SPECIAL FEATURE: ORIGINAL ARTICLE

The politics of making and un-making (sustainable) futures

Governing time for sustainability: analyzing the temporal implications of sustainability governance

Basil Bornemann[1] · Holger Strassheim[2]

Abstract

The idea of sustainability comes with numerous temporal ambitions and implications. It can be interpreted as a call to rethink and redesign the prevailing temporal orders of human–nature relationships in terms of governance. While there are multiple approaches to sustainability governance that implicitly or explicitly engage with time, the concrete links between time and sustainability-oriented governance remain largely unclear. The aim of this article is, therefore, to provide a more nuanced and critical picture of the temporal implications of sustainability governance. To this end, it reconstructs various exemplary approaches to sustainability governance from two analytical perspectives, namely *governance of time* and *governance by time*. On this basis, it is further argued that the interplay of different practices of sustainability-oriented governance creates different "timescapes of sustainability" with different normative and political implications. Proposals for future research and practice on the relationship between sustainability governance and time are derived from the analysis.

Keywords Time · Governance · Temporal governance · Sustainability governance · Sustainable development · Timescapes of sustainability

Introduction

While time has always been entwined with politics (Elchardus 1988), it has only recently become an important and explicit point of reference in the practice and analysis of governance (Howlett and Goetz 2014; Whipp et al. 2002). This new interest in the relationship between time and governance can be seen as an expression of multiple interrelated developments. These include, for example, the growing focus on future problems such as climate change and nuclear waste disposal (Adam 1998); the increasing pace of social and technological change (Rosa 2015), including a progressive de-synchronization from its regulation (Selin 2008); the emergence of new scientific and technological possibilities for the production of time-related knowledge and expertise (Howlett 2009; Strassheim 2016); and the increasing material, social and spatial complexity of challenges and solutions that make time an ever more important governing resource (Pollitt 2008).

The emergence and popularization of "sustainable development" or "sustainability" in science, politics, and society can be interpreted as a specific expression, driver, and result of this generally growing sensitivity to the relevance of time and its governance implications. By emphasizing norms such as "futurity" and "intergenerational justice" (Jacobs 1999; Burger and Christen 2011), these ideas[1] imply a fundamental reassessment of the relationship between society and time, and thus the consideration of temporal aspects in governance. In fact, sustainability has spawned a large variety of new governance approaches and practices that implicitly or explicitly deal with time (Adger and Jordan

✉ Basil Bornemann
basil.bornemann@unibas.ch

Holger Strassheim
holger.strassheim@uni-bielefeld.de

1 Sustainability Research Group, Department of Social Sciences, University of Basel, Bernoullistr. 16, 4056 Basel, Switzerland

2 Faculty of Sociology, Science and Politics, University of Bielefeld, Bielefeld, Germany

---

[1] Being aware of the differences between these two concepts, we will use them synonymously in the remainder of this article.

2009; Voss et al. 2006). For example, transition management concerns the shaping of future-oriented transformation dynamics (Kemp et al. 2007); sustainability impact assessments aim at predicting and evaluating the future effects of current decisions (Adelle and Weiland 2012); scenario techniques develop alternative visions and options that guide current decisions (Aykut 2015); experiments try to identify the factors and causal relationships that shape the future (Sengers et al. 2016).

In comparison to other challenges such as complexity, uncertainty and fragmented control (Newig et al. 2008), time is interestingly not yet an important explicit point of reference in the sustainability governance (SG) literature. Time, especially in form of "the future" is very often simply assumed, but has not been conceptualized and analyzed with regard to SG. Given the centrality of time in sustainability, we see, however, a need for a more nuanced analysis of the relationship between SG and time. More specifically, a time-oriented analysis of SG can provide a way to capture, sort and explain the emerging and increasing diversity of sustainability-oriented governance approaches by revealing how exactly and with what practices these refer to time. Since time and temporality can be highly normative and political, a time-oriented analysis can also serve to critically shed light on the often implicit normative and political qualities of SG approaches (cf. Voss and Bornemann 2011; Bornemann et al. 2019). Finally, understanding the temporal implications of approaches of SG is important for a more reflexive practice of SG, i.e., for the design and implementation of sustainability-oriented governance approaches that are sensitive to their temporal implications and can consciously make use of them.

By making time an explicit reference point for the analysis of SG, this paper aims to take a step further towards a time-critical understanding of SG. We investigate the relationship between sustainability-oriented governance and time by asking: *How do approaches of sustainability governance relate to time—and with what consequences?* Following an explorative logic, we try to give tentative answers to this question on the basis of some initial conceptual proposals and thereby prepare the topic for further scientific analysis and practical considerations.

The argument is developed as follows. First, we briefly examine the relationship between sustainable development, sustainability governance and time in current discourse ("Background: time in sustainable development and sustainability governance" Section). We then propose two perspectives of a time-oriented governance analysis ("Concepts and perspectives of temporal governance" Section). On this basis, we analyze the temporal implications of various examples of SG. Specifically, we reconstruct relevant SG approaches from a governance of time and a governance by time perspective to identify related time governance practices ("Sustainability governance of and by time" Section). We then reflect on the interplay between the two perspectives, arguing that combinations of different SG-related time governance practices lead to nine different "timescapes of sustainability", each with specific normative and political implications ("Reflections: shaping timescapes of sustainability through combined practices of temporal governance" Section). We conclude with suggestions for future research as well as considerations on time-sensitive SG design.

Background: time in sustainable development and sustainability governance

Following the Brundtland tradition, sustainable development is an overarching and virtually universal idea of human well-being (Burger and Christen 2011; Baker 2007), which is obviously concerned with the future. While this is most clearly visible at the political level of the idea, with Agenda 2030 and the sustainable development goals opening up a time horizon until 2030, the future orientation is also anchored at the philosophical level. Core concepts such as "futurity" and "intergenerational justice" express the fundamental normative idea that human societies should exist over time and remain capable of development. Therefore, sustainable development is about mediating between stability and change: creating the conditions of a stable, just and ideally endless future development. Apart from these normative references of moral quality, the future is also implied in the ontological world descriptions of sustainability (Bornemann 2014). The idea of a finite world, for example, points to the alleged existence of limits and eco-system boundaries likely to be reached in the near or distant future and behind which catastrophic developments lurk (Jackson 2011; Rockström et al. 2009). To avoid this, social development paths must change. Moreover, social learning must take place in the sense of a continuous process of adaptation and transformation of social practices to respond to dynamically evolving but persistent problems. In addition, sustainability itself is an idea in constant flux to be constantly reinterpreted in the light of current and future developments (Meadowcroft 2000).

Given the predominant future orientation of the concept, it is sometimes forgotten that sustainability has much to do with the present. The articulation of sustainability as a political idea cannot only be interpreted as a call to overcome presently existing problematic social–ecological relations (Meadowcroft 2000). A key value of sustainability is also oriented towards the present: Apart from justice towards future generations (intergenerational justice), the idea also includes the realization of justice in the here and now (intragenerational or international justice; Lafferty and Langhelle 1999; Bornemann 2014). Against the

background of its universal normative ambitions, sustainability also requires that we act today—a demand that is frequently marked with particular urgency. After all, sustainability is also about the past. It is not just an idea with its own roots and its own history that refers to a change in (the understanding of) human–nature relationships (Du Pisani 2006). The emergence and spread of sustainability as a political concept can also be interpreted as a reaction to (problematic) past decisions, such as those that have shaped the historical path dependencies of carbon-based societies (Unruh 2000). More generally, the rise of sustainability thinking and practice can be seen as an (unintended) side-effect of earlier lifestyles, social structures and governance patterns (Beck 2006). In addition to this negative framing, the past is sometimes stylized as a golden era of sustainability (Auclair and Fairclough 2015a).

While time in various forms is a central motif in general sustainability thinking, it is also, albeit to a lesser extent, a recurring point of reference in approaches and concrete practices for organizing collective action in the name of sustainability. In this debate on sustainability governance (Lange et al. 2013; Bornemann et al. 2019), time is primarily addressed in the form of an extension of the temporal horizons of political decisions beyond the usual short- or medium-term perspectives (Meuleman and Veld 2009; Voss et al. 2009). There has been a rich debate, particularly on institutional approaches and strategies for long-term governance, ranging from the establishment of future councils to changes in the electoral system (González-Ricoy and Gosseries 2016; Wallimann-Helmer et al. 2017; Dobson 1996). In addition, time references also play a role in the conceptualization of SG itself. For example, the currently much discussed concept of (socio-ecological) transformation emphasizes the dynamic and open character of sustainability problems (Stirling 2014) and implies that governance should be designed in a future-oriented and reflexive way to cope with uncertainties (Kemp et al. 2005; Voss et al. 2006; Grunwald 2007; Bornemann et al. 2016). There are certainly more than these references to time in the current SG discourse. Overall, however, the existing discourse appears rather vague with regard to its time references and, with its focus on the future, lags behind the more complex interpretation of temporality in general sustainability thinking. However, as there is also a lack of a more detailed analysis of the relationship between SG and time, the remaining sections will further examine the temporal implications of various existing SG approaches and practices.

Concepts and perspectives of temporal governance

As a step in this direction, we outline in this section two perspectives for analyzing the temporality of SG. Before that, we briefly clarify how we conceptualize governance and time.

Conceptualizing governance and time

Broadly, *governance* refers to all attempts of organizing collective action to reach common goals, such as sustainability. The concept reflects the empirical observation that in contemporary societies, collective issues are no longer dealt with by governments and public authorities alone. Rather, collective problem-solving is increasingly spread across society as a whole (Kooiman 2007). Collective issues are dealt with by numerous actors from different social areas who interact in different ways, including markets, hierarchies, and networks. It is, therefore, insufficient to look at formal rules and material acts of governing to understand how collective action works in a "governancialized" world. Rather, numerous and diverse informal and symbolic aspects such as discourses, narratives, and practices that structure, coordinate, and orient collective action must also be included in the analysis (Bevir 2013). These diverse aspects can be related to three dimensions of governance: polity, politics, and polity (Lange et al. 2013). The policy dimension refers to the formulation and implementation of goals and means of collective action in relation to policy problems. The politics dimension covers the agency, power, and process side of governance. And the polity dimension refers to institutions, norms, and structural settings, in which collective action is formed.

Time is a complicated concept, especially in relation to the social world and its analysis (Adam 1990). On the one hand, time is an ontological category and an objective fact that permeates all physical, biological and social processes. Time and temporal parameters, such as the temporal placement of events or temporal ordering patterns—the past, present, and future—duration, speed, acceleration, and dynamics (Adam 1998) can be objectively defined and measured from the perspective of an external observer. On the other hand, within the social world, time and temporal qualities are embedded in social and cultural contexts and practices. The meaning of time as such and its concrete expressions are socially constructed (Nowotny 1996). For example, it is a matter of (socially and culturally shaped) perceptions whether a process is considered to take a short or a long time or is qualified as evolving in a fast or slow manner, among others.

	Governance of time	Governance by time
Role of time in relation to governance	Time as an object of governance	Time as a governance tool
Meaning of time governance	Time governance as setting, shaping, and transforming collective temporal orders	Time governance as organization of collective action through the use of time

Fig. 1 Perspectives of time governance

This understanding of "social time" becomes even more complicated considering that time not only permeates the (first-order) experiences of the social world, but also forms a conscious point of reference for "knowing" and "doing" sociality. At this second-order level, time and temporal parameters figure as means for sorting and reflecting individual and collective perceptions and experiences of the social world (Barbehön 2018). This process of time-oriented sense-making is itself based on preconceived and culturally shaped notions and models of time (Adam 1998). Moreover, as these models structure our understandings and actions in the social world, they become performative, i.e., reified in social institutions, discourses, and practices (Rosa and Scheuerman 2011; Felt et al. 2014). This reflexive understanding of time as a matter of deliberate choice and control also makes it a relevant reference point for the practice and analysis of governance (Adam 2003).

Perspectives of time governance

On the basis of these conceptual considerations, we see two fundamental ways of thinking time and governance together. Based on an permeative concept of time, time can first be understood as an underlying dimension, as a medium of governance, as it were. According to this reading, which is reflected in many theoretical approaches about "politics in time" (Howlett and Goetz 2014; Strassheim 2016), governance evolves in or through time. Such an understanding of *governance time* implies that governance phenomena can be analyzed in terms of objectively given or socially constructed temporal characteristics. For example, a particular governance arrangement or particular polity, politics or policy elements may be more or less permanent, evolve at a certain pace, and follow certain time sequences. Although this approach brings with it numerous starting points for a differentiated description of the temporality of (sustainability) governance, it has its limits when it comes to understanding the actual interplay of governance and time.

To this end, a second way of thinking governance and time together can be considered, which is based on a reflexive understanding of time as a means of observation and engagement with the social world. Here, time is seen as detached from and at the same time connected with

governance. The corresponding analysis of *time governance* deals with different relationships between governance and time, i.e., how time and governance are related and interact with each other. There are two logical relations between governance and time. On the one hand, governance can influence, shape or structure time in terms of an object; on the other hand, time can become a tool for influencing, shaping or structuring governance. Accordingly, we propose two perspectives to examine the relationship between governance and time (see Fig. 1).

1. Starting from an understanding of time as an *object* of governance, the *Governance of Time* (GoT) perspective looks at how (social) temporality is produced, influenced and changed by governing practices (Whipp et al. 2002; Adam 2003). Accordingly, the GoT perspective draws attention to practices of configuring and shaping (the meaning of) time and collective temporal orders. These time-related governance practices can take many different forms, reflecting different parameters of time and dimensions of governance. For example, time horizons or dynamics can become objects of governance if they are structured, shaped or even controlled by institutional rules (polity), substantial visions, goals and means (policy) or power-related interactions (politics).

2. The *Governance by Time* (GbT) perspective conceives time as a *tool* for governance. It points to the fact that (social constructions of) time can be used instrumentally to enable, shape or prevent collective action in one way or another (see Pollitt 2008; Carter 2016). Given the different dimensions of governance and the diversity of temporal parameters, this instrumental use of time can assume many different forms. These range from the activation of collective norms and identities by invoking a common history (polity) to the use of forward-looking forecasts to shape goals (policy) to the promotion or obstruction of concrete decisions by a series of different time tactics (politics).

These two perspectives can be used to analyze the temporal implications of governance forms in different areas. Specifically, they can point to concrete narratives and practices of linking governance and time in an object-oriented

(GoT perspective) or instrumental (GbT perspective) way. Methodologically, such analysis faces the challenge that time reference are not always immediately apparent (Selin 2008: 1886). Therefore, the analysis of temporal governance is an interpretative reconstruction of the often implicit and hidden practices of time governance.

Sustainability governance of and by time

In this section, we refer to the two perspectives of time governance to interpret the temporal implications of sustainability governance. More specifically, we will identify and reconstruct concrete practices of sustainability-oriented governance *of* and *by* time. Since sustainability thinking prima facie focuses on different time horizons—the past, present and future (see "Background: time in sustainable development and sustainability governance" Section), we pay particular attention to how these three time horizons are addressed in time governance practices. As far as the objects of our analysis are concerned, we focus on several concrete SG approaches (without limiting ourselves to them). These range from conceptually founded governance designs that are more (transition management, national sustainability strategies) or less (sustainability impact assessment) comprehensive, to more emergent approaches that are also more (adaptive management, conservation practices) or less (sustainability experiments) extensive in scope. Taken together, these approaches represent an increasingly diversified SG discourse (Bornemann et al. 2019), and therefore form a good basis for identifying a broad spectrum of practices of sustainability-oriented governance *of* time and *by* time.

Sustainability governance *of* time

The GoT perspective regards time as an object of governance and sheds light on how SG shapes temporal orders of collectives through norms and rules (polity), visions, goals and means (policy) as well as the mobilization of power (politics). As already indicated in our brief consideration of the SG discourse above ("Background: time in sustainable development and sustainability governance" Section), references to the future are certainly the most important. Organizing collective action towards sustainability is primarily understood as a challenge to overcome the current myopia of existing governance arrangements in favor of long-term time horizons. These attempts of temporal extension involve different practices of making and shaping the future. At the (substantial) policy level, these include thematic or overarching sustainability visions or guiding principles that are part of many more comprehensive SG design approaches like transition management (Loorbach 2010) or national sustainability strategies (Bornemann 2014). The formation

of such visions is often based on the collective articulation of ideas about desirable social developments and destinies. By generating certain action-guiding imaginations of futures and at the same time suppressing alternative futures (cf. Selin 2008), they can be understood as practices of governing the future. While these visions rely on the future-creating power of imaginations and values, there are numerous more mundane practices of governing the future. Sustainability impact assessments aim, for example, to assess the possible long-term effects of specific policy or project-related decision options (partly in relation to concrete sustainability goals) and to use these assessments to enlighten the relevant decision-making processes themselves (Adelle and Weiland 2012; Meadowcroft and Steurer 2013). By aligning collective decisions and actions with a forward-looking timeframe, sustainability assessments indirectly shape the temporal norms and ideas of the respective collective in a forward-looking way. Other sustainability-oriented governance practices shape the future in—supposedly—more factual terms. Instead of referring to what should be the case, foresight, forecasting or integrated modeling practices generate systematic knowledge of what will be the case in the future (Schneider 1997; Vecchione 2012). Thus, they not only create a fact-oriented knowledge base (or epistemic infrastructure, see Voss and Freeman 2016) for the concrete design of future-oriented goals and measures, but also contribute to the creation of collective images of the future in general.

Yet, in SG the future is shaped not only through policy-oriented practices, but also in more politics- and polity-oriented ways. For example, within national sustainability strategies, there are attempts to shape the future through convening and institutionally integrating pluralistic sustainability councils. Besides their relative disembedding from short-term political rhythms and relevance orientations, these councils have in many cases a firm mandate to take the future into account and distinguish themselves in practice through concrete projects for shaping the future. Similarly, transition management is about extending the usual timeframe of politically embedded governance arrangements by creating an institutionally shielded "transition arena" that will not only develop long-term "transition visions", medium-term "transition paths" and short-term "transition experiments" (Loorbach 2010); the composition of the transition arena itself can also be understood as an act of future governing as the organizers of these arrangements are called upon to include particularly innovative frontrunners, whose thoughts and actions should contribute to overcoming existing transformation blockades and opening up future perspectives (Kemp et al. 2007).

While the SG discourse seems to be dominated by attempts to shape the future, there are also present-oriented practices, i.e., attempts to shape how a collective sees and relates itself to the present. The present emerges not only as

a by-product of future-oriented practices, for example, when current forms of governance are problematized because of their myopic orientation (as in transition management, Loorbach 2010) or when futures are made on the basis of analyses of the present (as in scenario techniques, see Aykut 2015). The present is very consciously flagged out by some practices as a relevant normative reference point. Approaches such as adaptive management or nature conservation concepts have a strong normative focus on the present. These approaches and the associated practices do not ignore the future, but rather draw attention to the present as a relevant temporal reference horizon for shaping a sustainable society. Adaptive Management, thus, concentrates on preparing the present for an imminent and uncertain future, for example, by providing institutional resilience (Folke et al. 2005). Nature conservation approaches also emphasize the present as a normative model as they refer to the current state of a particular cultural or natural area to justify and orient sustainability goals and strategies (Norton 2003).

Analyses of national sustainability strategies and related management-oriented practices (see Meadowcroft and Steurer 2013; Bornemann 2014) indicate that these are not only geared toward making the future (see above), but also include practices of shaping the present. This is expressed, for example, in practices that communicate current political activities under the umbrella of sustainability, i.e., attempts to present a current situation as (more or less) sustainable. With the claim to provide evidence of current sustainability transformations, these practices draw attention to the present and frame it as sustainable (Meadowcroft and Steurer 2013). A similar form of presentism is enshrined in evidence-based sustainability benchmarking practices. In these internationally comparative assessment systems, the focus is on the existing state of sustainability of different countries, which entails a dilution of historical contexts (Miller 2005; Swanson and Pintér 2007).

Finally, SG involves practices of governing the past. Being somewhat counterintuitive—is governance not by definition forward-oriented?—governance of the past is not about shaping or reshaping the past in an objective sense, but about creating, shaping and transforming interpretations of past events and historical knowledge. Thus, ruling the past seems possible only by understanding time and time references as socially constructed interpretations. In the context of SG, the past is often governed in an unspoken manner and, again, generated as a by-product of present and future-oriented practices. This can be seen, for example, when sustainability-oriented governance approaches are embedded in historical developments or address historically evolved problems underlying the current unsustainability. For example, the term "persistent problems", to which many SG approaches refer, indicates that such problems have been created in the past by unsustainable practices and have not

been resolved due to inadequate forms of governance (Schuitmaker 2012). It thus creates a certain interpretation of the past and the (governance) practices prevailing at that time. Such interpretive engagement with the past is even more evident in the attempt to actively explore, discover, reconstruct and restore sustainable ways of life, work, production, consumption, etc. (Auclair and Fairclough 2015b; Fischer 2017). These are practices of governing the past in so far as they refer selectively to the past and create distorted, romanticized and highly selective images of the past, with a potential to influence collective goals, identities and images.

Overall, our analysis from a GoT perspective shows that time is indeed an important object of SG. Specifically, we can see that concrete SG approaches create and shape time horizons related to sustainability, focusing primarily on the future and to a lesser extent on the present and the past (see "Background: time in sustainable development and sustainability governance" Section). However, attempts to shape certain time horizons cannot be easily separated from each other. For example, efforts to create the future are closely linked to practices of shaping the past and the present.

Sustainability governance *by* time

The GbT perspective highlights that time is not only an object of governance, but also a tool for promoting and shaping collective action. Applied to the field of SG, it reveals how approaches and practices for organizing collective action towards sustainability are enabled and structured by time in different ways. In transition management, for example, the instrumental use of time already becomes apparent when the approach is legitimated as a more adequate, future-oriented alternative to the conventional mode of short-sighted and innovation-hostile policy-making (Kemp et al. 2007). The purportedly more adequate temporal alternative itself is presented in the form of a cyclical management model that defines a specific, rational–systematic sequence of phases, each corresponding to a different temporal orientation—the creation of (strategic) visions and the establishment of the transition arena, the development of a (tactical) transition agenda, the (operational) mobilization of actors and the implementation of experiments as well as (reflexive) evaluation and monitoring (Loorbach 2010). As a common reference basis that describes a fundamental logic for initiating and shaping sustainability transformation, this time model becomes an instrument for coordinating and orienting individual actor strategies and interactions, thus enabling collective action towards sustainability. While transition management promotes its own future-oriented time model that becomes performative and governance-shaping when transition management is being implemented, studies on scenario techniques show how these sustainability-oriented governance practices are embedded in and shaped

by existing temporal contexts. Apart from the fact that scenarios are by themselves an expression of a certain (post) modern understanding of an open future, Aykut (2015) showed for the case of the German energy transition, how reference to a deadlock in the energy conflict has led to the development and official adoption of future energy policy scenarios, how these became means of organizing collective action and how the scenarios themselves have been influenced by political dynamics. Accordingly, although scenarios are about creating futures (see above), they also refer practices of activating the present, that is, emphasizing what is currently the case to enforce sustainability-oriented decisions and actions. Another practice of using the present as tool for SG is the reference to "urgency". It mobilizes the willingness of actors to support certain actions by condensing the time span for decisions to the present: to avoid a serious risk or to seize a particular unique opportunity, it is no longer possible to wait, but immediate action must be taken. In addition to the usual forms, for example, by means of deadlines (Carter 2016), urgency (or even emergency) is created in the particular context of SG by, for example, pointing to certain objectively given boundaries in biophysical systems, which are exceeded if no action is taken now, leading to catastrophic consequences. Likewise, there are practices of pulling sustainability-oriented decisions into the here and now by creating windows of opportunity, e.g., when collective action is required in the face of certain weather extremes, which are interpreted as the current expression of longer-term climate change. An instrumental use of the present can also be observed with regard to the practice of sustainability-oriented experiments. By defining a particular space as experimental and bringing together actors in present-oriented and evidence-based trial-and-error mode of action, experiments make it possible to overcome or at least temporarily eliminate fundamental differences of interest, and thus facilitate collective action towards sustainability, which would otherwise be blocked by a forward-looking calculation (Weiland et al. 2017).

Finally, the past is also used to enable and shape SG, for example, by highlighting past mistakes that now require a fundamental reorientation of governance towards sustainability. In addition to the use of general narratives about the past as a source of legitimacy and pressure for SG, there are also examples of a more structured practice of instrumentalizing the past. Adaptive management approaches, for example, draw on the concept of "social memory". This is a kind of collective archive that contains the experience and knowledge base of a community in dealing with crises and changes in human–nature relations. The existence of a social memory suggests that collective decisions can and should be based on these historically grown sources of wisdom. In this respect, the reference to the accumulated knowledge and experiences of the ancestors provides legitimacy and

support for related governance decisions in the here and now (Nykvist and Heland 2014). In a more normative way, restoration approaches use the reference to a more sustainable past or even a golden age of sustainability to legitimize collective action (Auclair and Fairclough 2015b; Dryzek 1997).

There are certainly many other examples of the instrumental use of time in the context of SG (some of which are also known from other areas, see Pollitt 2008). However, three practices that make use of different time horizons appear to be of particular significance. A practice of using the present consists in activating evidence and knowledge of what is currently the case to promote sustainability-oriented decisions and actions. Practices of using the future for promoting SG refer to, for example, the innovative appeal of alternative governance designs. Finally, there are practices of governance by time that seek to reactivate and use history in the form of legitimizing experiences and knowledge bases. These three kinds of practices of governing by time are not time-neutral. Being used as tools for enabling and shaping governance, the corresponding time horizons are themselves formed in the first place. This means that governance by time inevitably goes hand in hand with governance of time.

Reflections: shaping timescapes of sustainability through combined practices of temporal governance

In the previous section, we examined the relationship between time and SG on the basis of two analytical perspectives and various concrete examples. Our analysis provides a nuanced picture of the different object-related and instrumental time governance practices associated with various SG approaches and thereby shows the manifold temporal implications of the SG discourse as a whole. Time becomes an *object* of governance when governing practices influence temporal orders that structure and orient individual and collective perceptions and images of time. In the context of SG, this is most evident in governance practices that create and shape past, present and future time horizons in specific ways. Time becomes a *tool* of governance whenever temporal structures, windows of opportunity or the rhythm of the political process is used to guide and coordinate collective action. In the context of SG, such instrumental use of time includes in particular references to the past, present and future to manage expectations, generate legitimacy and create common identities as a basis for sustainability-oriented collective action.

While we have seen that the distinction between governance *of* and *by* time is analytically useful to discover and collect different practices of sustainability-oriented time governance, it has also become clear that these two

Governance of Time			
Governing the… / *by using the…*	*Past*	*Present*	*Future*
Past	**(1) Sustainability as re-enactment** Memorizing and idealizing the past and re-enacting it *Example: Back-to-the-roots movement*	**(2) Sustainability as learning** Understanding the present in view of the past *Example: Sustainability-oriented organizational learning*	**(3) Sustainability as doing heritage** Imagining the future based on analyses of the past *Example: Cultural heritage movement*
Present	**(4) Sustainability as retroaction** Reconstructing the past in view of present problems or goals *Example: Post-industrial community development*	**(5) Sustainability as presentism** Understanding the present in view of the present *Example: Sustainability benchmarking*	**(6) Sustainability as forecasting** Imagining the future based on present problems and desires *Examples: Integrated assessment modeling, scenario techniques*
Future	**(7) Sustainability as re-imagination** Retelling the past in light of possible future developments *Example: Discovery of the Anthropocene as new geobiological epoch*	**(8) Sustainability as backcasting** Understanding the present in view of the future *Examples: Scenario techniques, sustainability visions*	**(9) Sustainability as speculation** Envisioning the future based on imagined future trends *Example: Virtual experiments*

Note: leftmost vertical label reads "Governance by Time"

Fig. 2 Shaping sustainability timescapes through combined practices of temporal governance

general modes are strongly linked in reality. Thus, the use of time as a governance tool goes hand in hand with the shaping of time as an object and vice versa. For example, attempts to shape the future in one way or another narrow the repertoire of eligible time tools to those that generate legitimation for future-oriented practices (by delegitimizing the present). In turn, using certain practices, such as scenario techniques or experiments, as tools of governing may create new expectations or ideas of collectives regarding the future or the present, respectively. More generally, we believe that when different practices of *governance of time* and *governance by time* intertwine, different complex "timescapes" emerge. Following Adam (1998), these are clusters of different temporal characteristics that together influence the way collectives experience and imagine time. They have far-reaching normative and political implications to the extent that they produce norms of temporal appropriateness or "rightness" and imply certain practical frameworks for coping with problems (cf. Beckert 2016).

In this section, we will, therefore, extend and synthesize our previous analysis of sustainability-oriented time governance practices by examining distinct combinations of these practices and their implications for sustainability. We argue that, from a time governance perspective, the diversity of ways of knowing and doing SG can be condensed to nine *timescapes of sustainability*. Each of them represents a specific typical combination of temporal governance practices. Systematizing and comparing these timescapes of sustainability not only makes it possible to sort the diversity of SG approaches in temporal respects, but also sheds light on their specific limits and potentials, that is, how "time becomes a tacitly governing force" in sustainability, opening up or closing down possibilities of action (Felt et al. 2014, 17).

Figure 2 gives an overview of how the combination of different practices of *governance of time* (horizontal dimension) and *governance by time* (vertical dimension), which we encountered in the previous analysis, brings forth a universe of nine timescapes of sustainability, linking the past,

present, and future in different ways. These patterns are to be thought of as ideal types that are only approximated by empirical forms, which, as the illustrations in the table show (and corresponding to the broad understanding of governance introduced in "Concepts and perspectives of temporal governance" Section), relate to various forms of collective action—from general narratives through identities of social movements to specific instruments and techniques of governance. The patterns are explained in more detail below followed by some general implications.

1. Combined practices of governing the past using the past involve memorizing and idealizing history to legitimize certain features of SG and, in effect, bind the collective repertoire of experiences to a selective understanding of the past. The resulting sustainability timescape can be called "re-enactment"—the past is analyzed and sometimes idealized as a role model for society. In the resulting timescape, the past is not being reinterpreted or reimagined in light of the present but reified as a social, ecological or technological fact and fate that determines the present. Examples of this are back-to-the-roots movements or green romanticists that seek to radically roll back the present and move to the past by idealizing it as a golden age (Dryzek 1997). While most of the timescapes in Fig. 2 open up possibilities of action, sustainability as re-enactment belongs to a certain group of timescapes—the cells in Fig. 2 marked in gray—that are focused on single time horizons and tend to limit or even paralyze political action and decision-making.

2. In contrast, sustainability as learning emphasizes the necessity of sustainability innovations by building networks of informal relationships between people and organizations and collectively redefining present activities in light of past experiences (Henry 2018; Tsoukas 2005). Sustainability is understood as a process of constantly shaping the present in view of the past. Depending on the underlying mechanisms of learning and on the levels and constellations of actors involved, cognitive myopia, frictions between science and policy, value incompatibilities and conflicts over norms may limit the potential for learning. Therefore, learning for sustainability needs to be evaluated in terms of empirical and normative dimensions of the learned knowledge and both the social and individual aspects of the learning process itself (Henry 2018, 139).

3. The movement of "doing heritage" draws on heritage policies and projects to define the future (Auclair and Fairclough 2015b). To articulate and encourage cultural sustainability, heritage politics is "about intergenerational transfer and about the present day as a bridge from the past to the future" (Auclair and Fairclough 2015a). The emphasis is on using the materializations of the past—buildings, places, towns, landscapes—to ensure that future developments are "place-based, site-specific, locality-sensitive and community-contextualized" (Auclair and Fairclough 2015a). Sustainability is tied to cultural, historical, and political contexts to establish a long-term trajectory of memory. Some critics, however, have pointed out the ways "doing heritage" is limiting future decisions or causes unintended economic or social side-effects such as gentrification (Auclair and Fairclough 2015a).

4. Sustainability as retroaction is based on the idea that the knowledge and skill-sets of past communities or cultures are lost and need to be reactivated. Accordingly, proponents emphasize the need to cultivate a sense of community and cultural contexts, to both re-learn the ways of neighborly communication and respect the plurality of communities and to employ context-sensitive strategies of SG in each local context. The post-industrial community development perspective with its emphasis on non-profit community-based organizations and local partnerships is an example of this type of sustainability timescapes. It seeks for new modes of sustainability by relating present governance activities to a communal past (Hutson 2010). Others are arguing for a strengthening of the global relocalization movement with its emphasis on self-help and local environmental democracy (Fischer 2017).

5. Activating the present to shape the present creates a timescape of sustainability that can be called "presentism". Corresponding forms of governance are characterized by their orientation towards, on the one hand, insights into currently existing real problems and, on the other hand, best practice cases for dealing with them—thereby neglecting the influence of past events and future developments as well as the embedding of governance in political and cultural contexts (Miller 2005; Strassheim 2018). By comparing the results of political decisions to optimal benchmark values, presentism "may […] become a way of absorbing or assuming away critical contextual differences which are crucial to understanding why a particular program or activity works reasonably well at one place or time but not at the other…" (Pollitt 2008). As a result, sustainability takes the form of a temporally closed "adhocracy": a continuous, reshaping of the present through real-time governance practices.

6. Another governance pattern focuses on shaping the future based on the present. Instruments such as integrated assessment modeling, trend analyses or certain scenario techniques govern the future using present-day evidence and expertise. In most of these governance practices, the past is reduced to a stream of data that are interpreted in the light of the most recent, up-to-

date models and analytics. Some argue that from such a perspective, sustainability is bound to a scientifically proven rationale without being able to politically or ethically explore alternative futures (Vecchione 2012). Others point to the political potentials of these instruments to change the discourse on the future in unexpected ways. Regarding the German energy transition, Aykut (2015: 120) argues that "scenarios emerged as a part of the contentious repertoire used by the anti-nuclear movement to make its voice heard and influence German energy policy" and thereby contributed to an "opening up of energy futures."

7. In practices of sustainability as re-imagination future developments become the vantage point for re-evaluating governance practices and the foundations and historical roots of current societies. In light of the Anthropocene as new geological epoch and the consequences that follow from the influence of human activities on climate and environment, taken-for-granted assumptions about the relationship between culture and nature, the role of science in society and the meaning of the political are questioned (Lövbrand et al. 2015). From this perspective, "[g]eohistory requires a change in the very definition of what it means to have, hold, or occupy a space…" (Latour 2017, 291). The "climatic regime" (Latour 2017; Aykut 2016) that is suggested reframes the old notions of nature and asks for new collaborations between scientists, political actors and civil society that are based on a revised understanding of the past.

8. In a similar way, practices of backcasting use normative visions or factual expectations of the future to govern the present and develop strategies of how to move forward. From this perspective, sustainability is based on the capability to avoid lock-ins and think "out-of-the-box." Instead of colonizing future by relying on present evidence, "normative scenarios" are used as imaginaries for opening up decision-making and articulating preferences (Vergragt and Quist 2011). By practicing backcasting, sustainability itself is defined as a process of both collectively and continuously making transparent and re-defining the normative underpinnings of possible future development and of acting accordingly.

9. In completely focusing on the future, some practices seek to bypass the empirical rigidities of forecasting or integrated assessments. In "virtual experiments", different sector models are combined and the consequences of policy interventions are calculated. Using "what-if" scenarios, feedback-loops and nonlinear dynamics possible trajectories are explored. More recent efforts combine speculative design and design-thinking methods to identify alternative futures and a variety of virtual scenario methods (Angheloiu et al. 2017). These and other methods, however, have been criticized for creating a

"flatland" of futures, where different institutional and economic pressures, values, worldviews and ideologies are insufficiently examined and reflected (Schultz et al. 2012, 129).

Overall, the above considerations show that combinations of different individual practices of time governance produce very different (temporal) ideas of sustainability. First and foremost, this underlines the importance of a combined view of temporal SG practices. If we want to fully understand their implications, it is not enough to look at time-related SG practices in isolation; rather, we need to look at how they interplay with other practices and jointly create timescapes of sustainability.

Conversely, our analysis suggests that different (temporal) ideas of sustainability are essentially based on different combinations of time governance practices. While this supports the initial thesis that time is at the center of sustainability-thinking, it also points to the fundamental normative implications of time governance practices and their combinations. Time governance practices are not only means to realize sustainability, but also become productive elements in the design of sustainability timescapes.

Such timescapes have political implications in many respects. By drawing attention to different time horizons (and ignoring other horizons), they pre-structure the space for (legitimate) decisions regarding sustainability and require political actors to relate their actions to these time horizons. In addition, the timescapes shape the way in which political debates on sustainability can develop. It is interesting to see how the combination of different types of time horizons creates contingency and space for political discussion, and thus points to a potential for politicizing sustainability. At least, those combinations of time governance practices that relate to different types of time horizons (2, 3, 4, 6, 6, 7, and 8) seem to promote forms of learning, experimentation, and imagination, thus opening up space for political contingency. In contrast, combinations of identical time horizons (1, 5 and 9) seem to destroy contingencies and flatten the room for maneuver by tying action to an idealized past, being fixated on the evidence claim of the present, or tending to ignore present and past political conditions in creating "flatlands" of sustainable futures. In these cases, sustainability becomes a depoliticized inevitability. Analyzing how different time governance practices interplay and form different timescapes of sustainability thus also contributes to a better understanding of the dynamics of politicization and depoliticization around sustainability.

Conclusions and perspectives

Although sustainability-thinking is essentially about time, the temporal implications of SG have not yet been in the focus of related research and practice. This paper takes a step towards a more time-sensitive analysis and practice of SG, and attempts to develop a more differentiated understanding of the role of time in SG. To this end, we have proposed two analytical perspectives, *governance of time* and *governance by time*, and applied these two perspectives to different sustainability-oriented governance approaches. This cursory analysis has shown that time, although in many ways implicit, is indeed a relevant point of reference for sustainability-oriented governance. Different approaches of SG show different—instrumental and object-oriented—governance practices referring to different time horizons, namely the past, the present and the future. The combination of these different temporal governance practices opens up a universe of nine different patterns of temporal governance. These can be interpreted as timescapes of sustainability, implying different temporal interpretations sustainability. So, we find ourselves in a situation characterized by reflexivity in that the temporality of SG practices shapes the understanding of sustainability itself.

Overall and with regard to the objectives of the paper, our time-oriented analysis of SG has provided a more differentiated picture of the temporal implications of different approaches of SG. It has also shed new light on the multifaceted SG discourse as a whole. In particular, the universe of combined time governance practices can be seen as an alternative way to understand and order plurality in that discourse. In addition, given the general turn towards time in governance analysis and practice, our analysis suggests that the highly diverse SG discourse as such can be seen as a particular expression of increasingly important and differentiating practices of time governance.

Furthermore, our analysis has shown that the temporality of governance in general and SG in particular is associated with significant normative and political implications. Sustainability-oriented time governance practices, and especially their combinations to more complex temporal governance patterns, create different meanings of sustainability and structure the space of possible governance options. More precisely, they can close the spectrum of plausible options for action by locking up temporal horizons, and thus generating the idea of inevitability. Or they can show ways to open up spaces of action by linking different time horizons to each other. Both variants are highly political, either in a politicizing ("opening up") or depoliticizing ("closing down") manner.

What follows from these findings for future research and practice? First, we believe it is necessary to expand our analysis of temporal implications of SG. This includes the consideration of other forms of SG, and in particular the systematic linking of concrete SG approaches and practices with the timescapes of sustainability. Future research can include working out the normative temporalities, which are implied in various justice-oriented, resilience-oriented and deliberation-oriented sustainability conceptions, and linking them with the nine timescapes of sustainability as well as corresponding approaches of SG. Apart from these extensions, future research should also deal with the actual role of time in the action orientations and strategies of governance actors. To what extent and under which conditions are sustainability-oriented actors consciously concerned with what kinds of temporal governance?

With regard to governance practice, our insights that SG is associated with time in many ways suggests that time should move into the focus of actors involved in the design and implementation of SG arrangements. The orientation towards time brings with it both a burden and an opportunity for the design of SG. It is a burden because taking time into consideration increases the already high complexity of SG efforts even more (Newig et al. 2008). But time is also an opportunity. A time-oriented view of SG reveals previously undiscovered orientations for governance design: in the form of conscious options to address time as a governance object and in the form of the use of time as a strategic and tactical tool to promote the design and practice of SG. However, our analysis has also pointed out that different combinations of governance practices produce different timescapes of sustainability and ultimately shape the understanding of sustainability itself. The realization of the potential diversity of these combinations and their normative and political consequences can contribute to the advancement of time-reflexive designs of sustainability-oriented governance arrangements.

References

Adam B (1990) Time and social theory. Polity Press, Cambridge

Adam B (1998) Timescapes of modernity. The environment and invisible hazards. Routledge, London

Adam B (2003) Reflexive modernization temporalized. Theory Cult Soc 20(2):59–78

Adelle C, Weiland S (2012) Policy assessment: the state of the art. Impact Assess Project Apprais 30(1):25–33

Adger NW, Jordan A (eds) (2009) Governing sustainability. Cambridge University Press, Cambridge

Angheloiu C, Chaudhuri G, Sheldrick L (2017) Future tense: alternative futures as a design method for sustainability transitions. Des J 20:S3213–S3225

Auclair E, Fairclough G (2015a) Living between past and future. An introduction to heritage and cultural sustainability. In: Auclair E, Fairclough G (eds) Theory and practice in heritage and sustainability. Between past and future. Routledge, London, pp 1–22

Auclair E, Fairclough G (eds) (2015b) Theory and practice in heritage and sustainability. Between past and future. Routledge, London

Aykut SC (2015) Energy futures from the social market economy to the Energiewende: the politicization of West German energy debates, 1950–1990. In: Andersson J, Rindzeviciute E (eds) The Struggle for the long-term in transnational science and politics: forging the future. Routledge, London, pp 93–144

Aykut SC (2016) Taking a wider view on climate governance: moving beyond the 'iceberg', the 'elephant', and the 'forest'. WIREs Clim Change 7:318–328

Baker S (2007) Sustainable development. Routledge, London

Barbehön M (2018) Ever more complex, uncertain and urging? ›Wicked problems‹ from the perspective of antinaturalist conceptualizations of time. Z Diskurs 3:1–20

Beck U (2006) Reflexive governance: politics in the global risk society. In: Voss J-P, Bauknecht D, Kemp R (eds) Reflexive governance for sustainable development. Edward Elgar, Cheltenham, pp 31–56

Beckert J (2016) Imagined futures. Fictional expectations and capitalist dynamics. Harvard University Press, Cambridge

Bevir M (2013) Governance as theory, practice and dilemma. In: Bevir M (ed) The SAGE handbook of governance. Sage, Los Angeles, pp 1–16

Bornemann B (2014) Policy-Integration und Nachhaltigkeit. Integrative Politik in der Nachhaltigkeitsstrategie der deutschen Bundesregierung, 2nd edn. Springer, Wiesbaden

Bornemann B, Schmidt S, Schubert S (2016) Governing uncertainties in sustainable energy transitions—insights from local heat supply in Switzerland. Urban Plan (UP) 1(3):38–54

Bornemann B, Lange P, Burger P (2019) Toward systematic understandings of sustainability governance. A conceptual meta-framework. In: Hamman P (ed) Sustainability governance and hierarchy. Routledge, London

Burger P, Christen M (2011) Towards a capability approach of sustainability. J Clean Prod 19(8):787–795

Carter P (2016) Time tactics: project managing policy implementation in a network. Time Soc. https://journals.sagepub.com/doi/pdf/10.1177/0961463X16682517

Dobson A (1996) Representative democracy and the environment. In: Lafferty WM, Meadowcroft J (eds) Democracy and the environment. Problems and prospects. Edward Elgar, Cheltenham, pp 124–139

Dryzek J (1997) The politics of the earth. Environmental discourses. Oxford University Press, Oxford

Du Pisani JA (2006) Sustainable development—historical roots of the concept. Environ Sci 3(2):83–96

Elchardus M (1988) The rediscovery of Chronos: the new role of time in sociological theory. Int Sociol 3(1):35–59

Felt U, Felder K, Öhler T, Penkler M (2014) Timescapes of obesity: coming to terms with a complex socio-medical phenomenon. Health 18(6):646–664

Fischer F (2017) Climate crisis and the democratic prospect: participatory governance in sustainable communities. Oxford University Press, Oxford

Folke C, Hahn T, Olsson P, Norberg J (2005) Adaptive governance of social-ecological systems. Annu Rev Environ Resour 30(1):441–473

González-Ricoy I, Gosseries A (eds) (2016) Institutions for future generations. Oxford University Press, Oxford

Grunwald A (2007) Working towards sustainable development in the face of uncertainty and incomplete knowledge. J Environ Plan Policy Manage 9(3):245–262

Henry AD (2018) Learning sustainability innovations. Nat Sustain 1(4):164–165

Howlett M (2009) Policy analytical capacity and evidence-based policy-making: lessons from Canada. Can Public Adm 52:153–175

Howlett M, Goetz KH (2014) Introduction: time, temporality and timescapes in administration and policy. Int Rev Admin Sci 80(3):477–492

Hutson MA (2010) Power, politics, and community development. Community Dev 44:111–126

Jackson T (2011) Prosperity without growth. Economics for a finite planet. Earthscan, London

Jacobs M (1999) Sustainable development as a contested concept. In: Dobson A (ed) Fairness and futurity. Essays on environmental sustainability and social justice. Oxford University Press, Oxford, pp 21–45

Kemp R, Parto S, Gibson RB (2005) Governance for sustainable development. Moving from theory to practice. IJSD 8(1/2):12

Kemp R, Loorbach D, Rotmans J (2007) Transition management as a model for managing processes of co-evolution towards sustainable development. Int J Sustain Dev World Ecol 14(1):78–91

Kooiman J (2007) Governing as governance. Sage, London

Lafferty WM, Langhelle O (1999) Sustainable development as concept and norm. In: Lafferty W, Langhelle O (eds) Towards sustainable development. On the goals of development—and the conditions of sustainability. Macmillan, Basingstoke, pp 1–29

Lange P, Driessen PPJ, Sauer A, Bornemann B, Burger P (2013) Governing towards sustainability—conceptualizing modes of governance. J Environ Plann Policy Manage 15(3):403–425

Latour B (2017) Facing Gaia: eight lectures on the new climatic regime. Polity Press, Cambridge

Loorbach D (2010) Transition Management for sustainable development: a prescriptive. complexity-based governance framework. Governance 23(1):161–183

Lövbrand E, Beck S, Chilvers J, Forsyth T, Hedrén J, Hulme M, Lidskog R, Vasileiadou E (2015) Who speaks for the future of Earth? How critical social science can extend the conversation on the Anthropocene. Glob Environ Change 32:211–218

Meadowcroft J (2000) Sustainable development: a New(ish) idea for a new century? Polit Stud 48(2):370–387

Meadowcroft J, Steurer R (2013) Assessment practices in the policy and politics cycles: a contribution to reflexive governance for sustainable development? J Environ Pol Plan 20(6):734–751

Meuleman L, Veld RJ (2009) Sustainable development and the governance of long-term decisions. RMNO, Den Haag

Miller CA (2005) New civic epistemologies of quantification: making sense of indicators of local and global sustainability. Sci Technol Hum Values 30:403–432

Newig J, Voss J-P, Monstadt J (eds) (2008) Governance for sustainable development. Coping with ambivalence, uncertainty and distributed power. Routledge, London

Norton BG (2003) Searching for sustainability. Interdisciplinary essays in the philosophy of conservation biology. Cambridge University Press, Cambridge

Nowotny H (1996) Time. The modern and postmodern experience. Polity, Cambridge

Nykvist B, Heland J von (2014) Social-ecological memory as a source of general and specified resilience. Ecology and Society 19(2)

Pollitt C (2008) Time, policy, management. Governing with the past. Oxford University Press, Oxford

Rockström J, Steffen W, Noone K et al (2009) A safe operating space for humanity. Nature 461(7263):472–475

Rosa H (2015) Social acceleration. A new theory of modernity. Columbia University Press, New York

Rosa H, Scheuerman WE (eds) (2011) High-speed society. Social acceleration, power, and modernity. Penn State University Press, University Park

Schneider SH (1997) Integrated assessment modeling of global climate change: transparent rational tool for policy making or opaque

screen hiding value-laden assumptions? Environ Model Assess 2(4):229–249

Schuitmaker TJ (2012) Identifying and unravelling persistent problems. Technol Forecast Soc Chang 79(6):1021–1031

Schultz WL, Crews C, Lum R (2012) Scenarios: a hero's journey across turbulent systems. J Futures Stud 17:129–140

Selin C (2008) The sociology of the future: tracing stories of technology and time. Sociol Compass 2(6):1878–1895

Sengers F, Wieczorek AJ, Raven R (2016) Experimenting for sustainability transitions: a systematic literature review. Technol Forecast Soc Change. https://www.sciencedirect.com/science/article/pii/S0040162516302530

Stirling A (2014) Emancipating transformations: from controlling "the transition" to culturing plural radical progress. STEPS working paper 64, Brighton

Strassheim H (2016) Knowing the future: theories of time in policy analysis. Eur Policy Anal (EPA) 2(1):150–167

Straßheim H (2018) Policy as a body of expertise. In: Colebatch HK, Hoppe R (eds) Handbook on policy, process and governing. Edward Elgar, Cheltenham, pp 89–108

Swanson D, Pintér L (2007) Governance structures for national sustainable development strategies. In: OECD (ed) Institutionalising sustainable development. OECD (Organisation for Economic Co-operation and Development), Paris, pp 33–65

Tsoukas H (2005) Complex knowledge. Studies in organizational epistemology. Oxford University Press, Oxford

Unruh GC (2000) Understanding carbon lock-in. Energy Policy 28(12):817–830

Vecchione E (2012) Deliberating beyond evidence: lessons from integrated assessment modelling. Iddri working papers

Vergragt PJ, Quist J (2011) Backcasting for sustainability: introduction to the special issue. Technol Forecast Soc Chang 78(5):747–755

Voss J-P, Bornemann B (2011) The politics of reflexive governance: challenges for designing adaptive management and transition management. Ecol Soc 16(2):9

Voss J-P, Freeman R (eds) (2016) Knowing governance. The epistemic construction of political order. Palgrave Studies in Science, Knowledge and Policy. Palgrave Macmillan, Houndmills, Basingstoke

Voss J-P, Bauknecht D, Kemp R (eds) (2006) Reflexive governance for sustainable development. Edward Elgar, Cheltenham

Voss J-P, Smith A, Grin J (2009) Designing long-term policy: rethinking transition management. Policy Sci 42(4):275–302

Wallimann-Helmer I, Meyer L, Burger P (2017) Democracy for the future: a conceptual framework to assess institutional reform. Jahrbuch für Wissenschaft und Ethik 21(1):197–220

Weiland S, Bleicher A, Polzin C, Rauschmayer F, Rode J (2017) The nature of experiments for sustainability transformations: a search for common ground. J Clean Prod 169(15):30–38

Whipp R, Adam B, Sabelis I (eds) (2002) Making time. Time and management in modern organizations. Oxford University Press, Oxford