Bill 1547-B 2016). The remainder of this paper thus focuses on those 25 countries and regions (marked bold in Table 1) that have recently phased out coal from electricity production or have signalled their intention to do so in the near future.

4. Methods

This article studies the governance approaches followed by the 25 PPCA partner countries and regions identified in Section 3 through the lens of the three categories identified in Section 2.3 (political dimension, policy dimension, time-horizon). The analysis presented in this paper relies on publicly available information drawn from a wide range of documents for each of the countries/regions, including IEA country reports, energy statistics, national policy documents and legislation, and information pertaining to energy providers, thus allowing the author to triangulate information from different sources. A search of online databases of local, national and international newspapers further provided valuable contextual information. In total 159 documents were reviewed (see Appendix I for more detail).

The search focused both on documents in English and the respective country's native language. Publications in English, German and Dutch were analysed directly. Publications in other languages were translated into English using Google Translate. Translations were then checked

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[3] These include: Austria, Canada, Denmark, Finland, France, Ireland, Israel, Italy, Mexico, the Netherlands, New Zealand, Portugal, Sweden, the United Kingdom, the Balearic Islands, the Province of Alberta, and the States of California, Connecticut, Hawaii, Minnesota, New York, Oregon and Washington.

for consistency with English-language documents and – if required – corroborated for accuracy by native speakers.

Texts were coded using the MAXQDA software package. The author applied a simple coding method, mirroring the categories and sub-categories identified by Heyen et al. (see Section 2.3) to thematically group the relevant information. Relevant fragments of texts were identified through in-depth reading of the material and coded according to the relevant sub-category (see Table 2). These categories are not exclusive as governments can – and often do – rely on a range of political tactics and policy instruments to achieve its goals. These codes served as the basis for identifying the different governance approaches presented in Sections 4 and 5.

Table 2: Coding scheme on categories of exnovation governance (based on Heyen et al. 2017)

Category	Sub-category	Code	Example:
Political dimension	n.a.	n.a.	*Insufficient information available*
	None /	A	*"phase-out the result of a change in market conditions"*
	Coalition	B	*"Federal, provincial and territorial governments will work together to accelerate the coal phase-out"*
	Coercion	C	*"Plans to ban coal have met a heated response from power suppliers"*
	Consensus	D	*"The government will work together with business, industry and affected communities"*
Policy dimension	n.a.	*n.a.*	*Insufficient information available*
	None	*1*	*"Action to phase-out coal under consideration"*
	Ban	*2*	*"The use of coal will be prohibited by 2030"*
	Incentives	*3-* *3+*	*"Coal pricing and carbon support mechanisms will make coal generation economics significantly less favourable than natural gas"* (negative); *"transition payments will be made to coal generators"* (positive)
	Standards	*4*	*"Strict performance standards will be applied to coal-fired generating capacity"*
Time-horizon	-	-	*"[Country X] has plans in place to phase-out coal-fired electricity by 2030"*

5. Results

The following section focuses on the results of the analysis, looking in turn at the political dimension (5.1), policy dimension (5.2) and time-horizon (5.3) of exnovation processes in the selected countries and regions.

5.1 Political dimension

The analysis presented paid particular attention to evidence relating to the adoption of certain governance approaches in the political decision-making process. As explained in section 2, these

modes of governance can broadly be grouped under 'coalition', 'coercion' and 'consensus' approaches. An overview of the modes of governance in the selected PPCA partner countries and regions can be found in Table 3 below.

Table 3: Overview of political dimension in selected PPCA partners

Member	Code	Evidence political dimension
Austria	n.a.	
Balearic Islands	D	Broad participation process involving companies, social entities, associations and individuals in the formulation of the Balearic Law on Climate Change and Energy Transition, including coal phase-out
Belgium	A	Phase-out due to change in market conditions for coal rather than proactive government policy, with old generation capacity closed rather than retrofitted to meet greenhouse gas emissions standards
Canada	n.a.	
Denmark	n.a.	Not specified, but long tradition of governing by consensus between political parties
Finland	C	Despite opposition from the energy industry, the Finnish government will propose legislation to ban coal as an energy source
France	n.a.	Country yet to make public further details
Ireland	n.a.	Government continuing to examine options, to be decided before 2020
Israel	n.a.	Plan developed and proposed by Minister for Energy, still requires a phase of public consultation and comment before becoming a cabinet resolution
Italy	D	National Energy Strategy 2017 arose from a wide participative process including all public and private stakeholders in the sector, both in its preliminary stage and in the public consultation process
Mexico	A	Contrary to phasing-out coal, then President-elect Andrés Manuel López Obrador announced intending to open a new coal-fired power plant
Netherlands	C	Shift from consensus-based approach including a wide range of stakeholders, using incentives to encourage the closure of coal-fired power plants, to a coercive approach. Likely the result of increasing pressure to meet emissions reduction targets and ruling in *Urgenda*-case in Court
New Zealand	D	Broad consultation campaign that consulted business, churches, Maori groups and organisations, community organisations and young people
Portugal	n.a.	Insufficient information available
Sweden	A	Last coal-fired power plant to be closed in 2022
United Kingdom	D	Consultation process including individuals, business, trade bodies, NGOs and other organisations
Province of Alberta	D	Strategy brought together government, business, industry and the public, introduction of a new government led to inclusion of stakeholders who did not previously have a regular audience with the government
Province of Ontario	B/C	Regulation banning coal use points to coercive approach. In addition, community groups, municipalities and health organisations joined together in the Ontario Clean Air Alliance, to create support for action within government.
State of California	n.a.	Insufficient information available
State of Connecticut	A	No strong history of coal in the state, closure of power plants due to market conditions for coal rather than as a result of political action
State of Hawaii	B	Energy agreement based on involvement of only a small group of actors (administration, government departments, consumer advocate, electric companies)
State of Minnesota	A	Closure of power plants due to market conditions for coal compared to natural gas and renewables rather than as a result of political action

State of New York	n.a.	Insufficient information available. Proposal developed by Governor's office and state departments will take into account comments from stakeholders and public hearings
State of Oregon	D	Coalition of regional and national environmental groups, working with the two largest utilities in the State, as well as the state's utility consumer advocate
State of Washington	D	Negotiations between the State, TransAlta, environmental advocates and labour groups

The analysis of documents relating to the coal phase-out strategies of the selected PPCA countries and regions revealed that the political dimension is strongly underrepresented in the coding results. Out of the 25 countries and regions analysed, 14 either did not appear to have a clear political strategy to phase out coal (coded as 'A') or provided insufficient information to draw a reasoned conclusion ('n.a.'). There are a number of possible explanations for this underrepresentation. First, for some documents (e.g. IEA reports), the political dimension is beyond the purview of their reports, and therefore not explicitly discussed. Formal policy documents such as legislation and energy strategies often similarly omit explicit references to the governance process. In these cases, the analysis had to rely on NGO reports and online newspapers for more detail. Second, as governments have joined the Alliance only recently, some of them have yet to formulate or announce a clear strategy, as is the case in Ireland (Department of Communications Climate Action & Environment, 2018) and Denmark (Government of Denmark, 2018), where parties have agreed to investigate how, and under what time-horizon, coal can be phased out, and France (Ministère de la Transition Écologique et Solidaire, 2017), where no details have yet been made public.

In a number of countries and regions, the phase-out of coal-fired electricity is expected to occur without a need for government intervention. With the economics of coal-fired power generation increasingly under pressure, market actors increasingly decide to withdraw this generating capacity from the market, retiring existing coal-fired generating capacity or replacing it with cleaner alternatives. This has been observed in Belgium in the past (Europe Beyond Coal, 2018) and is likely to be the case in countries such as Austria (Climate Action Network Europe, 2016) and Sweden (Andersson, 2017), where energy companies have already announced the retirement of the last coal-fired power plants. This particular line of reasoning may, however, obscure important political aspects. The ageing of coal-fired capacity may, for example, be the result of a long-standing popular or political opposition to the construction of new capacity which could not fully be accounted for in this study. Based on the little evidence collected, it is impossible to draw definitive conclusions on the governance pathways adopted by PPCA members. Nevertheless, elements of by Heyen et al.'s (2017) governance approaches could be identified in the different cases. With respect to the *coalition approach* ('B'), this analysis has revealed only little evidence of settings in which like-minded actors from within and outside the political system worked

together to achieve a coal phase-out. In the Province of Ontario, however, community groups, municipalities and health organisations together formed the Ontario Clean Air Alliance to create support for action within government by focusing on the health benefits of a coal phase-out (Cundiff, 2015). While it is not clear to the author to what extent this actor coalition has affected the government's decision to ban coal-fired electricity generation, it cannot be ruled out.

In a small number of cases (*n*=3), governments have opted for a more *coercive approach* ('C') to phase out coal from electricity generation. In 2007, the Province of Ontario adopted Regulation 496/07 on the Cessation of Coal Use, banning coal-fired electricity generation by 2015. In April 2018, the Finnish government has confirmed it will propose legislation for a similar ban, despite strong opposition from the energy industry (Yle, 2018). In the Netherlands, a shift has been witnessed away from the traditional consensus-based energy policy and towards a coercive approach when the government imposed a ban on coal-fired electricity from 2030 in May 2018 (Rijksoverheid, 2018). This decision almost certainly has to be seen in conjunction with a recent court-ruling in the *Urgenda*-case, in which the country was ordered to step up its efforts to cut CO_2-emissions (Gerechtshof Den Haag, 2018).

Finally, for a number of PPCA partners (*n*=7), the analysis was able to identify elements of a *consensus-based approach* ('D') to phase out coal. The United Kingdom (Department for Business, 2018b) and New Zealand (Environment, 2018) launched a broad consultation process on proposals to end unabated coal generation. In the development of its National Energy Strategy of 2017, Italy involved over 250 stakeholders from associations, companies, public entities, citizens and representatives of academia from the preliminary stage (Ministero dello Sviluppo Economico and Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 2017). In the State of Washington, discussions took place between government and coal-fired operators in order to work out solutions acceptable to both parties (TransAlta, 2016, Paulos, 2018). There is some evidence to suggest that such processes may be a break from tradition in some cases, demonstrated by the State of Oregon, in which the process for the first time brought together regional and national environmental groups with electric utilities (Natural Resources Defense Council, 2016) and the Province of Alberta, in which a change in government led to the inclusion of stakeholders who would previously not have been consulted (Vriens, 2018). However, to adequately assess the quality and legitimacy of the participative process, as well as the degree of consensus achieved would require an in-depth case study analysis and stakeholder consultation, something that cannot be achieved within the confines of this article.

5.2 Policy dimension

Government partners to the PPCA can rely on a range of policy instruments, including bans, financial incentives and standards to achieve the goal of phasing out coal. Currently, a limited number of countries (*n=6*) do not appear to have policies in place. Of these, Austria and Sweden are on track to phase out coal without a need for intervention, while Ireland is continuing to examine the available options (Department of Communications Climate Action & Environment, 2018). In the State of Minnesota, utilities themselves are requesting the government for permission to retire or replace coal-fired generating capacity. Mexico, here, appears to be somewhat of an outlier. Currently, the country does not have specific plans in place to retire older coal-based infrastructure (Viscidi, 2018). While it is reported to be investigating action to reduce the use of coal (Climate Transparency, 2017), at the same time, Mexico's Federal Electricity Commission is investigating the option of opening a new state-owned coal-fired power plant (La Politica Online, 2018). An overview of the policy instruments adopted can be found in Table 4 below.

Table 4: Overview of policy dimension in selected PPCA partners

Member	Code	Evidence policy dimension
Austria	1	No specific policies on how coal phase-out is to be achieved
	3-	In favour of a minimum CO_2 price in the EU Emission Trading Scheme
Balearic Islands	2	Balearic Law on Climate Change and Energy Transition mandates the gradual closure of the coal-fired power plant by 2025
Belgium	4	EU air quality requirements
	3-	End to excise duty exemption; tax for energy produced from coal
Canada	4	Emission performance standards for coal-fired power plants
Denmark	3+	Financial incentives for conversion of coal-fired power plants to combined heat-and-power CHP
Finland	3-	Tax and aid schemes to price out coal
	3+	Subsidy package to reward energy firms to phase out coal before deadline
	2	Finland will propose legislation to ban coal as an energy source.
France	3+	Support to shut down or convert the last coal-fired power plants, no further detail provided
Ireland	3-	Drop in coal volumes attributed to increasing coal pricing and the UK's carbon Price Support Mechanism
	1	Department of Communications, Climate Action and Environment continuing to examine options
Israel	4	Stricter limit on emissions in permits for coal-fired power plants
Italy	3-	Concrete actions lacking, but Strategy proposes a carbon floor price
	3+	Proposed reimbursements for stranded costs of producers
Mexico	1	Significant action to reduce or phase-out coal under consideration
Netherlands	3+	Tax exemption for electricity produced from coal reintroduced to compensate energy companies for the closure of coal-fired power plants
	3-	Grants for co-firing biomass halted after 2024
	2	Law banning the use of coal for electricity production
New Zealand	3-	End of tax exemption on coal used to produce electricity

Portugal	3-	Reform of domestic carbon tax; removal of tax exemptions to coal-fired generation
Sweden	1	No proactive government policy
United Kingdom	3-	UK Carbon Price Support Mechanism
	4	Emission intensity limit to generating units
	3+	Capacity market scheme to provide back-up generating capacity (currently suspended), paid through consumer energy bills
Province of Alberta	3+	Transition payments to companies operating coal-fired power plants beyond 2030, representing the approximate disruption to capital investments. Paid from recycled industrial carbon taxes, thus avoiding an increase in consumer prices.
Province of Ontario	2	Regulation ordering the cessation of coal-use in coal-fired power plants
	3+	Subsidy payments to compensate for operating losses
State of California	4	Bill prohibiting energy utilities from entering into long-term financial commitments for baseload generation unless it complies with greenhouse gas emission performance standards
State of Connecticut	1	No proactive government policy, symbolic commitment to prohibiting the future construction of coal-fired power plants
State of Hawaii	2	Regulators reject an extension of the power purchase agreement between the plant owner and Hawaiian Electric after 2022, effectively banning coal
State of Minnesota	1	No proactive government policy, utilities requesting to retire or replace coal-fired generating capacity with natural gas plants.
State of New York	4	CO_2 performance / carbon emissions standard for electric generating facilities with a generating capacity of at least 25MW
State of Oregon	4	Other: PGE allowed to install fewer pollution controls in exchange for early closure
State of Washington	4	Greenhouse-gas emission performance standard for baseload electricity generation
	3+	Maintaining existing tax breaks for coal

Few partners (*n*=5) have opted to *ban* ('2') coal-fired electricity generation. As mentioned previously (see 5.1), the Finnish Environment Minister in April 2018 confirmed that the government would propose legislation banning the use of coal in energy generation in the coming year (Morgan, 2018). The Netherlands followed suit shortly afterwards in May 2018, which together with Ontario, makes these the only countries to place an outright ban on coal-fired electricity generation. Placing an outright ban on coal-fired electricity generation may be more straightforward where generating capacity is operated by state-owned utilities rather than private market actors, which is the case in the Balearic Islands, the Province of Ontario and the State of Hawaii. As will be explained in further detail below, other instruments can and have been used to indirectly achieve this goal through different means.

A large number of signatories to the PPCA have proposed or introduced a range of *incentives* ('3') to ensure a transition away from coal. These incentives can be negative – increasing the price of coal and thus making coal generation substantially less favourable compared to (cleaner) alternatives – or positive – encouraging a shift to alternative sources of energy through the positive reinforcement of new or existing initiatives. In many cases, a combination of both can be

found (see Table 4 for an overview of policy measures). Negative incentives often come in some form of carbon pricing or the removal of existing tax exemptions for electricity produced from coal. The Netherlands, in its 2017 Coalition Agreement (VVD et al., 2017) halted existing grants for the co-firing of biomass in coal-fired power stations after 2024, which is likely to render this option less economically attractive for energy companies. Positive incentives include financial support for the conversion of coal-fired power plants to other technologies, as is the case in Denmark (International Energy Agency, 2017b), subsidy packages for early movers in Finland (Yle, 2018), or tax breaks for electricity produced from coal, either to compensate for the closure of existing coal-fired power plants as was the case in the Netherlands in 2016 (Sociaal-Economische Raad, 2013), or to ensure companies' financial stability to transition to a cleaner source of energy as was the case in Washington (Washington Senate Bill 5769 2011). The Province of Alberta formally agreed to provide transition payments as compensation for unrecovered investments, the cost of which is estimated at CAD $1.1billion (approx. US$ 826 million) (Vriens, 2018). In the Province of Ontario, too, the Electricity Financial Corporation has received CAD $929 million to compensate it for the operating losses of its coal plants (Ontario Clean Air Alliance, 2011). In its 2017 Energy Strategy, the government of Italy explicitly recognises that the issue of reimbursement for stranded costs can be used as a "possible lever" to encourage a conversion away from coal (Ministero dello Sviluppo Economico and Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 2017).

Finally, *standards* ('4') are either in place or being considered by PPCA partners to provide an impetus to the coal phase-out. In some cases, partners have established new or tightened existing emission performance standard for electricity generation, such as Israel and the State of New York (see Table 4). In other cases, rather than regulate generating capacity directly, air quality requirements are established. In France, EU air quality requirements are considered to have forced the closure of fifteen coal-fired power plants that did not comply with emissions standards (International Energy Agency, 2017c), while in Belgium it has resulted in the closure or conversion to biomass of coal-fired power plants (International Energy Agency, 2016).

5.3 Time horizon

In their classification of exnovation, Heyen et al. (2017) state that short-termed exnovation processes may be possible in cases in which alternatives are easily available, minimal investments are required, or a long transition period is not considered socially acceptable, while extended transition periods may be useful to reduce resistance. The PPCA's Declaration clearly states that government partners commit to phasing out unabated coal power within their jurisdictions, but leaves open the time horizon within which this is to be achieved. While energy systems are

characterised by high costs and long investment periods, this analysis finds that there is considerable potential for a relatively quick innovation process in some countries and/or regions. Figure 1 below organises countries and regions according to the (proposed) time-horizon of the coal phase-out, showing the share of coal fired capacity in relation to the total electricity generation, the number of active coal-fired power plants, and the number of coal-fired power plants constructed before 1990.

Looking at Figure 1, the first observation is the relatively *high age of most generating capacity*. In a large number of countries and regions, the few coal-fired power plants that are still in operation are fast approaching the end of their technological lifespan. Nearing the end of their technological life-span, operators are thus faced with the choice of costly refurbishments to ensure power plants meet current air quality and emissions standards or conversion to biomass or, alternatively, retiring them. For these PPCA partners, the exnovation of unabated coal from electricity production may thus be relatively straightforward.

A second observation is that a number of countries and regions only recently commissioned *new coal-fired generating capacity*. In Italy, the last coal-fired power station was commissioned in 2009-10, while in the Province of Alberta the last coal-fired plant began commercial operations in 2011. The Netherlands, in turn, commissioned three of its five coal-fired power stations as late as 2015 and 2016. With the technological end-of-life and contracts running well beyond 2030, the forced closure of these facilities can be seen as a far-reaching intervention, with the Dutch Minister of Economic Affairs and Climate Policy considering it to constitute an intervention in the rights of the private owners of coal-fired power plants (Wiebes, 2017). Currently, two energy companies are expected to take the Dutch government to court over its recent decision to forcefully phase out coal (Nederlandse Omroep Stichting, 2018).

Finally, Figure 1 above demonstrates another important point in that most countries coal-fired electricity generation plays only a *minor role as a share of the energy mix*. For these countries, the (economic) investment required to move away from coal and replace it with alternative technologies available may be relatively limited. A shorter time-horizon of the exnovation process can thus logically be expected. The biggest users of coal, in absolute terms, include Italy, the Netherlands and the Province of Alberta (itself accounting for over sixty per cent of Canada's coal-fired generating capacity), suggesting that governments would face a much stronger challenge to phase-out coal in the short-term future in these jurisdictions. With a quick exnovation process looking unlikely, it is exactly these governments that have introduced (or proposed) compensation or transition payments (Italy and Alberta) and a mandatory ban on coal-fired electricity generation (Netherlands).

Fig. 1: Time-horizon of coal exnovation in PPCA partner countries and regions
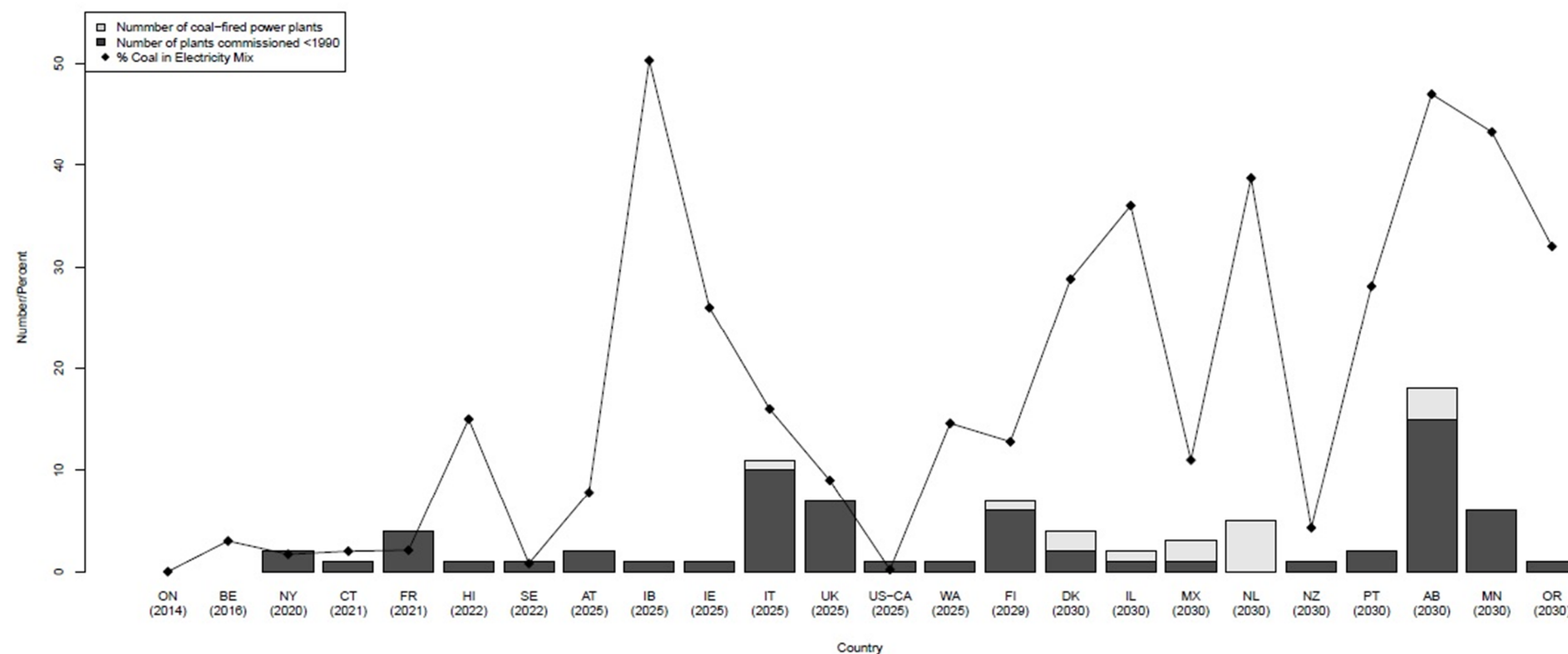
Note: Data on share of coal in electricity mix collected from IEA energy statistics (2018), with the exception of Austria (E-Control, n.d.), Belgium (Federatie van de Belgische Elektriciteits- en Gasbedrijven, 2018), Canada (Government of Canada, 2018), the UK (Department for Business, 2018a), the Balearic Islands (RED Eléctrica de España 2018), the Canadian Provinces of Alberta and Ontario (Government of Canada, 2018), and the States of California (California Energy Commission, 2018), Connecticut, Hawaii, Minnesota and New York (U.S. Energy Information Administration, n.d.), Oregon (State of Oregon, n.d.) and Washington (Washington State Department of Commerce, n.d.). All shares are based on 2015-16 data.
Data on number and age of coal-fired power plants based on own research relying on a variety of sources, including Climate Action Network Europe, SourceWatch and website of individual power plant operators. Numbers for Canada are excluded from this figure to avoid those provinces that did not sign up to the PPCA.

6. Discussion

This study aims to contribute to the further development of the concept of exnovation governance by applying the framework proposed by Heyen et al. (2017) to the empirical example of the Powering Past Coal Alliance. In doing so, the article contributes to a better understanding of the governance approaches used to phase out unabated coal. The following section thus focuses on the clusters of governance approaches that can be identified in the case study (6.1) and the broader implications of the findings of this research for the concept of exnovation governance (6.2).

6.1 Identifying governance approaches

Based on the findings presented in Section 5, four preliminary clusters of exnovation governance approaches can be identified.

1. **Cluster I:** No political strategy; no policy instruments for exnovation
2. **Cluster II:** Coercive approach; exnovation through ban
3. **Cluster III:** Consensus-based approach; exnovation through incentives
4. **Cluster IV:** No political strategy; exnovation through incentives

A more in-depth analysis would be required to corroborate and strengthen the findings presented here, particularly for those countries for which only limited information was available. A single-case study design could serve to enhance the insights into individual cases (see e.g. Yin, 2003). Particularly with respect to the political dimension, a more thorough analysis – e.g. interviews with decision-makers and other relevant stakeholders – could serve to shed more light on this underexposed aspect. Alternatively, a comparative small-*n* case study comparison could be applied to delve deeper into selected categories of exnovation governance to better understand commonalities and differences between cases. A clustering of approaches to exnovation governance is found in Figure 2.

Countries and regions in **Cluster I** have *no clear political strategy* and *no policy instruments* in place, for various reasons. In three of these cases, Austria,Sweden and the state of Connecticut, coal-fired electricity generation does not play an important role in the energy mix, with existing capacity scheduled to be phased out without a need for policy intensification. As their partnership in the PPCA is most likely symbolic in nature, they are unlikely to move out of this cluster. Ireland, on the other hand, relies on coal for more than a quarter of its electricity needs. With the government currently examining its options, it will almost certainly move out of this cluster before 2020. Mexico, finally, also currently does not have a specific governance approach to achieve phase out coal.

Fig. 2: Clustering of exnovation governance approaches
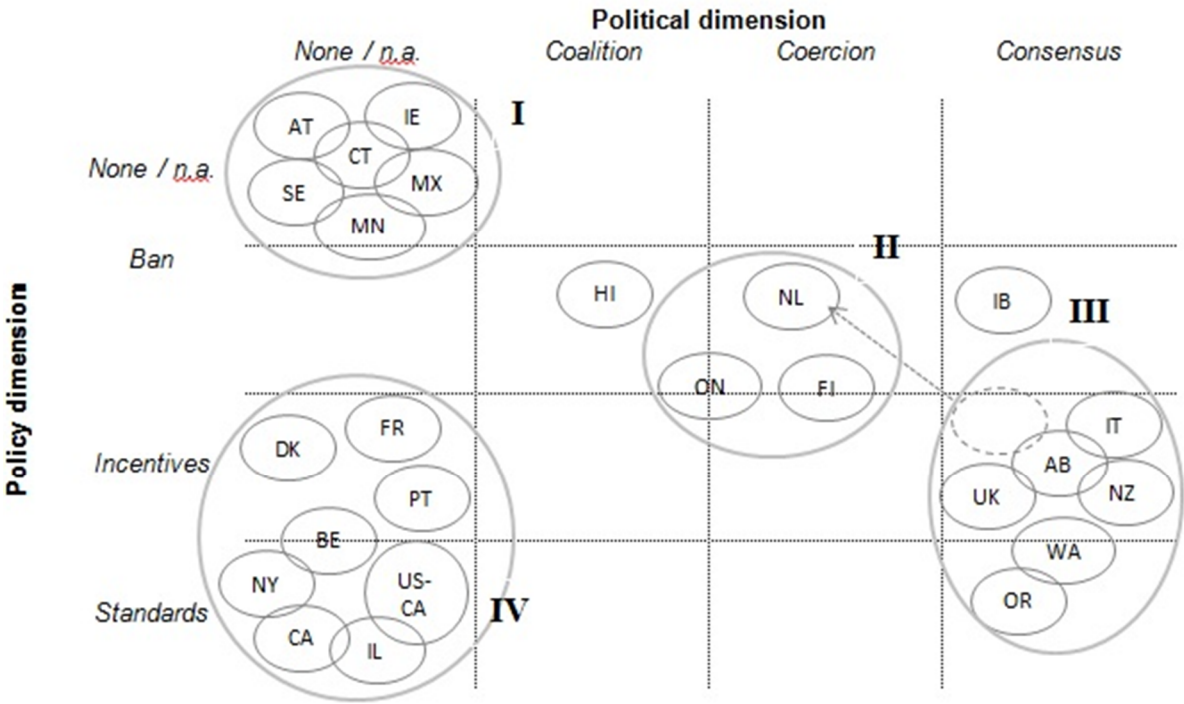
The national and sub-national governments in **Cluster II** have opted for a more *coercive approach* to phase out (unabated) coal-fired electricity generation, with all three governments placing an outright *ban* on coal-fired power within their jurisdictions. Different driving forces exist for the adoption of such an approach. In the Netherlands, the approach stems from the need to rapidly reduce greenhouse gas emissions by 2020 so as to meet its existing climate commitments. In the Province of Ontario, the problem was framed in terms of a "public health crisis" demanding urgent action. None of the governments have a vested interest in coal, with no coal deposits or coal-mining industry in their jurisdictions. Nevertheless, in both the Netherlands and Finland, this decision has met with strong opposition from certain actors in the energy sector. The Province of Ontario has managed to overcome opposition to this ban by agreeing to compensation payments to Ontario Power Generation, an issue that currently looks likely to surface in the Netherlands.

Countries and regions in **Cluster III** have adopted a *consensus-based approach*, with policy instruments to phase out coal revolving around positive and/or negative *incentives*. This cluster appears to contain a high degree of diversity - New Zealand, for example, only has one coal-fired power plant which is already scheduled to be shut down by 2025, while Italy, the United Kingdom and the Province of Alberta have a high number of coal-fired generating capacity. Nevertheless, they have in common an ageing and fleet of coal-fired generating capacity owned and operated by private utilities. Governments in this cluster engage with market actors through a range of

participative processes (e.g. public consultation) to achieve their intended goals. While the State of Ontario did not offer direct financial incentives to the State's only coal-fired power plant operator, the decision to allow the plant to install fewer pollution controls in exchange for early closure can be perceived as such. Where an intensification of efforts is required (either because countries are not meeting existing targets or because an overall intensification of efforts is required to keep global temperature rise within 1.5°C), the future may witness a shift away from consensus-based models focusing on incentives and towards more coercive models where coal-fired generation will be banned outright. While the issue of financial compensation for coal-fired operators currently remains controversial, evidence from the PPCA suggests it may be an effective instrument to intensify the exnovation process.

Finally, there are those countries and regions grouped together in **Cluster IV**. Although partners in thus cluster currently appear to have *no clear political strategy*, they have a range of *policy instruments in place* to phase out coal-fired electricity generation. As this cluster contains quite a few countries for which insufficient information was available – particularly with respect to the political dimension – closer analysis undertaken as part of single- or small-*n* case studies may allow researchers to delve deeper into the details of these cases and thus result in a shift to the right of the figure.

6.2 Implications for the exnovation governance framework

Based on the analysis presented, this article finds that the exnovation governance framework proposed by Heyen et al. (2017) offers valuable guidance for the study of governance processes in the case of the Powering Past Coal Alliance, revealing key features of governments' phase-out approaches. Nevertheless, it has a number of weaknesses, which do not necessarily reduce its usefulness as a tool to study governance processes, but which should nevertheless be addressed to strengthen its analytical value for future studies.

With respect to the **political dimension**, this article finds that the framework is largely ineffective to study the political aspects accompanying the decision to phase out coal in this medium-*n* case study setting. Although the lack of a clear political strategy for some PPCA members hampered a detailed analysis in some cases, overall there exists a lack of available information concerning the governance approach adopted and the role of different actors therein. While the analysis found initial evidence for each of the governance approaches identified in the framework, further research is required to provide a more nuanced picture on how governments arrived at the exnovation decision and how actor-coalitions influenced this process. This includes looking at ownership structures and ties between governments and the electricity sector. The framework

would therefore benefit from cross-fertilization with political science theories, which are more explicit about aspects such as advocacy coalitions, power dynamics and the legitimacy of participative processes.

Looking at the **policy dimension**, Heyen et al.'s (2017) framework distinguishes between 'direct' (e.g. bans) and 'indirect' exnovation instruments, e.g. efficiency requirements. While a number of governments are currently still in the process of formulating clear policies, overall, they largely appear to rely on (1) positive and negative incentives or (2) standards to discourage the use of coal for electricity generation. This research demonstrated that while few countries have banned the use of coal outright, indirect instruments such as stricter emission standards or air quality regulations are purposefully designed in such a way to effectively rule out coal as a viable technology. The relationship between direct and indirect instruments should therefore be explored in more detail in future exnovation studies. Further research is also required to better examine why different policy tools are selected by policy-makers and whether certain political approaches favour certain policies.

Finally, with respect to the **time-horizon** of exnovation, the exnovation governance framework takes into account socioeconomic, technological and political factors. This research found that those PPCA partners with a low share of coal in the electricity mix or with a high share of ageing coal-fired power plants within their jurisdictions are more likely to feature short-term exnovation processes, retiring coal-fired generating capacity when it can no longer compete in the market or requires costly refurbishment. Conversely, countries and regions that rely on coal for a larger share of their electricity needs or have recently commissioned new generating capacity are likely to feature long-term exnovation processes. This simple argument may obfuscate a deeper, underlying long-term political commitment to phase out coal. Future empirical applications of this framework should thus take care to pay sufficient attention to such institutional path dependencies and lock-ins.

7. Conclusion

The relevance of the PPCA has been questioned in recent past, arguing that those countries that joined the Alliance account for less than 3 percent of global coal use (Plumer and Popovich, 2017), and that it primarily focuses on industries that were already naturally declining (Jewell et al., 2018). Nevertheless, the findings presented in this article are important in three ways. First, this article contributes to a betterment of the exnovation governance framework proposed by Heyen et al. (2017). The three categories of exnovation governance (political dimension, policy dimension, time-horizon) have proven to be useful 'lenses' through which to observe exnovation

processes. The author would welcome the application of these categories to alternative examples of exovation to further test the framework's analytical strength, taking into account the recommendations made in the previous section. This author particularly encourages small-*n* case studies that focus on an in-depth analysis and comparison of exovation governance in two or three countries. Second, while the partner countries and regions do indeed only make up a small share of global coal-fired electricity generation, empirically the findings presented here may provide valuable starting points for the development of regulation in other countries which currently rely on coal for a large share of their electricity generation (e.g. China and India). Finally, the author recommends that these categories of exovation governance be extended to the real-world exovation of other technologies (e.g. natural gas or crude oil) and other sectors (e.g. transportation) that count for a large share of global greenhouse gas emissions and are not yet declining. In this way, the lessons learned from the Powering Past Coal Alliance can be used to steer the purposeful destabilisation of other unsustainable technologies.

8. References

AGENCY, I. R. E. 2017. Renewable Energy: A Key Climate Solution. IRENA.

ANDERSSON, A. 2017. *Fortum Värme fasar ut kolet i Stockholm. Stockholms stad har utsett Fortum Värme till månadens klimatsmarta exempel i december.* [Online]. Stockholm Exergi. Available: https://www.stockholmexergi.se/nyheter/fortum-varme-fasar-ut-kolet-i-stockholm/ [Accessed December 7 2018].

ANTES, R., EISENACK, K. & FICHTER, K. 2012. Wirtschaftswissenschaftliche Ansätze zur Gestaltung von Wandlungsprozessen. *Ökologisches Wirtschaften,* 3**,** 35-39.

ARNOLD, A., DAVID, M., HANKE, G. & SONNBERGER, M. (eds.) 2015. *Innovation - Exnovation: Über Prozesse des Abschaffens und Erneuerns in der Nachhaltigkeitstransformation,* Marburg: Metropolis-Verlag.

Australian Capital Territory Government. 2011. ACT Sustainable Energy Policy: Energy for a sustainable city. Published by the Environment and Sustainable Development Directorate.

AVLONITIS, G. J. 1983. Ethics and Product Elimination. *Management Decision,* 21**,** 37-45.

BARDACH, E. 1976. Policy Termination as a Political Process. *Policy Sciences,* 7**,** 123-131.

BAUER, M. W. & KNILL, C. 2014. A Conceptual Framework for the Comparative Analysis of Policy Change: Measurement, Explanation and Strategies of Policy Dismantling. *Journal of Comparative Policy Analysis: Research and Practice,* 16**,** 28-44.

BEKELIS, K., SKINNER, J., GOTTLIEB, D. & GOODNEY, P. 2017. De-adoption and exnovation in the use of carotid revascularization: retrospective cohort study. *BMJ (Clinical research ed.),* 359**,** j4695.

CALIFORNIA ENERGY COMMISSION 2018. Electric Generation Capacity & Energy.

CHRISTENSEN, C. M. 1997. *The Innovator's Dillema: When New Technologies Cause Great Firms to Fail,* Boston, MA, Harvard Business Review Press.

CLAUSEN, J., FICHTER, K. & WINTER, W. 2011. Theoretische Grundlagen für die Erklärung von Diffusionsverläufen von Nachhaltigkeitsinnovationen. Berlin: Borderstep Institut.

CLIMATE ACTION NETWORK EUROPE. 2016. *Austria's biggest power company to quit coal by 2020* [Online]. Climate Action Network Europe,. Available: http://www.caneurope.org/publications/press-releases/995-austria-s-biggest-power-company-to-quit-coal-by-2020 [Accessed December 7 2018].

CLIMATE TRANSPARENCY 2017. Brown to Green: The G20 transition to a low-carbon economy. Mexico Country Facts 2017. Berlin: Climate Transparency, c/o Humboldt-Viadrina Governance Platform.

CUNDIFF, B. 2015. Ontario's Coal Phase Out: Lessons learned from a massive climate achievement. Ontario: Ontario Clean Air Alliance Research.

DAVID, M. 2014. Exnovation-Governance im Nachhaltigkeitskontext: Annäherung an eine Typologie. *Regierungsforschung.de, Forschung* [Online]. Available: http://regierungsforschung.de/exnovation-governance-im-nachhaltigkeitskontext-annaeherung-an-eine-typologie/.

DAVID, M. 2017. Moving beyond the heuristic of creative destruction: Targeting exnovation with policy mixes for energy transitions. *Energy Research and Social Science,* 33**,** 138-146.

DAVID, M. 2018a. Exnovation as a necessary factor in succesful energy transitions. In: DAVIDSON, D.J and GROSS, M. (eds.) *Oxford Handbook of Energy and Society*, Oxford: University Press, pp.519-538.

DAVID, M. 2018b. The role of organized publics in articulating the exnovation of fossil-fuel technologies for intra- and intergenerational energy justice in energy transitions. *Applied Energy 228*, 339-350.

DAY, P. 1986. Is the concept of freedom essentially contestable?. Philosophy, 61(235), 116-123.

DELEON, P. 1978. Public policy termination: An end and a beginning. *Policy Analysis,* 4**,** 369-392.

DEPARTMENT FOR BUSINESS, E. I. S. 2018a. Fuel used in electricity generation and electricity supplied.

DEPARTMENT FOR BUSINESS, E. I. S. 2018b. Implementing the end of unabated coal by 2025: Government response to unabated coal closure consultation. *In:* DEPARTMENT FOR BUSINESS, E. I. S. (ed.). Government of the United Kingdom.

DEPARTMENT OF COMMUNICATIONS CLIMATE ACTION & ENVIRONMENT 2018. Department of Communications Climate Action & Environment Annual Report 2017. *In:* ENVIRONMENT, D. O. C. C. A. (ed.). Government of Ireland.

E-CONTROL. n.d. *Statistiken für den Elektrizitäts-, Erdgas- und Ökostrombereich* [Online]. Available: https://www.e-control.at/statistik [Accessed August 28 2018].

ENVIRONMENT, N. Z. M. F. T. 2018. *15,000 submissions on Zero Carbon Bill consultation publicly released* [Online]. Available: https://www.mfe.govt.nz/news-events/15000-submissions-zero-carbon-bill-consultation-publicly-released [Accessed December 7 2018].

EUROPE BEYOND COAL 2018. Overview: National coal phase-out announcements in Europe. Status as of 22 June 2018. Europe Beyond Coal.

EVANS, K. 2018. *Genesis establishes a pathway to a coal-free electricity future* [Online]. Available: https://www.genesisenergy.co.nz/about/media-centre/news/genesis-establishes-a-pathway-to-a-coal-free-elect [Accessed March 28 2018].

FABER, A. & HOPPE, T. 2013. Co-constructing a sustainable built environment in the Netherlands - Dynamics and opportunities in an environmental sectoral innovation system. *Energy Policy,* 52**,** 628-638.

FEDERATIE VAN DE BELGISCHE ELEKTRICITEITS- EN GASBEDRIJVEN 2018. Statistieken elektriciteit: Productie, verbruik en productiecapaciteit van elektriciteit in België.

FICHTER, K. 2009. Interaktionsökonomik. Berlin: Borderstep-Institut.

FICHTER, K., VON GLEICH, A., PFRIEM, R. & SIEBENHÜNER, B. (eds.) 2010. *Theoretische Grundlagen für erfolgreiche Klimaanpassungsstrategien,* Bremen / Oldenburg: Projektkonsortium 'nordwest2050'.

FOUQUET, R. 2016. Path dependence in energy systems and economic development. *Nature Energy,* 1**,** 16098.

FRANK, R. G. 2004. Behavioral Economics and Health Economics. Cambridge, MA: National Bureau of Economic Research.

FROST, L. & MCHANN, J. 2015. Cleaning the Closet of Management Innovation: The Forgotten Stage of Exnovation. *Global Business & Economics Anthology,* 2**,** 15-31.

GEELS, F. & SCHOT, J. 2007. Typology of sociotechnical transition pathways. *Research Policy,* 36**,** 399-417.

GEELS, F. W. 2002. Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy,* 31**,** 1257-1274.

GERECHTSHOF DEN HAAG 2018. ECLI:NL:GHDHA:2018:2591 Den Haag: Gerechtshof Den Haag, Available: https://uitspraken.rechtspraak.nl/inziendocument?id=ECLI:NL:GHDHA:2018:2591.

GEVA-MAY, I. 2004. Riding the wave of opportunity: Termination in public policy. *Journal of Public Administration Research and Theory,* 14**,** 309-333.

GOVERNMENT OF CANADA. 2018. *Provincial & Territorial Energy Profiles* [Online]. Available: http://www.neb-one.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/index-eng.html [Accessed August 28 2018].

GOVERNMENT OF DENMARK 2018. Energiaftale af 29. juni 2018.

GROSS, M. & MAUTZ, R. 2015. *Renewable Energies,* Oxon & New York, NY, Routledge.

HARTLEY, J. 2005. Innovation in Governance and Public Services: Past and Present. *Public Money and Management,* 25**,** 27-34.

HEYEN, D. A. 2016. Exnovation: Herausforderungen und politische Gestaltungsansätze für den Ausstieg aus nicht-nachhaltigen Strukturen. *Öko-Institut Working Paper.* Freiburg [u.a.]: Öko-Institut e.V.

HEYEN, D. A., HERMWILLE, L. & WEHNERT, T. 2017. Out of the Comfort Zone! Governing the Exnovation of Unsustainable Technologies and Practices. *GAIA,* 26**,** 326-331.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 2018. GLOBAL WARMING OF 1.5 °C: an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. *In:* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (ed.).

INTERNATIONAL ENERGY AGENCY 2014. Energy Policies of IEA Countries: Luxembourg. 2014 Review. Paris: OECD/IEA.

INTERNATIONAL ENERGY AGENCY 2015. Energy and Climate Change. World Energy Outlook Special Report. Paris: OECD/IEA.

INTERNATIONAL ENERGY AGENCY 2016. Energy Policies of IEA Countries: Belgium. 2016 Review. Paris: OECD/IEA.

INTERNATIONAL ENERGY AGENCY 2017a. Electricity information: Overview. International Energy Agency.

INTERNATIONAL ENERGY AGENCY 2017b. Energy Policies of IEA Countries: Denmark. 2017 Review. Paris: OECD/IEA.

INTERNATIONAL ENERGY AGENCY 2017c. Energy Policies of IEA Countries: France. 2016 Review. Paris: OECD/IEA.

INTERNATIONAL ENERGY AGENCY 2018. Global Energy & CO_2 Status Report 2017. OECD/IEA.

JEWELL, J., BRUTSCHIN, E. & CHERP, A. 2018. Explaining the Power Past Coal Alliance: An Example of Dismantling Incumbents or Just Business as Usual Industry Aging? *ECPR General Conference 2018.* Hamburg.

JOHNSTONE, P. & HIELSCHER, S. 2017. Phasing out coal, sustaining coal communities? Living with technological decline in sustainability pathways. *Extractive Industries and Society,* 4**,** 457-461.

KERN, F. & SMITH, A. 2008. Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. *Energy Policy,* 36**,** 4093-4103.

KIMBERLY, J. R. 1981. Managerial innovation. *In:* NYSTROM, P. C. & STARBUCK, W. H. (eds.) *Handbook of Organizational Design. Volume 1: Adapting Organizations to their Environments.* New York: Oxford University Press.

KROPP, C. 2015. Exnovation – Nachhaltige Innovationen als Prozesse der Abschaffung. *In:* ARNOLD, A., DAVID, M., HANKE, G. & SONNBERGER, M. (eds.) *Innovation - Exnovation: Über Prozesse des Abschaffens und Erneuerns in der Nachhaltigkeitstransformation.* Marburg: Metropolis-Verlag.

KROPP, C. 2018. Sustainable Innovations: Theories, Conflicts and Strategies. Research Contributions to Organizational Sociology and Innovation Studies, Discussion Paper 2018-02. LEACH, M., ROCKSTRÖM, J., RASKIN, P., SCOONES, I., STIRLING, A. C., SMITH, A., THOMPSON, J., MILLSTONE, E., ELY, A., AROND, E., FOLKE, C. & OLSSON, P. 2012. Transforming innovation for sustainability. *Ecology and Society,* 17**,** 11.

LEIPPRAND, A. & FLACHSLAND, C. 2018. Regime destabilization in energy transitions: The German debate on the future of coal. *Energy Research and Social Science,* 40**,** 190-204.

MARKARD, J. & TRUFFER, B. 2008. Technological innovation systems and the multi-level perspective: Towards an integrated framework. *Research Policy,* 37**,** 596-615.

MARKIDES, C. 2006. Disruptive Innovation: In Need of Better Theory. *Journal of Product Innovation Management,* 23**,** 19-25.

MCCOLLUM, D. L., ZHOU, W., BERTRAM, C., DE BOER, H.-S., BOSETTI, V., BUSCH, S., DESPRÉS, J., DROUET, L., EMMERLING, J., FAY, M., FRICKO, O., FUJIMORI, S., GIDDEN, M., HARMSEN, M., HUPPMANN, D., IYER, G., KREY, V., KRIEGLER, E., NICOLAS, C., PACHAURI, S., PARKINSON, S., POBLETE-CAZENAVE, M., RAFAJ, P., RAO, N., ROZENBERG, J., SCHMITZ, A., SCHOEPP, W., VAN VUUREN, D. & RIAHI, K. 2018. Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals. *Nature Energy,* 3**,** 589-599.

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE ET SOLIDAIRE 2017. Plan Climat. 1 planète, 1 plan. *In:* SOLIDAIRE, M. D. L. T. É. E. (ed.). Gouvernement de la République française.

MINISTERO DELLO SVILUPPO ECONOMICO & MINISTERO DELL'AMBIENTE E DELLA TUTELA DEL TERRITORIO E DEL MARE 2017. Strategia Energetica Nazionale.

NATURAL RESOURCES DEFENSE COUNCIL. 2016. Oregon Passes Historic Bill to Phase Out Coal and Double Down on Renewables Available: https://www.ecowatch.com/oregon-passes-historic-bill-to-phase-out-coal-and-double-down-on-renew-1882185757.html.

NEDERLANDSE OMROEP STICHTING. 2018. Twee oudste kolencentrales dicht in 2025. Available: https://nos.nl/artikel/2232450-twee-oudste-kolencentrales-dicht-in-2025.html [Accessed August 28, 2018].

OGBOLU, Y., IWU, E. N., ZHU, S. & JOHNSON, J. V. 2013. Translating Research into Practice in Low-Resource Countries: Progress in Prevention of Maternal to Child Transmission of HIV in Nigeria. *Nursing Research and Practice,* 2013**,** 848567.

ONTARIO CLEAN AIR ALLIANCE (2011). Finishing the coal phase out: An historic opportunity for climate leadership. Revised November 21, 2011. Ontario: Ontario Clean Air Alliance.

OWEN, A.D., 2004. Environmental externalities, market distortions and the economics of renewable energy technologies. The Energy Journal 25, 127–156.

PAECH, N. 2012. *Nachhaltiges Wirtschaften jenseits von Innovationsorientierung und Wachstum: eine unternehmensbezogene Transformationstheorie,* Marburg, Metropolis Verlag.

PAULOS, B. 2018. Washington State leaves coal behind, but not its workers. *Energy Transition. The Global Energiewende* [Online]. Available from: https://energytransition.org/2018/01/washington-state-leaves-coal-behind-but-not-its-workers/ [Accessed January 4.

PLUMER, B. & POPOVICH, N. 2017. 19 Countries Vowed to Phase Out Coal. But They Don't Use Much Coal. *The New York Times*, November 16.

POWERING PAST COAL ALLIANCE 2017. Powering Past Coal Alliance Declaration.

POWERING PAST COAL ALLIANCE. n.d. Members. Available online at: https://poweringpastcoal.org/about/Powering_Past_Coal_Alliance_Members. Last accessed on March 19, 2019.

RASKIN, P., BANURI, T., GALLOPÍN, G., GUTMAN, P., HAMMOND, A., KATES, R. & SWART, R. 2002. Great Transition: The Promise and Lure of the Times Ahead. Boston: Stockholm Environment Institute.

RED Eléctrica de España. 2018.The Spanish Electricity System 2017. Published June 2018.

REN21 2018. Renewables 2018 Global Status Report. Paris: REN21 Secretariat.

RIJKSOVERHEID. 2018. *Kabinet verbiedt elektriciteitsproductie met kolen* [Online]. Available: https://www.rijksoverheid.nl/actueel/nieuws/2018/05/18/kabinet-verbiedt-elektriciteitsproductie-met-kolen [Accessed December 7 2018].

ROBIOU DU PONT, Y. & MEINSHAUSEN, M. 2018. Warming assessment of the bottom-up Paris Agreement emissions pledges. *Nature communications,* 9**,** 4810.

RODRIGUEZ, H. P., HENKE, R. M., BIBI, S., RAMSAY, P. P. & SHORTELL, S. M. 2016. The Exnovation of Chronic Care Management Processes by Physician Organizations. *Milbank Quarterly,* 94**,** 626-653.

ROGGE, K. S. & JOHNSTONE, P. 2017. Exploring the role of phase-out policies for low-carbon energy transitions: The case of the German *Energiewende. Energy Research and Social Science,* 33**,** 128-137.

SCHNEIDER, M., SCHOLZ, J., LUBELL, M., MINDRUTA, D. & EDWARDSEN, M. 2003. Building Consensual Institutions: Networks and the National Estuary Program. *American Journal of Political Science,* 47**,** 143-158.

SCHUMPETER, J. A. 1950. *Kapitalismus, Sozialismus und Demokratie,* Tübingen, A. Francke Verlag GmbH.

SENATE BILL 1547. 2016. State of Oregon.

SENATE BILL 5769. 2011. State of Washington.

SKINNER, J. & CHANDRA, A. 2016. The Past and Future of the Affordable Care Act. *JAMA - Journal of the American Medical Association,* 316**,** 497-499.

SOCIAAL-ECONOMISCHE RAAD 2013. Energieakkoord voor duurzame groei. Den Haag: Sociaal-Economische Raad.

STATE OF OREGON. n.d. *Electricity Mix in Oregon* [Online]. Available: https://www.oregon.gov/energy/energy-oregon/Pages/Electricity-Mix-in-Oregon.aspx [Accessed August 28 2018].

SVEIBY, K.-E., GRIPENBERG, P. & SEGERCRANTZ, B. 2012. Challenging the innovation paradigm: Conclusions, practical implications, and future research. *In:* SVEIBY, K.-E., GRIPENBERG, P. & SEGERCRANTZ, B. (eds.) *Challenging the innovation paradigm.* New York, NY & Oxon, UK: Routledge.

TRANSALTA. 2016. TransAlta Reaches Agreement with the Government of Alberta on Transition Payments and Executes Memorandum of Understanding. Available: https://www.transalta.com/newsroom/news-releases/transalta-reaches-agreement-government-alberta-transition-payments/ [Accessed August 28, 2018].

TURNHEIM, B. & GEELS, F. W. 2012. Regime destabilisation as the flipside of energy transitions: Lessons from the history of the British coal industry (1913–1997). *Energy Policy,* 50**,** 35-49.

TURNHEIM, B. & GEELS, F. W. 2013. The destabilisation of existing regimes: Confronting a multi-dimensional framework with a case study of the British coal industry (1913-1967). *Research Policy,* 42**,** 1749-1767.

UNITED NATIONS 2015. Paris Agreement.

UNITED NATIONS 2018. The Sustainable Development Goals Report 2018. New York: United Nations.

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE. 2017. More than 20 Countries Launch Global Alliance to Phase Out Coal. Available: https://cop23.unfccc.int/news/more-than-20-countries-launch-global-alliance-to-phase-out-coal.

UNRUH, G. C. 2000. Understanding carbon lock-in. *Energy Policy,* 28**,** 817-830.

UPHAM, P., KLITKOU, A. & OLSEN, D. S. 2016. Using transition management concepts for the evaluation of intersecting policy domains ('grand challenges'): The case of Swedish, Norwegian and UK biofuel policy. *International Journal of Foresight and Innovation Policy,* 11**,** 73-95.

U.S. Energy Information Administration (n.d.). 'State Prifules and Energy Estimates'. Retrieved from https://www.eia.gov/state/.

VERBONG, G. & GEELS, F. 2007. The ongoing energy transition: Lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960-2004). *Energy Policy,* 35**,** 1025-1037.

VISCIDI, L. 2018. Mexico's Renewable Energy Future. A Working Paper. Mexico Institute, Wilson Center.

VRIENS, L. 2018. The End of Coal: Alberta's coal phase-out. Winnipeg: International Institute for Sustainable Development.

VVD, CDA, D66 & CHRISTENUNIE 2017. Vertrouwen in de toekomst: Regeerakkoord 2017 – 2021.

WASHINGTON STATE DEPARTMENT OF COMMERCE n.d. Fuel Mix Disclosure - Washington State Department of Commerce

WEIBLE, C.M. 2005. Beliefs and perceived influence in a natural resource conflict: An advocacy coalition approach to policy networks. Political Research Quarterly, 58(3), 461-475.

WHITE, J. B. 2018. France to shut all coal-fired power stations by 2021, Macron declares: An ambitious climate change agenda from France's leader. *The Independent*, January 25.

WIEBES, E. (2017) RE: Uitwerking aspraak over kolencentrales uit regeerakkoord. Letter to Parliament by the Minister of Economic Affairs and Climate, December 13, 2017.

WORLD HEALTH ORGANIZATION. n.d. Economic instruments as a lever for policy. Available: https://www.who.int/heli/economics/econinstruments/en/

YAN, H. L. 2001. *Projektmanagement für Europaweite Produktinnovationsprozesse am Beispiel der Lebensmittelindustrie* Diplomarbeit, Universität Bremen.

YIN, R. K. 2003. *Case Study Research. Design and Methods,* London, Sage.

YLE. 2018. Environment Minister proposes coal-free Finland by 2025. *Yle*, January 6.

Overview of articles included in this cumulative Ph.D. thesis

(in accordance with the guideline for cumulative dissertations in Sustainability Science [January 2012], in the following termed "the guideline")

Title of Ph.D. thesis: Institutional Dynamics in Sustainability Transformations: Advancing the Productive Functions of Failure and Decline

Papers included:

[I]   **Derwort, P.**, Newig, J. and Jager, N. (2018). Towards Productive Functions? A Systematic Review of Failure, its Causes and Consequences. *Policy Sciences,* 1-18.

[II]   Newig, J. **Derwort, P.** and Jager, N. (2019). Sustainability through institutional failure and decline? Archetypes of Productive Pathways. *Ecology and Society* 24(1):18.

[III]   **Derwort, P.**, Jager, N. and Newig, J. (2019). How to explain major policy change towards sustainability? Applying the Multiple Streams Framework and the Multi-Level Perspective on Socio-Technical Transitions to the German 'Energiewende'. Revise and resubmit with major revisions in *Policy Studies Journal*.

[IV]   **Derwort, P.** (2019). Phasing out not in: Exnovation Governance for Sustainability and the Powering Past Coal Alliance. Conditionally accepted for publication in *Energy Research and Social Science*.

Authors' contributions to the articles and articles publication status (according to §16 of the guideline):

Article #	Short title	Specific contributions of all authors*	Author status	Weighting factor	Publication status	Conference contributions
I	Towards productive functions? A Systematic Review of Failure, its Causes and Consequences.	PD: a-f JN: a-b, e-f NJ: a-b, e-f	Co-author with predominant contribution	1.0	Published in *Policy Sciences* (IF=3.023)	INAPP 2016
II	Sustainability through institutional failure and decline?	JN: a-f PD: a-f NJ: a-f	Co-author with equal contribution	1.0	Published in *Ecology & Society* (IF=3.256)	UC 2018; LP 2019
III	How to explain major policy change towards sustainability?	PD: a-f NJ: a, b, e, f JN: a, b, e, f	Co-author with predominant contribution	1.0	Revise and resubmit with major revisions in *Policy Studies Journal* (IF=2.830)	IPSA 2018; ECPR 2018
IV	Phasing out not in: Exnovation Governance for Sustainability and the Powering Past Coal Alliance		Single-author	1.0	Conditionally accepted for publication in *Energy Research & Social Science* (IF=3.815)	DIW 2018
			Sum:	4.0		

*(a) = Conception of research approach; (b) = Development of research methods; (c) Data collection and data preparation; (d) Execution of research; (e) Analysis/Interpretation of data or preliminary results; (f) Writing or substantive rewriting of the manuscript

Explanations

Specific contributions of all authors
PD = Pim Derwort, JN = Jens Newig, NJ = Nicolas Jager

Author status
according to §12b of the guideline:
Single author [Allein-Autorenschaft] = Own contribution amounts to 100%.
Co-author with predominant contribution [Überwiegender Anteil] = Own contribution is greater than the individual share of all other co-authors and is at least 35%.
Co-author with equal contribution [Gleicher Anteil] = (1) own contribution is as high as the share of other co-authors, (2) no other co-author has a contribution higher than the own contribution, and (3) the own contribution is at least 25%.
Co-author with important contribution [Wichtiger Anteil] = own contribution is at least 25%, but is insufficient to qualify as single authorship, predominant or equal contribution.
Co-author with small contribution [Geringer Anteil] = own contribution is less than 20%.

Weighting factor
according to §14 of the guideline:

Single author [Allein-Autorenschaft]	1.0
Co-author with predominant contribution [Überwiegender Anteil]	1.0
Co-author with equal contribution [Gleicher Anteil]	1.0
Co-author with important contribution [Wichtiger Anteil]	0.5
Co-author with small contribution [Geringer Anteil]	0

Publication status
IF = ISI Web of Science – Impact Factor 2017

Conference contributions (acronym, society, date, venue, website)

INAPP 2016   Summer School Institutions and Policy Change, July 18-23, 2016, Padova (Italy),
http://www.sispsg.unibo.it/files/Flyerpadova2016.pdf

UC 2018   6th Unintended Consequences Workshop, May 7-8, 2018, Warsaw (Poland), http://unintended.uw.edu.pl/

LP 2019   Leverage Points for Sustainability Transformation, February 6-8, 2019, Lüneburg (Germany), http://leveragepoints2019.leuphana.de/

IPSA 2018   World Congress of the International Political Science Association, July 21-25, 2018, Brisbane (Australia),
https://www.ipsa.org/events/congress/brisbane2018

ECPR 2018   General Conference of the European Consortium for Political Research, August 22-25, Hamburg (Germany),
https://ecpr.eu/Events/EventDetails.aspx?EventID=115

DIW 2018   Doctoral Colloquium of the Leibniz Research Alliance on Energy Transitions, April 23-24, 2018, Berlin (Germany),
https://www.diw.de/de/diw_01.c.334039.de/publikationen_veranstaltungen/veranstaltungen/kalendarium/archiv_der_veranstaltungen/archiv_der_veranstaltungen.html

Declaration (according to §16 of the guideline)

I avouch that all information given in this appendix is true in each instance and overall.