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Striking the balance: Sustainability and institutional transitions in the European Environment Agency

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ABSTRACT

We look at how concepts of uncertainty and complexity undergo a series of balancing acts when moving between scientific research and policy. By questioning the prediction and control framework, uncertainty and complexity create both opportunities for new policy framings to emerge and challenges to the current role of institutions. We identify three balancing acts. First, there is the challenge of acknowledging the limits of the govern-ability of the future while retaining a role for governing agents. Second, the interface with policy leads to the selection of policy-relevant evidence that may be in tension with creating an inclusive space for the plurality of legitimate but often contrasting, perspectives at the interface with society. Third, there is a tension between the expectation that policy recommendations be formulated to solve existing problems and the new questions and processes that are opened when taking uncertainty and complexity into account. The paper takes as its case study the policy recommendations formulated by the European Environment Agency about sustainability transitions. Results show that the innovative and disruptive suggestions, which are made in the main text, are very much nuanced when it comes to policy recommendations and part of the transformative power of these concepts is lost through the balancing of opposing institutional needs. The value of the report lies not necessarily in the practical advice it formulates but in the more modest contribution of giving visibility to debates about uncertainty and complexity. Sustainability transition concepts serve as gatekeepers for new debates and new narratives to develop if sustained in time. Opportunities windows for new debates to emerge, however, may close fast.

1. Introduction

The last years have seen a new surge in interest by European institutions in issues of complexity and uncertainty, as exemplified by the 2019 report “Making sense of science for policy under conditions of complexity and uncertainty” by the Science Advice for Policy by European Academies (SAPEA, 2019). The COVID pandemic has brought such issues to the core of political and societal debate (SAM, 2020; Waltner-Toews et al., 2020). At the same time, there is increasing recognition of the unsustainability of the current economic model (OECD, 2020) and of the inadequacy of existing institutions in correcting it. The 2021 Dasgupta Review on the Economics of Biodiversity, states as one of its headline messages that at the heart of the problem of “our unsustainable engagement

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with nature [...] lies deep-rooted, widespread institutional failure” (Dasgupta, 2021: 494).

While it is remarkable that high-level reports about the impacts of uncertainty and complexity are commissioned and that reflections about the role of governing institutions themselves emerge, it is unclear whether these concepts have a reach beyond the publication of reports. In this paper, we analyse how uncertainty and complexity are interpreted by the European Environment Agency (EEA) in its policy recommendations about sustainability transitions. We assess to what extent disruptive elements are normalised and reinterpreted to fit into existing governance frameworks and to what extent new opportunities are created to broaden the range of knowledge elements and policy recommendations that enter the science-policy interface.

In the past, debates about uncertainty and complexity have emerged from time to time but seem to have little impact on the relationship between science and policy. For instance, the EEA published in 2001 what has come to be considered a landmark report “Late lessons from early warnings” (EEA, 2001). This report has greatly influenced thinking about the risks and uncertainties of new and emerging technologies. Yet, in the 2013 follow-up publication “Late lessons from early warnings II”, the EEA laments that there has been less progress with “the call to ‘identify and reduce institutional obstacles to learning and action’. Both political and scientific ‘bureaucratic silos’ do not seem to have disappeared, despite the frequent calls for policy integration and inter-departmental coordination” (EEA, 2013: 670).

The difficulty in having a life beyond the report can be related to a more general challenge faced by many researchers who engage with the science-policy interface. Turnheim, Asquith, and Geels (2020) have argued that efforts to increase engagement of sustainability transitions scholarship with policy requires more synthetic research findings, which in turn affect conceptual rigour and nuance. Weber and Truffer (2017) analyse the uptake of the innovation systems approach and argue that the scientific ambitions of the approach degenerated somehow in the policy discourse. In both cases, the interpretive flexibility of the concepts presented made them at once appealing for their novelty and susceptible to being interpreted according to existing institutional framings. As Waterton and Wynne (2004) argue, scientific knowledge undergoes a process of standardisation and stabilisation to become policy-useful “information”.

Bradshaw and Borchers (2000) refer to the “science-policy gap” to indicate the “dysfunctional aspects of the science-policy interface” (2000: 3). They argue that while science has a good understanding of uncertainty, the public and policy-makers seek certainty and deterministic solutions. Craye (2006) argues that complexity and uncertainty create policy controversies and disputes. In order to avoid these disputes, the tendency is to reduce uncertainty and integrate it into evidence. As a result, uncertainty and complexity thinking have often failed to have a life beyond the report because they require a change in institutional practices. Seeking certainty makes it possible to define clear roles for science and policy. When faced with difficult decisions, the questions that policy has to solve are reduced to technical-scientific problems (Ravetz, 1971), which can be treated like a puzzle. Science supposedly solves the puzzle and tells policy what to do. When problems cannot be treated as a puzzle to be solved, the division of labour between science and policy is upset and the science-policy interface needs to be re-defined.

The call to redefine the science-policy interface can be interpreted in very different ways. For some, it means letting go of the Cartesian dream of prediction and control (Pereira & Funtowicz, 2015) and fostering reflexivity (Strand & Cañellas-Boltà, 2006). For the EEA, the challenge of translating the scientific insights of sustainability transitions into policy is seen as one of producing “actionable knowledge,” which the EEA defines as “going beyond creating knowledge about the world to *rapidly* creating the wisdom about how to act appropriately” (emphasis added, EEA, 2021b).

We focus on the challenges that uncertainty and complexity pose to the science-policy interface from a post-normal science perspective (Funtowicz & Ravetz, 1990, 1994). In post-normal contexts, science does not act as a puzzle-solver, high uncertainty makes it difficult to provide guidance to policy, as solutions can only be partial. In this context, uncertainty and complexity are uncomfortable yet unavoidable. Based on the literature on governance in complexity (Kovacic, Strand, & Völker, 2019; Strand & Cañellas-Boltà, 2006; Strand, 2002), we suggest that a change in institutional practices could include stepping away from the aim of translating knowledge into action and moving towards creating pockets of reflexivity in policy-relevant institutions, which may include value pluralism and debate even when time-consuming. We take as our case study the interpretation of the sustainability transitions literature by the EEA. The sustainability transitions framework is of interest because it is presented as an open-ended future-oriented process, characterised by uncertainty and non-deterministic pathways, as transitions depend on the complex interplay between different levels, defined as niche, regime, and landscape. The EEA makes a good case study because it acts as a knowledge broker for policymakers and for the public, translating scientific insights into the language of European institutions. We ask: How are sustainability transitions rendered as policy recommendations? How are institutional practices affected by the inherent uncertainty and complexity of sustainability transitions?

2. Theoretical framework

There are a variety of different ways of conceptualising the relationship between science and policy, and understanding how knowledge moves between science and policy. A very common conceptualisation is the modern model (Funtowicz & Strand, 2007) of science speaking truth to power (Wildavsky, 1989), or the “get the facts then act” model (Pielke, 2004). In the modern model, science and policy are seen as two separate realms with separate responsibilities. Science is tasked with providing facts, solutions and “policy-relevant evidence” (Pereira & Funtowicz, 2009) to policy-makers and policy is tasked with the political decisions and the implementation of the solutions identified by science. This separation relies on the understanding of science as “normal science” (Kuhn, 1962), that is, a puzzle solving exercise in which clearly defined problems have unique solutions for science to find. Solutions can then be communicated to policy and translated into action. Importantly, solutions are scientific and therefore supposedly neutral and objective. The separation between science and policy is created in the hope of alleviating the difficult decisions that policy-makers

have to make by turning political problems into technical problems. The knowledge that is communicated is limited to what is considered policy-relevant. It often comes in the form of solutions and policy recommendations that are meant to guide action, and only as a secondary objective to promote reflexivity, revision, and learning.

The modern model has been widely criticised. From the perspective of science and technology studies, [Jasanoff \(2004\)](#) has questioned the idea that science and policy act separately and argues that science and political orders co-produce each other. In planning theory, there is a long research tradition on wicked problems ([Rittel & Webber, 1973](#)), which criticises the idea that problems can be neatly defined and corresponding solutions can be identified. Issues of uncertainty and complexity mean that problems may be hard to define and there may only be partial solutions, with trade-offs, winners and losers, and unexpected and unintended consequences, rather than optimal solutions. Alternative models have suggested fostering values such as transparency, accountability, precaution, and responsibility as a means of dealing with uncertainty and complexity ([Pereira & Funtowicz, 2009](#)). New conceptions of science have emerged beyond the puzzle-solving exercise of normal science, together with new ways of thinking about the relationship between science and policy. Post-normal science ([Funtowicz & Ravetz, 1993](#)) and Mode 2 science ([Nowotny, Scott, & Gibbons, 2003](#)) explore the possibility of including non-experts in the production of knowledge, through extended peer communities and the production of socially robust knowledge. The knowledge that moves between science and policy is contextualised, it is a knowledge that takes into account social, ethical and political aspects and that is aware of the known and unknown consequences of the solutions suggested. What is communicated may include uncertainty and may be aimed at the revision of current policies, at precautionary action, and at learning. The co-production framework includes the study of how scientists and practitioners may work collaboratively to produce knowledge that is actionable ([Arnott, Mach, & Wong-Parodi, 2020](#)).

In this paper, we focus on the hybrid space in between the modern model and the co-production model. This space is created when ideas of doing “science with and for society” (a phrase used in the Horizon 2020 and Horizon Europe Framework Programmes of the European Commission) co-exist with the expectation that the knowledge produced should guide action ([EEA, 2021a](#)). Ideas of co-production, extended and participatory modes of knowledge production and appraisal, and transdisciplinarity are known not to be a panacea ([Lemos et al., 2018](#)) and often do not give clear indications to policy about what to do. Deliberative modes of research can be conflictive, reproduce power asymmetries ([Strumińska-Kutra & Scholl, 2022](#)) and be too slow to respond to urgent concerns, amplifying the challenges of uncertainty and complexity. We argue that the EEA, as an EU agency that works at the science-policy interface and is responsible for ‘moving’ knowledge from science to policy, finds itself in this hybrid space. On one hand, the desire to be policy-relevant makes the EEA give preference to actionable knowledge ([EEA, 2021a](#)). On the other, the Agency produces numerous reports that aim at giving a comprehensive and reflexive outlook of the complexities and systemic challenges involved in environmental issues. In this context, translating knowledge about uncertainty and complexity requires navigating a series of tensions, balancing different expectations and negotiating strategic messages in the science-policy interface.

We identify three balancing acts through which the EEA navigates. First, drawing on scholarly work on the impacts of uncertainty and complexity in policy-making ([Funtowicz & Ravetz, 1994](#); [Funtowicz & Strand, 2007](#); [Wynne, 1992](#)), we argue that the insights of uncertainty and complexity point to the limits of govern-ability. Uncertainty and complexity are often used to point to failures of the ‘prediction and control’ paradigm ([Pereira & Funtowicz, 2015](#)). The limited ability to govern and control complexity creates a tension between the desire, on one hand, to maintain control through new governance tools and more holistic approaches, and, on the other hand, the need of rethinking governance in a context of limited control. The alternatives provided point not only to alternative models for action but also to reconfigurations of the science-policy interface itself. As an alternative to ex-ante prediction, the adaptive governance literature ([Chaffin, Gosnell, & Cosens, 2014](#); [Rijke et al., 2012](#)) suggests the ex-post concept of adaptation, which gives governing institutions a reactive rather than proactive role. Paraphrasing [Rip \(2006\)](#), it may be more helpful to think of governance in complexity rather than governance of complexity.

The second point of tension emerges from the double role of the European Agencies as an interface with both policy and society and is based on the work of [Waterton & Wynne \(2004\)](#), who also take the EEA as their case study.¹ The authors critically discuss how the role of the EEA was originally conceived and how it crystallised in practice. On one hand, the Agency aims at providing timely, targeted and relevant information to policy. The mandate of the EEA can be seen as a call to “speak truth to power”. As a knowledge broker, the EEA strives to retain an authoritative and science-based voice ([Waterton & Wynne, 2004](#)). On the other hand, the EEA aims to provide information to the public, and works together with a network of countries (the European Environment Information and Observation Network, Eionet), enabling an informed discussion of environmental challenges in line with Europe’s democratic values ([EEA, 2022](#)). The interface with policy tends to favour a narrowing of the debate that focuses on data, indicators and solutions, while the interface with society favours opening up and being inclusive of a variety of legitimate, even if contrasting, perspectives. This double interface with policy and with society creates the tension between what Waterton and Wynne call the “symbolic commitment” to foster public participation and the “practically more fundamental principle of unitary political order in Europe” (2004: 97), the latter being underpinned by the authoritative voice of science as guardian of a ‘unified truth’.

Third, we focus on the tension that is created when “hard facts” are not available to inform policy action, yet policy guidance is still expected. If uncertainty and complexity are taken seriously, science does not merely provide different types of solutions that fit into existing decision-making processes, but initiates new processes in which scientific answers are not final and complete and require broader deliberation to guide policy. In the context of uncertainty, the range of inputs that science contributes to policy debates may expand beyond evidence and include also narratives, future visions and spaces for reflexivity ([Strand, Saltelli, Giampietro,](#)

¹ Since we use the same case study, we would like to clarify that the tension is identified based on the work of [Waterton and Wynne \(2004\)](#), not on our empirical material.

Rommetveit, & Funtowicz, 2016; Voss, Bauknecht, & Kemp, 2006). In doing so, scientific input may not only take the form of evidence that informs the debate but may also serve to generate new questions and create new processes, such as the extended peer review of post-normal science. The double role of providing evidence that answers existing policy questions, on one hand, and raising new questions that open new processes, on the other hand, creates the third tension. We argue that this balancing act creates the potential for reflexive insights and the opportunity for the seeds of institutional change to be planted.

One example of a reflexive insight can be found in the statement: “This raises the question of whether it is sufficient to address the existing knowledge gaps, complement them with additional knowledge and introduce more participatory, interdisciplinary and transdisciplinary approaches — or do we need a new knowledge system for systemic transformation?” (EEA, 2021b: 10). Whether this reflection can plant a seed of institutional change depends on how the different balancing acts are resolved. The EEA defines the “ideal knowledge system” as one in which “the development, uptake and use of knowledge would be organised as an iterative and holistic co-creation process with a broad spectrum of societal actors” (EEA, 2021b: 10). This ideal resonates with the co-production model. However, the ideal “is challenged by incommensurability of world views, competing and vested interests, multidimensional objectives, and a lack of trust, time and resources” (EEA, 2021b: 10), which suggests unease with situations in which the modern model of science speaking truth is challenged. The institutional mandate to provide “timely, targeted, relevant, and reliable” (Waterton & Wynne, 2004) information may be in tension with co-production models, which may be seen as problematic when solutions are contested and time-consuming. Whether knowledge co-production is seen as an opportunity to better respond to the institutional mandate by enriching the form and types of knowledge that are mobilised, or it is perceived as a complication to the “rapid” transfer of knowledge into policy action, very much depends on how the mandate of the EEA is interpreted.

3. Case study and methods

We chose to focus on the EEA because as an organisation at the boundary between science and policy (Oliver et al., 2021), the Agency provides a privileged viewpoint to identify and analyse the tensions that complexity and uncertainty create for the science-policy interface. As Waterton and Wynne (2004) explain, the EEA navigates a hybrid terrain. “While it was expected that the EEA would provide information so as to be relevant to and effective for EU environmental policy, it was nevertheless also expected that this new institution would avoid trespassing into areas of policy prescription or advocacy” (2004: 90). Consequently, the EEA does not make policy, nor does it advocate for specific policies, but it aspires to provide “timely, targeted, relevant, and reliable” information to policy, that is, information that is timed to political agendas, targeted to political needs, relevant to policy and reliable in a way that allows policy-makers to act even though uncertainties may be present (Waterton & Wynne, 2004: 94). This definition of the EEA’s mission shows its proximity to policy processes. The interface with policy creates the opportunity of influencing the policy discourse, such as in the recent case of the EU’s European Green Deal (European Commission, 2019) and of the 8th Environment Action Programme (European Parliament, 2021). These high-level documents are directly informed by EEA’s knowledge products and underpinning framings (including the publications on sustainability transitions) and may be seen as a response to EEA’s calls for action. As the boundaries between the world of policy and politics and the world of scientific advice cannot be completely disentangled, the Agency finds itself in a hybrid position. As Guston (2001) argues, boundary organisations may be better understood as working at the blurred space between science and policy rather than enacting an idealised and unrealistic separation between the two.

To analyse how concepts of uncertainty and complexity travel from science to policy, we focus on the publications about sustainability transitions. The EEA has published a series of three reports on the topic of sustainability transitions starting from 2016, which include the 2016 report by the European Environment Information and Observation Network (Eionet) “Sustainability transitions: Now for the long term” (Eionet, 2016), the 2017 report “Perspectives on transitions to sustainability” (EEA, 2017), which provides an overview of different academic perspectives on sustainability transitions, and the 2019 report “Sustainability transitions: policy and practice” (EEA, 2019b), which attempts to translate the scientific insights of sustainability transitions into policy recommendations. The sustainability transition reports are jointly authored by leading academic experts in the field and EEA staff (Turnheim et al. (2020), over 4 years of collaboration. In this paper, we focus on the 2019 report “Sustainability transitions: policy and practice.” The 2016 and 2017 reports give an overview of research on sustainability transitions, while the 2019 report aims at translating the research insights into policy recommendations and moving this knowledge from science to policy. We assess this translation to understand how the process of standardisation and stabilisation of scientific information happens, but also whether a process of institutional reflexivity and change can be started.

The choice of focusing on the sustainability transitions reports is motivated by two main reasons. First, sustainability transitions are a relevant example of research in which complexity and uncertainty play a prominent role. Sustainability transitions studies emerged in the 1990s as an interdisciplinary field aimed at understanding long-term, large-scale and non-linear social change, as well as accelerating and guiding transitions towards more sustainable systems (Loorbach & Rotmans, 2010; Rotmans, Kemp, & van Asselt, 2001). Sustainability transitions studies have been influenced, among other fields, by post-normal science, and the management of transitions explores non-technocratic approaches to sustainability governance that are aware of uncertainty and complexity. Sustainability transitions are conceptualised as processes of systemic change that are to a large extent unpredictable and contested. Transitions entail creative destruction, suggesting that although the process can be conflictive, a better understanding of these systemic changes helps steer transitions in the desired direction. Relations of power are a central concern (Avelino & Rotmans, 2009). Complexity is captured by conceptualising transitions through a multi-level perspective (Geels & Schot, 2007), which distinguishes between niche (small networks of actors where innovation emerges), regime (the level of the macro-economy, cultural patterns and macro-political developments) and landscape (the contextual or exogenous level that forces change from above) and emphasises how change is not transmitted linearly from one level to the next but requires an alignment of bottom-up and top-down pressures for a

socio-technical regime to change.

Second, the sustainability transitions reports are of interest to this paper because this line of work has become an umbrella for some of the flagship products of the EEA, including State of the Environment reporting in Europe (EEA, 2019c), the Drivers of Change report (EEA, 2019a), and the Agency's work on urban sustainability (see <https://www.eea.europa.eu/themes/sustainability-transitions/urban-environment>). Concepts of uncertainty and complexity have thus been taken up and developed in novel knowledge products of the Agency as well as in its established products, such as the State and Outlook of the Environment Report, which is published every 5 years. We are aware of the fact that these concepts are interpreted differently in different reports and further work of translation occurs, therefore with the current analysis we provide insight into only one step of the process.

The 2019 report was analysed using the NVIVO software and coded by the authors. The coding structure was developed based on the theoretical framework and focused on understanding how the three balancing acts identified in the literature play out in this particular report. Table 1 lists the codes that were used in correspondence to each of the theoretical debates identified.

4. Results

This paper analyses an EEA report, not the most advanced state-of-the-art academic research on sustainability transitions. The content of the report is not particularly new from an academic perspective. Our aim is not to present new information about sustainability transitions, nor new discussions about the limits of the modern model of science speaking truth to power, but to observe how the sustainability transitions framework is translated into a policy document and how the concepts of uncertainty and complexity are interpreted. The balancing acts play an important role in translating the concepts of uncertainty and complexity into policy recommendations, a discussion we return to in the final section of the paper.

4.1. Balancing the limited govern-ability of the future while retaining a role for governing institutions

Transitions defy many of the tenets of policy-making, such as the ability to predict the outcomes of policy, the ability to estimate costs and benefits of policy interventions, the ability of policy to achieve desired outcomes, and the ability to establish a timeline for the execution of policies. Transitions are "fundamentally uncertain and open-ended. Surprises and unintended outcomes are to be expected" (EEA, 2019b: 8). This means that one cannot predict the outcomes and timing of a transition beyond macro-trends about what should be phased out and what general principles are to be encouraged. In this context, the setting of policy targets is challenging. The achievement of targets ceases to be a measure of success and a source of accountability of public policies, which can create a challenge in terms of ensuring output legitimacy.

One may then turn to input legitimacy: if outcomes cannot be predicted, the government can still be seen to act in the interest of its citizens by ensuring the legitimacy of the process. This aspect too is challenged. The report continues, "Transitions are also conflictual and deeply political, producing trade-offs, winners and losers, and related struggles, as politically influential and well-resourced incumbents often resist change" (EEA, 2019b: 8). The role of the government as the mediator of the common good is put in peril, transitions may create disagreement about the very idea of "common good" as losers will not see the benefit of change. Resistance on the part of "politically influential and well-resourced incumbents" means creating and engaging in political struggles, rather than mediating conflict, and debates may possibly arise about the input legitimacy of the institution promoting the transition.

Moreover, the very centrality of the government may be questioned. It is not clear that the government needs to have a central role in the transition: "Transitions emerge through interactions among multiple actors, including businesses, users, scientific communities, policymakers, social movements and interest groups" (EEA, 2019b). All in all, transitions governance may be equated to an unclear action course, towards unclear results, through a conflictual pathway. Transitions take policymaking into unchartered territory: what is the role of the government? Is there a role for the government, if govern-ability is so reduced? The report argues that "Public policies and institutions are part of the regime structures, implying that they too need to be transformed" (EEA, 2019b: 8). Not only is govern-ability limited, but the very existence of governing institutions may come to be questioned.

This is a very radical proposal to endorse, especially for an Agency of the European Union. Sustainability transitions potentially open a space for thinking outside of the box, for rethinking the role of government and engagements with civil society, and for

Table 1
Coding structure.

Balancing act	Codes
Acknowledging the limits of govern-ability of the future (Funtowicz & Ravetz, 1994; Funtowicz & Strand, 2007; Wynne, 1992) while retaining a role for governing institutions	(1) the concepts related to uncertainty and complexity that are introduced (such as open-endedness, unpredictability, conflicts and disruptions); (2) how these concepts are translated into the policy recommendations that are formulated;
Selecting policy-relevant evidence (Waterton & Wynne, 2004) while creating an inclusive space for the plurality of legitimate perspectives at the interface with society	(3) the stated aims of the report; (4) the type of knowledge that the report aims to produce;
Formulating policy recommendations to solve existing problems while opening the debate to new questions and processes (Strand et al., 2016; Voss et al., 2006)	(5) the recommendations about new modes of governance and about institutional change .

rethinking governance by prediction and control, planning and monitoring. Just as there are uncertainties and challenges to the established ways of policymaking, there is also space for hope, deep creativity and radical novelty.

There is a very fine balance between recognising the limits of govern-ability in the context of uncertainty and complexity without disempowering the governing institutions. This challenging balancing act presents itself most clearly in the formulation of policy recommendations. The report states that transitions “require a much broader policy mix, aimed at enabling innovation, experimentation, diffusion and networking, as well as facilitating structural economic change” (EEA, 2019b: 8). The way transition thinking is translated into policy recommendations is through a series of 10 “key messages for policy:”

- Message 1: Promote experimentation with diverse forms of sustainability innovation and build transformative coalitions (EEA, 2019b: 9)
- Message 2: Stimulate the diffusion of green niche innovations (EEA, 2019b: 9)
- Message 3: Support the reconfiguration of whole systems, phase out existing technologies and alleviate negative consequences (EEA, 2019b: 9)
- Message 4: Leverage and strengthen the role of cities in sustainability transitions (EEA, 2019b: 10)
- Message 5: Reorient financial flows towards sustainable and transformative innovations (EEA, 2019b: 10)
- Message 6: Promote clear direction for change through ambitious visions, targets and missions (EEA, 2019b: 10)
- Message 7: Align policies between different domains to improve policy coherence for transitions (EEA, 2019b: 11)
- Message 8: Promote coherence of actions across EU, national, regional and local governance levels (EEA, 2019b: 11)
- Message 9: Monitor risks and unintended consequences and adjust pathways as necessary (EEA, 2019b: 11)
- Message 10: Develop knowledge and skills for transitions governance and practice (EEA, 2019b: 11)

The policy recommendations find multiple roles for governing institutions to play, but in the process, both uncertainty and complexity are reduced to technical problems that can be solved through innovation, coherence and new skills. Innovation is explicitly mentioned in three out of ten recommendations. There is a specific recommendation on cities, chosen “because they are hubs for innovation and experimentation, providing great opportunities for learning and networks, and offering the potential for achieving whole system change at local scales” (EEA, 2019b: 10).

Complexity is rendered by identifying different levels (niche, regime and landscape), as defined by the multi-level perspective from the sustainability transitions literature (Geels, 2002). When it comes to policy recommendations, the different levels become entry points for policy: stimulating “green niches” may be conducive to innovations that can later be scaled up to the regime level, and “reconfiguration of whole systems” opens space for top-down action, through phasing-out and compensation.

Inconsistencies, tensions and conflicts are governed by pursuing policy coherence. The report refers to horizontal coherence between different policy areas and vertical coherence between national and sub-national levels. Coherence is to be pursued through policy coordination and integration, identifying misalignments and promoting dialogue. Complexity is not completely tamed: there is mention of the possibility that policy mixes may need a “fundamental redesign” (EEA, 2019b: 11). However, recommendations rest on the assumption that different policies can fit together like puzzle pieces, there is no explicit discussion of fundamental incompatibilities between policies, or “risk-risk trade-offs” as studied by other reports (Collins, Florin, & Sachs, 2021).

Uncertainty is reduced to a matter of risk and mitigated by monitoring such risks. There is a broad body of literature discussing the multiple ways in which uncertainty can be framed, which highlights how certain framings are more amenable to quantification and monitoring (namely risk and the estimate of the probability of occurrence, potential hazard and possible outcomes), while other definitions discuss the difficulty (if not impossibility) of knowing outcomes, of quantifying and of mitigating uncertainties. Open-endedness, unpredictability and unintended consequences require dealing with higher levels of uncertainty, such as ignorance and indeterminacy (Wynne, 1992). By focusing on risks, uncertainty is rendered in a form that warrants govern-ability.

Overall, the analysis of this balancing act shows that the conceptual framing used clearly acknowledges the limits of govern-ability of sustainability transitions but the policy recommendations revert to the simplification of complexity and the reduction of uncertainty that suggest that transitions can be steered in the desired direction. The contribution of the report may be to spell out explicitly both arguments that question and seek govern-ability, thus leaving the door open to different debates.

4.2. *Balancing the wish to be policy relevant and the commitment to involving the public*

A second point of tension can be observed in the positioning of the EEA in the European policy scene.

In line with the aim of providing knowledge for action, the 2019 report aims at responding to the knowledge gap identified by the European Commission: “It is now well understood how transitions arise. However, turning this understanding into sound advice on how to better manage present and future transitions is still a major challenge”. The present report represents a response to that knowledge gap” (EEA, 2019b: 8). In previous reports (EEA, 2017; Eionet, 2016), the EEA acts as a knowledge broker (Pielke, 2007), gathering the state-of-the-art in transitions research. The 2019 report changes register and is explicit about its aim of providing policy advice and filling the knowledge gap of turning the understanding of transitions into actionable knowledge to better manage transitions. In the words of the report, “the EEA requires a shift in emphasis – extending beyond a focus on monitoring and assessing existing environmental problems towards creating a more solutions-oriented knowledge base” (2019b: 6).

The focus on seeking solutions and actionable knowledge seems to rehearse the desire to manage transitions and creates a fine line between the understanding of transitions as a process that can be supported and the planning paradigm. This line is acknowledged in the report: “The complexity and uncertainty of societal change means that the future of society cannot simply be planned” (EEA,

2019b: 105). This tension runs throughout the report, which uses many of the concepts of transitions research grounded in complexity and uncertainty, such as the reference to “highly unpredictable results”, while at times seeming to promise to provide policy tools to “steer deliberate processes of systemic change” (EEA, 2019b: 39).

The tension between providing policy solutions and creating a space for an open dialogue with the general public can be observed in the mention of “collaborative and forward-looking approaches such as foresight” (2019b: 105), which can be used as a means of fostering the participation of multiple actors, while at the same time future visions are expected to help “conveying urgency and commitment” (2019b: 105). Urgency may limit the dialogue space and the possibility for time-consuming iterative processes. The dilemma of planning an unpredictable process is solved with the expectation that “visions, missions and targets provide a means to create directionality in complex and uncertain transition processes” (EEA, 2019b: 105). The definition of future visions, missions and targets is itself located in the tension space: the report at once informs European publics and aims at creating shared storylines that are societally desirable, visions “inspire as well as enable stakeholders, researchers, entrepreneurs and citizens alike” (EEA, 2019b: 106). Foresight exercises create the possibility for collective future-making and give an authoritative voice to a specific (environmentally sustainable) version of the common good. The report refers to narratives as a means of “promoting social acceptance,” not necessarily of fostering pluralism. Similarly to complexity and uncertainty, diversity is treated in parts of the text as a challenge to be reduced and conflict as a problem to be avoided, rather than an inevitable part of large-scale transformations such as those envisioned by sustainability transitions.

Actionable knowledge, if narrowly interpreted and enacted as a way to assertively inform the public on ‘what’ has to be done, ‘how’, ‘when’ and for ‘how long’ to ensure sustainable path, becomes problematic. If actionable is interpreted as leading to unitary solutions mirroring a technocratic *modus operandi*, and not as enabling a multiplicity of actions by a plurality of actors it creates the danger of disempowering the democratic processes of decision making. The report on sustainability transitions does not explore this question further, but the debate on this point has acquired a life beyond the report. In the more recent report “Knowledge for action”, the EEA acknowledges the need for actionable knowledge to be “integrated, spanning policy domains, disciplines, types of knowledge and different ways of framing problems and possible solutions” (EEA, 2021b: 53).

4.3. Balancing the provision of solutions and the opening of new questions and processes

The third point of tension we analyse is created by the implications of complexity for policy-making. Acknowledging complexity does not necessarily lead to providing alternative solutions that can fit in the existing policy-making processes. Alternative ‘solutions’ may raise new questions and beget alternative processes, thus creating the need to balance the desire to close the debate by guiding action with solutions and answers and the opening of new uncertainties.

This tension is dealt with through different strategies. First, diversification of policy measures is used as a remedy against “silver bullets” (EEA, 2019b: 71). The report states that “the systemic perspective on innovation emphasises that no single policy instrument can act as a silver bullet to improve socio-technical systems towards sustainability transitions. Hence, a policy mix approach is recommended” (EEA, 2019b: 111). Diversity is used as a proxy for complexity. Diversity of approaches makes it possible to plan for sustainability transitions in an incremental way: rather than questioning the effectiveness of existing policy measures, more and more measures are called for and the challenge becomes that of ensuring “policy coherence”. Policy coherence is a way of acknowledging complexity but also expresses the wish to reduce it, showing once again the tension that emerges between the desire to provide solutions and the opening of new debates.

The benefit of an incremental approach to the governance of complexity is that it does not need to question existing policies, measures and power structures. When unmet needs are identified, new measures and policies are added on top of existing ones, and power structures are maintained. As a result, there is very limited scope for new processes to be introduced. The limits of incremental change are acknowledged in the report: “These incremental innovations are relevant because they can increase environmental performance, but they do not enable sustainability transitions. Incumbent firms normally favour incremental innovation, as it is compatible with their established technologies, organisational structures, expertise, markets and business models” (EEA, 2019b: 43). The alternative suggested is to support “radical innovations”, which “form the seeds for sustainability transitions” (EEA, 2019b: 44).

Consistent with open-endedness, the risk of policy failure is acknowledged and adaptive governance is called for: “experimentation is risky and inevitably involves a degree of failure, which may create accountability challenges (about appropriate spending of public money)” (EEA, 2019b: 83). This means that “portfolio approaches” need to be combined with “adaptive governance”. Adaptive governance is a somewhat ambiguous concept that represents the tension between solutions that close the debate and new questions that open the debate. In the academic realm, adaptive governance emerged from scholarship of common resources governance and resilience and refers to a system of environmental governance that can mediate the complexity and uncertainty inherent in socio-ecological systems (Chaffin et al., 2014). In the EEA’s interpretation of sustainability transitions, adaptation is both invoked when risks cannot be anticipated, as an ex-post approach that can “complement ex-ante anticipatory approaches” (2019b: 138), and it is mobilised to promote more open-ended forms of governance through experimentation, by acknowledging the possibility of policy failure and the need to learn from errors. In the first case, as a complementary approach to risk management, adaptive governance turns the “predict and control” model (Rijke et al., 2012) into “adapt and control”. In the second case, the concept of experimentation can be associated with the emergence of a new system and a challenge to existing systems, but innovation *per se* may not lead to transformation. This double reading clearly exemplifies the balancing act that the report carries out.

Paradoxically, according to Chaffin et al., “an entrenched status quo controlling environmental governance through a combination of policy, funding, authority, or knowledge can be a significant barrier to the emergence of adaptive governance” (2014: 55). What is missing in the references to adaptive governance in the report is the explicit acknowledgement that an exercise in adaptation may

involve institutions themselves. However, by discussing adaptation through different lenses, and not just as a technical fix to the challenge of complexity, the report potentially opens the door for more reflexive debates.

5. Discussion and conclusions

The concept of sustainability transitions has been rather successful in EU policy and it is now at the core of major EU strategies, including the European Green Deal. The introduction of the “sustainability transitions” framework in the EU institutions, albeit through simplification and translation into actionable knowledge, has contributed to raising the status of environment and sustainability issues in European policy. This has made ideas of uncertainty and complexity carried by the sustainability transition framework more accessible to several key institutional actors.

Such development brings new opportunities by opening policy debates and introducing new narratives within the very institutional contexts that championed the practices that sustainability transitions now challenge. For instance, the idea of open-ended futures has been taken up in the series “Narratives for Change,” which started in 2021. The “Narratives for Change” briefs are a new knowledge product of the EEA: they are not policy briefs but rather short communications that aim at “enhancing societal dialogue around dominant paradigms” (EEA, 2021b). The aim of the “Narratives for Change” is to create pockets of reflexivity rather than to produce actionable knowledge. This is an example of how the reports on sustainability transitions have generated debates and reflections that have a life beyond the report.

To be able to plant the seeds of change, sustainability transitions thinking has also undergone a process of simplification and translation into institutional parlance. In Table 2, we show how the policy messages of the 2019 report interpret and translate the concepts of uncertainty and complexity. Innovation is explicitly mentioned in messages 1, 2 and 5, and is central to messages 3 and 4. Messages 2 and 4 refer to the multi-level perspective, calling for “niche innovations” (message 2) and focusing on cities as hubs of innovation (message 4). While the report acknowledges that innovation is not a panacea by recognising the uncertainties in “radical innovations,” it does not consider that uncertainty may be irreducible, that innovations may create new uncertainties and that solutions may not be available. The only exception is message 9, in which the recommendation is to monitor “risks and unintended consequences” rather than to reduce these types of uncertainty.

The report reinterprets technological solutionism (Morozov, 2013) by promoting the idea of “transformative” innovation (see messages 1 and 5) and innovation that catalyses the “reconfiguration of whole systems” (message 3). The discussion of the need to choose between “patching of existing policy mixes and a more fundamental redesign” (EEA, 2019b: 11) is an example of the third tension we have identified: the balancing act between formulating solutions to existing problems while opening the debate to new questions and processes. “Transformative” innovation is a way of managing this balancing act: technological and innovative solutions are called for, with the caveat that they be transformative and create new system configurations.

Complexity is rendered in two ways. First, the policy recommendations mobilise the multi-level perspective by focusing on niches (message 2) and cities (message 4) on one hand, and the whole system (message 3), on the other hand. The multi-level perspective departs from approaches that call for a single solution to be applied at different system levels, by scaling it up or promoting trickle-down. Instead, a diversity of approaches and solutions is called for. Second, messages 7 and 8 focus on vertical and horizontal coherence between policies, which can be seen both as an acknowledgement of the inconsistencies and tensions that arise in a complex

Table 2

Translation of complexity and uncertainty in policy recommendations from the “Sustainability Transitions: Policy and Practice” report.

Policy messages of the 2019 report	Interpretation of complexity and uncertainty
Message 1: Promote experimentation with diverse forms of sustainability innovation and build transformative coalitions	“Radical innovations” and uncertainties are considered, but there is the underlying expectation that solutions will come from innovation
Message 2: Stimulate the diffusion of green niche innovations	Focus on solutions based on “green” innovation. Unclear whether/how uncertainty and complexity are considered.
Message 3: Support the reconfiguration of whole systems, phase out existing technologies and alleviate negative consequences	Move beyond simple solutions towards a systemic approach, based on synergies between different innovations. No consideration of inconsistencies and incompatibilities that complex systems may generate.
Message 4: Leverage and strengthen the role of cities in sustainability transitions	Focus on action as a means of limiting complexity.
Message 5: Reorient financial flows towards sustainable and transformative innovations	Cities as hubs of innovation and experimentation are seen as examples of transition. Focus on reducing uncertainty for investors.
Message 6: Promote a clear direction for change through ambitious visions, targets and missions	Focus on visions, targets and missions rather than ‘hard’ governance tools. Periodic review of the visions. Uncertainty and complexity can be seen as motivating a more adaptive mode of governance, as well as alternatives to planning.
Message 7: Align policies between different domains to improve policy coherence for transitions	Reduction of complexity by reconciling contrasting objectives (horizontal integration).
Message 8: Promote coherence of actions across EU, national, regional and local governance levels	Reduction of complexity by reconciling different levels of governance (vertical integration).
Message 9: Monitor risks and unintended consequences and adjust pathways as necessary	Uncertainty is explicitly considered in the form of risks and unintended consequences. When uncertainty cannot be reduced, it should be monitored.
Message 10: Develop knowledge and skills for transitions governance and practice	Unclear whether/how “transitions governance and practice” consider uncertainty and complexity.

system and as a way of reducing complexity through “policy coordination and policy integration” (EEA, 2019b: 11). The possibility of irreducible complexity and unsolvable incompatibilities is mentioned as “significant risks of inconsistencies and incoherence” (EEA, 2019b: 11) but does not limit govern-ability. The insights of complexity are treated as a puzzle to be solved and solutions reduce systems’ complexity to a socio-engineering challenge. The treatment of complexity reflects tension 1 between acknowledging the limits of govern-ability and retaining a role for governing institutions. In this case, the balance is solved by envisioning “new policy framings” (EEA, 2019b: 13) in which governing institutions play the central role in policy coordination and complexity is reduced.

Finally, tension 2 between selecting policy-relevant evidence while creating an inclusive space for a plurality of legitimate perspectives plays out in messages 6 and 10. In both cases, ‘soft’ governance tools are suggested, such as visions (message 6) and the generic “new knowledge and tools” (message 10). These suggestions do not exclude more traditional tools such as targets and missions (message 6). Policy recommendations suggest a shift away from approaches based exclusively on planning and make space for adaptive approaches based on periodic reviews. Although complexity and uncertainty are not explicitly mentioned in these policy messages, the inclusion of adaptive approaches and ‘soft’ governance tools can be seen as a means of acknowledging uncertainty and complexity, rather than solely focusing on reducing them.

Suggesting “visions” as a governance tool can be interpreted as creating openness to pluralism and dialogue. The role of civil society, policy-makers and investors, however, is somewhat confined to those of campaigners, advocates and embracers whose task is to create the right framework conditions for innovations to diffuse and scale-up (e.g. through coalitions of actors, regulatory frameworks and incentives). That is, involving more stakeholders and including a plurality of perspectives is expected to support the governance of sustainability transitions. The report speaks of transitions being conflictual, political and involving struggles (EEA, 2019b: 27) but these considerations are not reflected in the policy messages. The balancing act is reached by enlisting different social actors as part of and consistent with the recommendations made for policy.

The ambiguous uptake of potentially disruptive concepts is the result of a series of balancing acts, which reflect the hybrid space in which the Agency operates. The result of these balancing acts is that new frameworks that may highlight the limited ability of institutions to govern in a context of complexity and uncertainty are introduced while solutions to complexity and uncertainty are presented. More innovative and disruptive suggestions that are made in the main text, are very much nuanced when it comes to the policy recommendations. We suggest that the nuancing of policy messages is due to an implicit process of standardisation and stabilisation of the insights of uncertainty and complexity within the report in which the balance is more often than not solved by reducing uncertainty and complexity. Such process can be better understood as an emergent outcome of the interplay between the authors’ views, the pool of knowledge actors consulted, the institutional context, and the institutional desire of ensuring relevance and uptake by policy makers.

Alternative ways of solving the balancing acts faced by policy could be conceptualised from the idea of governance *in* complexity (Rip, 2006). As opposed to governance *of* complexity, uncertainty and complexity are not something to be reduced or rendered as a puzzle to be solved. Governance *in* complexity requires spaces for reflexivity and commitment to pluralism (Kovacic et al., 2019). With regard to the policy messages of Table 2, the governance in complexity approach may include: (i) assessing the changes and emerging uncertainties created by innovation instead of expecting only solutions, (ii) being more explicit about the trade-offs and conflicts that sustainability visions created entail, instead of promising a “clear” direction, and (iii) identifying irreducible inconsistencies and creating better capacity to manage conflicts when coherence cannot be achieved. This can be done by using ‘softer’ governance tools such as narratives, as opposed to the ‘hard’ tools of indicators, target setting, and monitoring of progress. Narratives can be a means of maintaining the plurality of problem framings and exploring different cause-effect relationships.

We argue that the value of the “Sustainability transitions: Policy and practice” report lies in the fact that debates about the implications of uncertainty and complexity are spelt out and that both disruptive and stabilising elements are explicitly discussed, even if policy messages are standardised as “actionable knowledge” (EEA & EPSC, 2019; EEA, 2021a), driven by the intention to influence and speak the same language of the recipients, i.e. policy makers in Brussels. Change cannot be expected of individual reports or innovative ideas (including the idea of sustainability transitions) alone. In the 2019 report, complexity and uncertainty are discussed in ways that are compatible with the idea of guiding policy-making and providing answers to policy problems. At the same time, we can interpret this report as a first step that opens the doors for further debates (such as those developed in the series “Narratives for change”) in which the more radical implications of uncertainty and complexity can be further addressed. Balancing acts might serve as gatekeepers for the goal of promoting, modesty, humility and reflexivity (Jasanoff, 2003; Strand & Canellas-Boltà, 2006). At each iteration, the balancing acts may expand and enrich the dialogue space.

The seeds of institutional change towards governance *in* complexity may flourish if reports generate broader debates and the process is sustained in time. Overall, rethinking institutional structure, functions and/or practice, is likely to challenge institutions’ identity. For this reason, institutional change occurs over long-time scales and proceeds through small steps. The challenge is that while institutional change happens slowly, opportunity windows that create a favourable context for established narratives to be challenged (such as the emerging “beyond growth” debates and rapid institutional responses to major disruptions such as those caused by the COVID-19 pandemic) may close fast.

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