



HAL
open science

Forever stuck in old ways? Pluralising incumbencies in sustainability transitions

Bruno Turnheim, Benjamin Sovacool

► **To cite this version:**

Bruno Turnheim, Benjamin Sovacool. Forever stuck in old ways? Pluralising incumbencies in sustainability transitions. *Environmental Innovation and Societal Transitions*, 2020, 35, pp.180-184. 10.1016/j.eist.2019.10.012 . hal-03162822

HAL Id: hal-03162822

<https://hal.inrae.fr/hal-03162822>

Submitted on 9 Dec 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution| 4.0 International License



Contents lists available at ScienceDirect

Environmental Innovation and Societal Transitions

journal homepage: www.elsevier.com/locate/eist

Viewpoint

Forever stuck in old ways? Pluralising incumbencies in sustainability transitions

Bruno Turnheim^{a,b,c,*}, Benjamin K. Sovacool^{c,d}^a Manchester Institute of Innovation Research (MIOIR), University of Manchester, United Kingdom^b Laboratoire Interdisciplinaire Sciences Innovations Sociétés (LISIS) - CNRS, ESIEE, INRA, UPEM - Université Paris-Est Marne-la-Vallée, F-77454, Marne-la-Vallée, France^c Science Policy Research Unit (SPRU), School of Business, Management, and Economics, University of Sussex, United Kingdom^d Center for Energy Technologies, Department of Business Development and Technology, Aarhus University, Denmark

ARTICLE INFO

Keywords:

Socio-technical transitions
Sustainability transitions
Incumbency
Innovation

ABSTRACT

In this Viewpoint, we argue that transitions research needs to engage more firmly with the role of incumbents and various forms of incumbencies. We identify shortcomings of existing research, notably a tendency to portray incumbents as ‘villains’ wedded to resisting, slowing down or preventing transition efforts. With that in mind, the Viewpoint briefly summarises shortcomings within existing research and proposes four steps for pluralising the discussion. We call attention to more emphasis on 1) a multiplicity of incumbent actor types, 2) a variety of actor strategies within (and across) organisational populations, 3) the transient nature of strategic positioning (over time), and 4) the varied resources that incumbents may deploy to support transformative change.

1. Introduction

Transitions studies seeks to understand the dynamics of change that can lead to entirely new or fundamentally transformed socio-technical configurations (Köhler et al., 2019; Markard et al., 2012). Within this process, socio-technical transitions are envisioned as slow, challenging, multi-dimensional, multi-layered, uncertain, and rare processes. Sustainability transitions present additional difficulties linked to the dual challenge of bringing forward radical innovation, a problem of technology and design, along with radical changes in selection criteria for innovation, a problem of society and user acceptance (Kemp and Van Lente, 2011).

Nonetheless, transitions studies may frequently carry an unintentional bias for novelty, which is manifest in the conceptual frames (e.g. SNM, TIS, MLP) deployed and the empirical work (privileging bottom-up dynamics and niche-level studies) carried out. So, because *and* in spite of a strong tendency for continuity in established socio-technical systems, transitions research has to date primarily adopted an outlook focussed on change driven by alternatives emerging from below and outside existing regimes. Table 1 illustrates how alternative outlooks may be pursued along core tensions (e.g. stability *and* change, new *and* old configurations, external *and* internal forces, bottom-up *and* top-down dynamics), and may allow more firm engagement with a variety of transition contexts (Smith et al., 2005).

In this Viewpoint, we argue that losing sight of alternative outlooks presents a risk of oversimplifying the nature and dynamics of incumbency. With that in mind, the Viewpoint summarises shortcomings within existing research and proposes four steps for introducing greater nuance.

* Corresponding author at: Manchester Institute of Innovation Research (MIOIR), University of Manchester, United Kingdom.
E-mail address: bruno.turnheim@manchester.ac.uk (B. Turnheim).

<https://doi.org/10.1016/j.eist.2019.10.012>

Received 16 September 2019; Received in revised form 10 October 2019; Accepted 18 October 2019
2210-4224/ © 2019 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license
(<http://creativecommons.org/licenses/by/4.0/>).

Table 1
Different outlooks on tensions at play in transition dynamics.

	Prevailing outlook	Possible alternative outlook
Change and stability	Emergent change <i>given</i> inherent stability	Stability and continuity <i>in spite</i> of change efforts
New and old	Novel configurations emerge as alternative to existing configurations	Existing configurations also have potential for renewal
External and internal	Radical change comes from the outside	Radical change may also come from the inside
Bottom-up and top-down	Alternatives emerge from below through gradual dynamics	Strategically guided and directed search paths are also possible

2. Shortcomings of existing research

While “[s]ystem-level change is, by definition, enacted through the coordination and steering of many actors and resources” (Smith et al., 2005), analytical efforts may have in practice become overly focussed on the role of challengers (over that of incumbents). For instance, while the MLP provides significant scope for analysing a wide variety of pathways involving combinations of mechanisms and interactions between different structuration levels (Geels, 2011), it has been argued that empirical studies have overemphasised bottom-up dynamics (Berkhout et al., 2004) by privileging a niche-level focus, reinforcing a misrepresentation according to which change inevitably comes from below. More recently, scholars have suggested that niche-regime interactions suffer from an asymmetrically treatment (Mylan et al., 2019) or that “regimes have been black-boxed, and few studies have explored incumbents’ responses to transition processes” (Steen and Weaver, 2017). Similarly, SNM has largely become fraught with a focus on ground-up dynamics (through e.g. gradually broadening networks, sharpening visions, and knowledge accumulation) (Jenkins and Sovacool, 2019), at the expense of recognising the possibility of more strategically-guided search paths (Turnheim and Geels, 2019). Further, TIS has been criticised for being better suited to studying the emergence of novel configurations than their later (de-)stabilisation (Köhler et al., 2019).

Over the course of past decades, the field may hence have contributed to artificially reducing its analytical scope, and – possibly worse – mis-representing crucial actors and dynamics of change. We can ask, as other have done, whether these shortcomings are linked to inherent conceptual limitations of frameworks or whether these can be repurposed to better represent neglected dynamics (Markard, 2018; Turnheim et al., 2018).

Nonetheless, some voices have started calling for greater attention to stability and continuity (Wells and Nieuwenhuis, 2012) and the role of incumbencies in transitions (Bergek et al., 2013; Berggren et al., 2015; Penna and Geels, 2012; Steen and Weaver, 2017; Stirling, 2019; Turnheim and Geels, 2013). Related research has contributed to revealing how different sources of lock-in (Arthur, 1989; Klitkou et al., 2015; Seto et al., 2016; Unruh, 2000) and active actor resistance (Geels, 2014; Penna and Geels, 2012; Roberts et al., 2018) can prevent change from happening, delay and constrain patterns of change (Turnheim and Geels, 2013), and how superficial or temporary change may conceal the deeper and long-term stability of institutional structures (Johnstone et al., 2017; Streeck and Thelen, 2005) and path-dependencies.

So, while we observe growing interest in the role of incumbencies in transitions research, we also note a dominance of perspectives portraying incumbents as ‘villains’ who irremediably resist, slow down, prevent transition efforts (Byrne and Rich, 1983; Geels, 2014; Penna and Geels, 2015; Sovacool et al., 2017; Stirling, 2014, 2011) due to their shared and deep attachment to ‘dominant regimes’. These perspectives are grounded in empirical observations: incumbents can (and often do) prevent the successful emergence of new business models and institutional structures that would enable the more rapid deployment of alternatives such as renewable sources of electricity, cleaner fuels for mobility or more sustainable agricultural practices (Darnhofer et al., 2019; Geels, 2014; Hess, 2016) through more or less intentional moves. In other cases, however, incumbent actors have been observed to contribute to niche-regime interactions (Berggren et al., 2015) and to contribute to regime fragmentation by pursuing divergent strategies (Steen and Weaver, 2017).

In this context, we ask whether it is time for the field to engage more subtly with claims around the role of incumbents in transitions processes. We are not alone in proposing to cast a new light on forms of incumbency: Berggren et al. (2015) have argued for a more ‘dynamic’ understanding of incumbent actors and their influence over transitions pathways, Steen and Weaver (2017) have suggested a need to disentangle the partial overlap between incumbent actors and regimes, while Stirling (2019) has recently proposed that the depth and intractability of patterns of incumbency calls for a pluralising of perspectives.

3. Four steps for pluralising incumbencies

How then, might we start thinking constructively about pluralising how incumbencies are understood in transitions studies? We call attention here to a richer emphasis on various shades of incumbency including: 1) a multiplicity of incumbent actor types, 2) a variety of actor strategies within (and across) organisational populations, 3) the transient nature of strategic positioning (over time), and 4) the varied resources that incumbents may deploy to support transformative change.

Firstly, when thinking about incumbencies, it is useful to recognise a multiplicity of incumbent actor types, representing the heterogeneous make-up of socio-technical systems. Indeed, inasmuch as socio-technical systems are understood as complex bundles of heterogeneous interacting elements jointly contributing to the provision of societal functions, the make-up of actors developing, operating, maintaining or ‘disbanding’ from such configurations is also heterogeneous.

Accordingly incumbency or incumbent-like attributes are likely to be found in a variety of societal realms (e.g. market, state, civil society, knowledge production), at a variety of levels, and in different degrees. Incumbency is not the exclusive monopoly of certain corporate firms or powerful governmental actors (although these might be the most visible and usual protagonists of power concentration over socio-technical configurations). If incumbency is linked to a default disposition for reinforcing prevailing practices and systems at play in a particular configuration, such attributes are also likely to be observed in (and reproduced through) the practices of certain non-governmental actors, knowledge organisations, trade unions, user groups, and so on – if only in qualitatively different forms - and these warrant dedicated research efforts.

Research on incumbency and its influence over the stability and change of socio-technical configurations should hence reflect a more heterogeneous makeup and seek to uncover nuances of incumbency and its actualisation in the actions, motives and interests of a broader variety of social agents involved and embedded in different systems. It is, for instance, realistic to also observe incumbency at work in the actions of environmental NGOs within the formation, establishment and maturation of environmental regimes (Doyle and Doherty, 2006). This point aligns with wider calls for resisting the temptation of portraying socio-technical regimes as monolithic and inherently coherent entities (Stirling, 2011).

Secondly, it is useful to recognise a multiplicity of actor dispositions and positioning strategies vis-à-vis prevailing orders – including amongst the ranks of incumbent actors. Across and within heterogeneous forms of incumbencies, different styles and sensitivities are likely to underpin a wide range of positioning strategies pursued (intentionally or not) by incumbent actors. With reference to the dual challenge of sustainability transitions (Kemp and Van Lente, 2011), two broad kinds of strategic actions can be distinguished: a) those related to techno-economic dimensions, and b) those related to socio-political and institutional dimensions.

Within the organisational change and strategic management literatures, Ansari and Krop (2012) recognise that incumbent firm response strategies in the face of radical innovation vary significantly within and across organisational fields, namely according to differences in industry settings (e.g. kinds of product, market structure, supply chains, institutional environment), intrinsic actor properties (e.g. capabilities, strategies, boundary management), and kinds of challenges (e.g. innovation type, scope, maturity). Here again, transitions contexts, and their interpretation by actors involved, are crucial. Identifying the varied forms of incumbent responses to various transitions contexts is an interesting direction. Mossel et al. (2018), for instance, have reviewed what various organisational theories have to say concerning the role and behaviour of incumbent firms during transitions. Others are exploring how incumbent industry actor strategies hinge upon the nature and perception of opportunity structures by said actors (Lee and Hess, 2019; Steen and Weaver, 2017).

Research into the dynamics of organisational fields has also moved from a hypothesis of inherent homogeneity and isomorphic forces, to greater recognition of a variety of positions within fields (Wooten and Hoffman, 2016), which can themselves be arenas for contestation, struggles, and deviance amongst its members. This means, for instance, that within the constellation of actors related to a so-called automobility regime, different actors (firms, decision-makers, users) may exhibit different levels and qualities of commitment to the core norms, values, and beliefs that are constitutive of ‘automobility’ at any given time. In agentic terms, i.e. the ability to exert self-determination and pursue autonomous actions in spite of field rules, any ‘automobility regime’ may be the theatre of significantly divergent and changing positioning strategies (Axsen and Sovacool, 2019). Importantly, institutional plurality and changes in institutional environments may mutually reinforce each other (Fuenfschilling and Truffer, 2016) and accelerate ‘regime fragmentation’ (Steen and Weaver, 2017).

Thirdly, it is crucial to recognise the transient nature of incumbent positioning strategies and incumbencies themselves. Indeed, the behaviours and strategies of incumbents are likely to change over time as part of internal dynamics (e.g. organisational learning) as well as significant changes in transitions contexts (e.g. accelerated dynamics or altered opportunity structures).

The sustainability transitions literature has within the past decade become subtler concerning the changing role of incumbents in transitions (Bergek et al., 2013; Berggren et al., 2015; Turnheim and Geels, 2013; Wesseling et al., 2015). This enables a shift away from over-stylised accounts of large established actors (from industry, government, and beyond) as inherently and solely resisting change, and indomitably ‘clinging on’ to established business models, templates and routines (Bergek et al., 2013). It hence becomes possible to explore how specific incumbent actors may change their strategies over time (e.g. from initial resistance and denial, to exploration and re-orientation when economic, environmental or societal pressures become too overwhelming) (Hockerts and Wüstenhagen, 2010; Turnheim and Geels, 2013) and to approach a variety of incumbent strategies related to sustainability innovation with greater nuance (Steen and Weaver, 2017). For instance, progress with low-carbon transitions is making a purely resistive stance increasingly short-term and untenable (Markard, 2018; Roberts et al., 2018), which may explain why we are empirically seeing greater engagement of incumbent actors.

Indeed, incumbent actors may tactically recognise the value of proactively engaging with transitions to exert influence on institutional change (e.g. keeping radical decentralisation visions off the electricity decarbonisation agenda), or to gain a competitive edge over (incumbent or new) rivals. They may seek to leverage their resources (power, finance, skills, influence) to diversify into novel activities or beyond their primary domain of activity (as e.g. ICT industry actors investing in the development of electric cars), or to operate transformative re-creation of their core mission and activities. They may engage in various forms of political advocacy, by shaping visions and expectations, or by pushing for reforms and the adoption of stricter standards, or even by manipulating political campaigns, information and knowledge (Sovacool and Brisbois, 2019). The resulting possible divergence of incumbent actor strategic positioning within regimes is likely an important source of ‘regime fragmentation’ (Steen and Weaver, 2017) that can accelerate destabilisation, decline or transformation (re-orientation or re-creation) pathways (Turnheim and Geels, 2013).

Fourthly, it is imperative to recognise the kinds of resources (material, capabilities, political, ideational) that incumbents might constructively deploy to support transformative change. While resistive incumbents might be considerable obstacles to any kind of transformative change, namely given their mastery of relevant material and institutional resources, their proactive involvement – if

and when it materialises – can conversely significantly accelerate and orient transitions dynamics. So, ‘not all incumbents remain stuck in old technological paradigms’ (Hansen and Coenen, 2017:503).

For example, in the case of market actors, under certain circumstances, incumbent firms may mobilise power and resources to buy-out innovative new entrants, ambidextrously diversify their portfolios (O’Reilly and Tushman, 2013), and exert strong influence over the development of new standards (Markard and Erlinghagen, 2017). Furthermore, the pursuit of radical innovation is not necessarily exclusive to the pursuit of incremental strategies, as suggested by the literature on ambidextrous organisations (O’Reilly and Tushman, 2013), but requires suited mindsets and competences. The considerable resources linked to incumbency can be deployed in various ways, potentially tilting the field on which transition dynamics and struggles play out. An important caveat is that with potential influence over transitions dynamics comes significant power, which cannot be assumed to be deployed for collective goods or according to distributive fairness. This raises questions about whether ‘just transitions’ can involve a strong involvement of incumbents, and if so under which conditions and according to which modalities.

4. Conclusion

What is needed, to better capture heterogeneity, strategic variety, transience and the resourcefulness of incumbencies in thinking about socio-technical and sustainability transitions, are more nuanced and dynamic approaches. Incumbency can be understood in relation to a status and position of power (and by extension mastery of key resources and processes) at a given time, which confers a) privileged agency over the current workings and fate of established systems, and b) exposure to potential overthrow or defeat, but c) may also be leveraged to influence and shape transition efforts.

In our view, this calls for pluralising (perspectives on) incumbencies, and engaging in a serious, open and critical debate on the concept and its practical applications, but also of how such pluralising challenges analytical frameworks and the implicit assumptions that they carry. The role of incumbencies in transitions is a vibrant and promising avenue for research (Berggren et al., 2015; Steen and Weaver, 2017; Stirling, 2019). We have provided arguments as to why more plural understandings of incumbencies are needed.

It is nevertheless important that we start exploring how more pluralised understandings of incumbencies can lead to novel insights on the destabilisation, phase-out and transformation of unsustainable socio-technical systems. In our view, conceptual and analytical elaboration should concentrate on a) identifying varieties of incumbencies at play in socio-technical dynamics, and b) further specifying the conditions under which these may contribute (positively or negatively) to transformative pathways.

Acknowledgements

The authors are appreciative to the Research Councils United Kingdom (RCUK) Energy Program Grant EP/K011790/1 “Centre on Innovation and Energy Demand,” which has supported elements of the work reported here. We also wish to thank the EIST editorial team, an anonymous reviewer, and Jochen Markard for constructive comments on earlier version of this paper. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors.

References

- Ansari, S., Krop, P., 2012. Incumbent performance in the face of a radical innovation: towards a framework for incumbent challenger dynamics. *Res. Policy* 41, 1357–1374. <https://doi.org/10.1016/j.respol.2012.03.024>.
- Arthur, W.B., 1989. Competing technologies, increasing returns, and lock-in by historical events. *Econ. J.* 99, 116–131.
- Axsen, J., Sovacool, B., 2019. The roles of users in electric, shared, and automated mobility transitions. *Transp. Res. D* 1–21.
- Bergek, A., Berggren, C., Magnusson, T., Hobday, M., 2013. Technological discontinuities and the challenge for incumbent firms: destruction, disruption or creative accumulation? *Res. Policy* 42, 1210–1224.
- Berggren, C., Magnusson, T., Sushandoyo, D., 2015. Transition pathways revisited: established firms as multi-level actors in the heavy vehicle industry. *Res. Policy* 44, 1017–1028. <https://doi.org/10.1016/j.respol.2014.11.009>.
- Berkhout, F., Smith, A., Stirling, A., 2004. Socio-technological regimes and transition contexts. In: Elzen, B., Geels, F.W., Green, K. (Eds.), *System Innovation and the Transition to Sustainability: Theory, Evidence and Policy*. Edward Elgar, Cheltenham, pp. 48–75.
- Byrne, J., Rich, D., 1983. Energy markets and energy myths: the political economy of energy transitions. In: Byrne, J., Callahan, M., Rich, D. (Eds.), *Technology and Energy Choice*. University of Delaware, Newark, DE, pp. 124–160.
- Darnhofer, I., D’Amico, S., Fouilleux, E., 2019. A relational perspective on the dynamics of the organic sector in Austria, Italy, and France. *J. Rural Stud.* <https://doi.org/10.1016/j.jrurstud.2018.12.002>.
- Doyle, T., Doherty, B., 2006. Green public spheres and the green governance state: the politics of emancipation and ecological conditionality. *Env. Polit.* 15, 881–892.
- Fuenschilding, L., Truffer, B., 2016. The interplay of institutions, actors and technologies in socio-technical systems - an analysis of transformations in the Australian urban water sector. *Technol. Forecast. Soc. Change* 103, 298–312. <https://doi.org/10.1016/j.techfore.2015.11.023>.
- Geels, F.W., 2014. Regime resistance against low-carbon transitions: introducing politics and power into the multi-level perspective. *Theory Cult. Soc.* 31, 21–40. <https://doi.org/10.1177/0263276414531627>.
- Geels, F.W., 2011. The multi-level perspective on sustainability transitions: responses to seven criticisms. *Environ. Innov. Soc. Transit.* 1, 24–40. <https://doi.org/10.1016/j.eist.2011.02.002>.
- Hansen, T., Coenen, L., 2017. Unpacking resource mobilisation by incumbents for biorefineries: the role of micro-level factors for technological innovation system weaknesses. *Technol. Anal. Strateg. Manag.* 29, 500–513. <https://doi.org/10.1080/09537325.2016.1249838>.
- Hess, D.J., 2016. The politics of niche-regime conflicts: distributed solar energy in the United States. *Environ. Innov. Soc. Transit.* 19, 42–50. <https://doi.org/10.1016/j.eist.2015.09.002>.
- Hockerts, K., Wüstenhagen, R., 2010. Greening Goliaths versus emerging Davids - theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. *J. Bus. Ventur.* 25, 481–492. <https://doi.org/10.1016/j.jbusvent.2009.07.005>.
- Jenkins, K., Sovacool, B., 2019. Managing energy and climate transitions in theory and practice: a critical systematic review of strategic niche management. In: Jenkins, K.E.H., Hopkins, D. (Eds.), *Transitions in Energy Efficiency and Demand: The Emergence, Diffusion and Impact of Low-Carbon Innovation*. Routledge, New York, pp. 235–257.
- Johnstone, P., Stirling, A., Sovacool, B., 2017. Policy mixes for incumbency: exploring the destructive recreation of renewable energy, shale gas ‘fracking,’ and nuclear

- power in the United Kingdom. *Energy Res. Soc. Sci.* 33, 147–162. <https://doi.org/10.1016/j.erss.2017.09.005>.
- Kemp, R., Van Lente, H., 2011. The dual challenge of sustainability transitions. *Environ. Innov. Soc. Transit.* 1, 121–124. <https://doi.org/10.1016/j.eist.2011.04.001>.
- Klitkou, A., Bolwig, S., Hansen, T., Wessberg, N., 2015. The role of lock-in mechanisms in transition processes: the case of energy for road transport. *Environ. Innov. Soc. Transit.* 16, 22–37. <https://doi.org/10.1016/j.eist.2015.07.005>.
- Köhler, J., Geels, F.W., Kern, F., Markard, J., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., et al., 2019. An agenda for sustainability transitions research: state of the art and future directions. *Environ. Innov. Soc. Transit.* 31, 1–32. <https://doi.org/10.1016/j.eist.2019.01.004>.
- Lee, D., Hess, D.J., 2019. Incumbent resistance and the solar transition: changing opportunity structures and framing strategies. *Environ. Innov. Soc. Transit.* 0–1. <https://doi.org/10.1016/j.eist.2019.05.005>.
- Markard, J., 2018. The next phase of the energy transition and its implications for Research and Policy. *Nat. Energy*. <https://doi.org/10.1038/s41560-018-0171-7>.
- Markard, J., Erlinghagen, S., 2017. Technology users and standardization: game changing strategies in the field of smart meter technology. *Technol. Forecast. Soc. Change* 118, 226–235. <https://doi.org/10.1016/j.techfore.2017.02.023>.
- Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: an emerging field of research and its prospects. *Res. Policy* 41, 955–967. <https://doi.org/10.1016/j.respol.2012.02.013>.
- Mylan, J., Morris, C., Beech, E., Geels, F.W., 2019. Rage against the regime: niche-regime interactions in the societal embedding of plant-based milk. *Environ. Innov. Soc. Transit.* 31, 233–247. <https://doi.org/10.1016/j.eist.2018.11.001>.
- O'Reilly, C.A., Tushman, M.L., 2013. Organizational ambidexterity: past, present, and future. *Acad. Manag. Perspect.* 27, 324–338.
- Penna, C.C.R., Geels, F.W., 2015. Climate change and the slow reorientation of the American car industry (1979–2012): an application and extension of the Dialectic Issue LifeCycle (DILC) model. *Res. Policy* 44, 1029–1048. <https://doi.org/10.1016/j.respol.2014.11.010>.
- Penna, C.C.R., Geels, F.W., 2012. Multi-dimensional struggles in the greening of industry: a dialectic issue lifecycle model and case study. *Technol. Forecast. Soc. Change* 79, 999–1020. <https://doi.org/10.1016/j.techfore.2011.09.006>.
- Roberts, C., Geels, F.W., Lockwood, M., Newell, P., Schmitz, H., Turnheim, B., Jordan, A., 2018. The politics of accelerating low-carbon transitions: towards a new research agenda. *Energy Res. Soc. Sci.* 44, 304–311. <https://doi.org/10.1016/j.erss.2018.06.001>.
- Seto, K.C., Davis, S.J., Mitchell, R., Stokes, E.C., Unruh, G., Ürge-Vorsatz, D., 2016. Carbon lock-in: types, causes, and policy implications. *Annu. Rev. Environ. Resour.* <https://doi.org/10.1146/annurev-environ-110615-085934>.
- Smith, A., Stirling, A., Berkhou, F., 2005. The governance of sustainable socio-technical transitions. *Res. Policy* 34, 1491–1510. <https://doi.org/10.1016/j.respol.2005.07.005>.
- Sovacool, B., Brisbois, M., 2019. Elite power in low-carbon transitions: a critical and interdisciplinary review. *Energy Res. Soc. Sci.* 57, 1–10.
- Sovacool, B.K., Noel, L., Orsato, R.J., 2017. Stretching, embeddedness, and scripts in a sociotechnical transition: explaining the failure of electric mobility at Better Place (2007–2013). *Technol. Forecast. Soc. Change* 123, 24–34. <https://doi.org/10.1016/j.techfore.2017.05.037>.
- Steen, M., Weaver, T., 2017. Incumbents' diversification and cross-sectorial energy industry dynamics. *Res. Policy* 46, 1071–1086. <https://doi.org/10.1016/j.respol.2017.04.001>.
- Stirling, A., 2019. Energy Research & Social Science how deep is incumbency? A 'configuring fields' approach to redistributing and reorienting power in socio-material change. *Energy Res. Soc. Sci.* 58, 101239. <https://doi.org/10.1016/j.erss.2019.101239>.
- Stirling, A., 2014. Transforming power: social science and the politics of energy choices. *Energy Res. Soc. Sci.* 1, 83–95. <https://doi.org/10.1016/j.erss.2014.02.001>.
- Stirling, A., 2011. Pluralising progress: from integrative transitions to transformative diversity. *Environ. Innov. Soc. Transit.* 1, 82–88. <https://doi.org/10.1016/j.eist.2011.03.005>.
- Streeck, W., Thelen, K. (Eds.), 2005. *Beyond Continuity: Institutional Change in Advanced Political Economies*. Oxford University Press, Oxford.
- Turnheim, B., Geels, F.W., 2019. Incumbent actors, guided search paths, and landmark projects in infra-system transitions: Re-thinking Strategic Niche Management with a case study of French tramway diffusion (1971–2016). *Res. Policy* 48, 1412–1428. <https://doi.org/10.1016/j.respol.2019.02.002>.
- Turnheim, B., Geels, F.W., 2013. The destabilisation of existing regimes: Confronting a multi-dimensional framework with a case study of the British coal industry (1913–1967). *Res. Policy* 42, 1749–1767. <https://doi.org/10.1016/j.respol.2013.04.009>.
- Turnheim, B., Wesseling, J., Truffer, B., Rohracher, H., Carvalho, L., Binder, C., 2018. Challenges ahead: understanding, assessing, anticipating and governing foreseeable societal tensions to support accelerated low-carbon transitions in Europe. In: Foulds, C., Robinson, R. (Eds.), *Advancing Energy Policy: Lessons on the Integration of Social Sciences and Humanities*. Palgrave Pilot, pp. 145–161. https://doi.org/10.1007/978-3-319-99097-2_10.
- Unruh, G.C., 2000. Understanding carbon lock-in. *Energy Policy* 28, 817–830. [https://doi.org/10.1016/S0301-4215\(01\)00098-2](https://doi.org/10.1016/S0301-4215(01)00098-2).
- van Mossel, A., van Rijnsoever, F.J., Hekkert, M.P., 2018. Navigators through the storm: a review of organization theories and the behavior of incumbent firms during transitions. *Environ. Innov. Soc. Transit.* 26, 44–63. <https://doi.org/10.1016/j.eist.2017.07.001>.
- Wells, P., Nieuwenhuis, P., 2012. Transition failure: understanding continuity in the automotive industry. *Technol. Forecast. Soc. Change* 79, 1681–1692. <https://doi.org/10.1016/j.techfore.2012.06.008>.
- Wesseling, J.H., Niessen, E.M.M.I., Faber, J., Hekkert, M.P., 2015. Business strategies of incumbents in the market for electric vehicles: opportunities and incentives for sustainable innovation. *Bus. Strategy Environ.* 24, 518–531. <https://doi.org/10.1002/bse.1834>.
- Wooten, M., Hoffman, A.J., 2016. *Organizational Fields Past, Present and Future*. The SAGE Handbook of Organizational Institutionalism, pp. 130–148.