Futures 159 (2024) 103325

Contents lists available at ScienceDirect

Futures

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

Transformative or incumbent futures? How the future of mobility is imagined in sustainability transitions research

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ARTICLE INFO

Keywords:
Governance
Futures
Transitions
Mobility
Sustainability
Incumbency

ABSTRACT

How actors relate to the future has long been considered important in research on the governance of transformations towards sustainability. Recent contributions have explored the politics at play in the 'making' of futures and the forming of collective expectations. Building on the concept of socio-material incumbency and integrating academic discussions which appreciate the politics of future-making, we consider the forming of collective expectations as a process through which prevailing socio-material arrangements are challenged and reproduced. We introduce the concept of 'scope incumbency', through which the particular ideas about the future collectively deemed plausible are shaped by prevailing power arrangements. Consequently, we suggest it plays an important and underappreciated role in the reproduction of locked-in systems. We illustrate this perspective by exploring how mobility futures are imagined in sustainability transition research. We investigate academic contributions which explicitly articulate possible, plausible and/or desirable alternative mobility arrangements and consider the extent to which and how contributions challenge and reproduce hegemonic socio-technical orders. We find that a substantial portion of the contributions collectively limits the scope of the plausible around automobile-centric futures in several ways.

1. Introduction

The future, or rather the ways through which actors make sense of the future, has become an important area of research interest (Beckert & Suckert, 2021). Engagement with the future is particularly prominent in sustainability transitions research (STR). Like other research communities interested in understanding the dynamics underpinning transformative change, STR is constantly grappling with questions around probable, plausible, possible and desirable futures. Following Wenzel et al. (2020, p. 1443), future-making is understood here as "the specific ways in which actors produce and enact the future". Different future-making activities produce different futures or conceptualisations of possible future worlds. This perspective recognises that there are "no future facts" and nothing that can be truly known about the future (Brumbaugh, 1966, p. 649). In the face of this inherent uncertainty, actors deploy a range of future-making practices which help fulfil diverse social functions (Aykut et al., 2019) and make collective action possible (Beckert, 2016). Yet there are always questions about for whom and by whom futures are made (Aykut et al., 2019; Stirling, 2011). Thus, a growing research interest in the future has coincided with emerging questions about the politics at play in future-making and

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https://doi.org/10.1016/j.futures.2024.103325
Received 9 March 2023; Received in revised form 1 December 2023; Accepted 15 January 2024
Available online 17 January 2024

the forming of collective ideas about the later-than-now (Altstaedt, 2023; Beckert, 2016; Knappe et al., 2019; Lösch et al., 2019; Oomen et al., 2021).

At the same time, STR explicitly aims to understand the complex and plural forces that shape and reproduce obdurate socio-technical systems and propose interventions to realise fundamentally different futures (Loorbach et al., 2017; Turnheim et al., 2020). Regarding these plural forces, there are dimensions of complexity which remain elusive. Kok et al. (2021, p. 1) articulate this with a call to better understand the mechanisms underpinning "the stability of locked-in constellations, and to conceptualize the power at play in sustaining and changing these".

This research aims to bridge these two discussions: to explore the role of future-making in stabilising and destabilising obdurate socio-technical systems. We are responding to calls to reflect on the extent to which future-making practices are fit for the purposes they are designed to fulfil (Mangnus et al., 2021). This exploration goes beyond investigating the fit between specific micro-level future-making practices and the purposes they aim to fulfil. We rather investigate the fit between types of futures which are imagined collectively within a given community and the goals of that community more broadly.

To explore this perspective, we focus on the case of mobility and examine STR as one forum where mobility futures are *made*. We analysed scholarly articles in STR that articulate an explicit narrative, vision, prediction, etc. about the future of mobility, interpreting these as manifestations of future-making practices and reflecting on the possible implications for the types of mobility futures imagined collectively. Drawing on the concept of a regime of automobility (RoA) (Böhm, 2006), we investigate the extent to which and how automobility futures are challenged and reproduced through future-making practices utilised within the community. We find that a significant portion of the imagined futures would still be characterised as a system dominated by the personal-motorised vehicle (PV) and that deeper characteristics of a RoA, such as the preference for speed, efficiency and privacy, and the cultural meanings associated with the car, are rarely imagined otherwise.

To explain this tendency to (often unintentionally) extend the dominant power arrangements of the present into imagined futures, we draw on the notion of deep incumbency as a "self-reinforcing trajectory in obdurate configurations of actors, practices, interests, infrastructures, institutions and cultures, that dominate in some specific political setting" (Cox & Johnstone, 2016, p. 16). We contend that this self-reinforcing trajectory is also present in the forming of ideas about the future through future-making practices. We thus argue that research needs to take into account the ways through which the future is conceived of as an underappreciated source of socio-technical stability as a starting point for establishing approaches which can counteract these tendencies.

The paper is structured as follows. First, we trace the emergence of STR with a focus on the relationships with the future that have been developed in its different strands of research and integrate ongoing discussions about the politics involved in the making of futures. Second, we draw on the notion of deep incumbency and outline a particular form of incumbency termed here 'scope incumbency' through which the dominant ideas about what is collectively considered possible, plausible and desirable are shaped by power arrangements in the present. Third, considering this view and building on the objectives of the STR research community, we develop four archetypical functions of future-making for transformative change which could help work against scope incumbency. After that, we introduce the case study and methodology to investigate possible mechanisms of scope incumbency through the making of mobility futures in STR. Building on the findings, we outline seven types of future-making elicited from the data corpus and consider them in relation to the functions of future-making for transformative change. We illustrate these types by referring to specific examples from the data corpus and reflect on the extent to which and how the analysed future-making practices challenge and reproduce a RoA. In the final section, we reflect on the findings and discuss the possible implications for future research in STR.

The main contributions of the paper are twofold. Firstly, it serves as an invitation to investigate the underappreciated ways through which incumbency is reproduced through future-making in a range of possible arenas. Secondly, it investigates one such arena as a reflexive practice considering the extent to which the future-making deployed in the research community is aligned with the goals of that community.

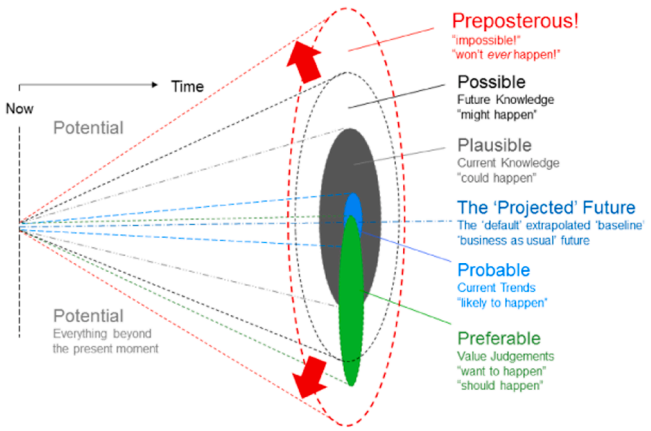

Fig. 1. 'Futures Cone' adapted from Voros (2003, 2017).

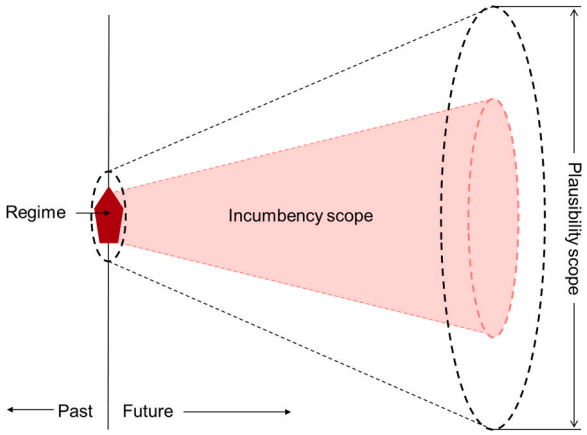

Fig. 2. Conceptualising scope incumbency based on an adapted futures cone (Voros, 2003).

2. Background

2.1. Problematising the future in STR

Two main goals can be understood to guide STR: *understanding transitions* and *supporting transitions*; both with the broader overarching objective to "help move society in the direction of sustainability" (Köhler et al., 2019, p. 2). Transitions research, therefore, tends to be located on a spectrum ranging from underlying *analytical* motivations which aim primarily to understand transitions and underlying *normative* motivations which are more interested in bringing about transformative change. Each approach tends to treat the future in fundamentally different ways.

Research driven by analytical motivations looks to the past or present to better understand how and why transitions (do not) play out. For much of the work, the future does not play an explicit role. For example, retrospective contributions have improved the understanding of the stability of certain regimes in terms of diverse lock-ins and path dependencies (Klitkou et al., 2015; Simoens et al., 2022; van der Vooren et al., 2012). These perspectives focus on decisions made and phenomena emerging from the past, which need to be overcome before realising desirable futures (Grin et al., 2010; Loorbach et al., 2017). Retrospective research focusing on past transitions has also been instrumental in improving our understanding of broader transition dynamics (Martínez Arranz, 2017; Zolfagharian et al., 2019). Theoretical development building on the knowledge accrued about past transitions has allowed the key concepts of the Multi-level Perspective (MLP) (e.g. regime, niche, landscape) (Geels, 2002; Rip & Kemp, 1998; Smith et al., 2010) to be operationalised for analysing unfolding dynamics in the present and potentially hypothesising about future developments. This has led to a significant body of research which aims to better understand 'transitions in the making' (e.g. Farla et al., 2012).

Research in STR has also explicitly recognised and explored the *performativity* of futures: that futures do not only describe or represent something but also have the power to bring about a particular action or change in the world. The significance of future-making in transition processes is widely accepted (Hebinck et al., 2018; Lösch et al., 2019; Späth & Rohracher, 2010). Studies have demonstrated the importance of collective expectations (Geels, 2005; van Lente & Rip, 1998), the emergence of promising technologies (van Lente, 1993), visions (e.g. Smith et al., 2005) and other articulations of desirable futures in attracting the interest of (potential) allies, defining roles, showing direction, advising or establishing mutually-binding obligations (Borup et al., 2006; Hajer & Pelzer, 2018; Lösch et al., 2019; van Lente, 1993).

The understanding of the performativity of future-making led to the emergence of more prescriptive approaches that utilise future-making practices (e.g. through the development of shared visions) to support the governance of transitions. One prominent example of this is Transition Management, where actors are facilitated in the creation of a collective guiding vision of a desirable future as an important step in transition processes (Loorbach, 2010). Various creative approaches to better understand and improve deliberative vision development have become prominent activities in STR (John et al., 2015; Quist et al., 2011; van der Voorn et al., 2017). These approaches are explicitly future-oriented, recognising the performativity of future-making and assuming a relatively open future if actors or stakeholders can be mobilised around such a collective vision.

Despite an understanding of the importance of ideas about the future in transitions research, to date, there has been limited critical reflection on the types of future-making deployed by researchers and the implications for the underlying objectives of the research community. This view has been articulated elsewhere with calls for researchers to consider constructions of the future, such as visions, scenarios, and predictions as "*explanandum* (that what should be explained)" to compensate for a tendency to see constructions of the future as "*explanans* (that what explains)" within STR (Hajer & Pelzer, 2018, p. 223). This limited reflexivity is particularly problematic considering the complex relationship STR has with the future: implicitly or explicitly, the theories and approaches at the core of STR are also involved in negotiations of what is deemed collectively possible, plausible and desirable. Considering the ambition of both understanding and supporting sustainability transitions, future-making in STR should question "taken-for-granted assumptions that often shut down potentially promising imaginations" (Beck et al., 2021, p. 143) while making visible "the ways in which imaginaries

reconstitute underlying constitutional relationships in the triad of state–society–environment" (Beck et al., 2021, p. 147).

To help bring a more reflexive and critical view on future-making in STR, we build on the emerging body of work which interrogates the ways through which ideas about the future are brought to influence action in the present. These contributions come from a range of disciplines including (but not limited to) science and technology studies (STS), technology assessment, environmental governance, economic sociology and human geography. Scholars differ slightly in emphasis when developing different perspectives on future-making. Examples include 'approaches to anticipation' (Muiderman, Gupta, et al., 2020; Muiderman, Zurek, et al. 2022), 'anticipatory practices' (Anderson, 2010), 'future-making practices' (Reckwitz, 2016; Wenzel et al., 2020), 'instruments of imagination' (Beckert, 2021), or 'techniques of futuring' (Hajer & Pelzer, 2018; Oomen et al., 2021).

What these perspectives have in common is an emphasis on the ways through which futures are performed, practised and enacted. Therefore, there is an appreciation that future-making—like other forms of knowledge production—is political (Knappe et al., 2019). The domination of particular forms of future-making can close-down the "horizon of the possible for social and political creation" (Schulz, 2015, p. 132), obscuring particular views of the future whilst bringing others to the fore (Aykut et al., 2019). Beckert (2021), for example, argued that firms utilise 'instruments of imagination' not only to guide activities within the organisation but also to convince other actors of the legitimacy of their imaginaries. Through this legitimation, imaginaries can become collective expectations thus supporting the firm in achieving its objectives. Less overt examples of power being exercised through future-making can be seen in the crowding-out of perspectives as a product of mismatches between the future-making tools and methodologies applied on the ground and the nature of the problems being addressed through those tools and methodologies (Muiderman et al. 2022). These examples demonstrate that the sites where collective expectations, ideas and visions of the future are formed should be understood as sites of contestation where intentionally or unintentionally particular ideas about the future become dominant whilst others remain at the periphery. In the following section, we link this argument to another central focus of transitions research: the search for under-appreciated sources of system lock-in and obduracy inhibiting transformative change.

2.2. The forming of collective expectations in challenging and reproducing governance arrangements and the notion of scope incumbency

Whether considering transitions in the past, present or future, at the heart of transitions research are questions of (in)stability and change (Geels & Kemp, 2007; Rip & Kemp, 1998). The dynamics underpinning the stability of regimes are highly complex and interdependent and can be conceptualised from diverse epistemological and ontological perspectives (Stirling, 2019). Stirling (2019) proposes a relational and emergent understanding of the power underpinning regimes which is referred to as 'socio-material incumbency'. Early work associated with incumbency would focus on incumbent actors: actors who are deeply entrenched in positions of power in a given regime. Work has been done in recent years to 'pluralise' incumbency, to help move away from notions of good vs bad actors in transitions, and to acknowledge the systemic nature of power relations and agency in transitions processes (Späth et al., 2016; Turnheim & Sovacool, 2020). Beyond primarily focusing on *incumbents* as actors, *incumbency* considers the diverse overlapping socio-material relations that reproduce the prevailing arrangements (Stirling, 2019). An incumbency perspective highlights the *dynamic* nature of a dynamically stable regime (Grin et al., 2011), recognising the permanent reproduction of arrangements that constitute system stability. This perspective, in turn, shifts focus towards the various fields in which this occurs. These fields can be elusive as they often constitute activities which are taken for granted due to their embeddedness in everyday life. Considering inertia through a lens of incumbency can help shed light on the taken-for-granted and often unconsciously reproduced sources of stability, such as the relationships formed with the future.

To contribute to accounting for the politics of future-making in transitions research and consider its role in challenging and reproducing incumbency, we propose a heuristic (stylised in Fig. 2) building on the 'futures cone' (Fig. 1), which was developed initially by Hancock and Bezold (1994) building on a taxonomy of futures by Henchey (1978) and further developed by Voros (2003, 2017). Amara's (1981) classic distinction of possible (what could happen?), probable (what will likely happen?) and preferable (what should happen?) futures can be stylised in a futures cone as a heuristic device to interact with futures as an object of enquiry (Voros, 2017). Other taxonomies can and have been deployed in the same way (see e.g. Voros, 2017).

At the centre of the futures cone is typically some form of extrapolation of the present arrangements, business-as-usual, and/or projected future. Taking power in future-making seriously, we propose an alternative view through the notion of scope incumbency. Scope incumbency recognises the ideological contestation that occurs when defining what is collectively considered possible, probable and preferable. Here, we refer to the Gramscian notion of 'hegemony' and hegemonic futures – seeing dominance exercised through the use of ideological, cultural, and intellectual means – in our case through the forming of ideas about the future (also see Haas, 2020). It also recognises the existence of counter-hegemonic futures pushed by subordinate or oppositional groups to challenge and contest the dominant hegemonic order. This view takes into account that particular expectations and ideas about the future become hegemonic whilst others remain beyond the scope of the collectively plausible. It further recognises how this distinction is constantly under contestation with future-making playing an important role in this regard.

This view also considers asymmetries amongst different societal actors regarding access to the 'instruments of imagination' (Beckert, 2021) to shape collective expectations. Powerful actors are likely to enjoy privileged access to such instruments, or their perspectives are more likely to be integrated by other actors utilising such instruments. Incumbents 'tend to be powerful, materially resourceful, politically influential, societally authoritative, strategically conservative and risk-averse' (Sovacool et al., 2020, p. 3). As another tool at their disposal, future-making can be consciously and strategically performed "by those representing specific positions on social issues, substantial values, and particular interests in order to produce future visions corresponding to their interests and to employ these to assert their particular positions in debates" (Grunwald, 2019, p. 26).

Beyond merely maintaining the status quo, actors can also utilise future-making to imagine and realise radically different futures

from the current arrangements. In the case of the making of mobility futures, Hajer and Versteeg (2019) outline the example of 'Futurama', an exhibition sponsored by General Motors (GM) at the New York World's Fair of 1939 as setting the stage for the transition to the car-centric city that would follow in the decades after. This suggests the perspective highlighted by considering scope incumbency can serve as an indication of what a business-as-usual scenario might look like, even when it does not reflect extrapolated present arrangements.

The shaping of scope incumbency does not necessarily have to be as overt and strategic as the GM example. Instead, future-making can also be deployed for diverse ad hoc planning purposes (Muiderman et al., 2020), such as a municipal department figuring out how many lanes a street to be completed years after should have. There are cognitive limits amongst the actors performing such tasks. Collective definitions of plausible and possible tend to mirror the prevailing conceptions of technological utility (Borup et al., 2006). In this regard, much of the reproduction of scope incumbency is not necessarily merely driven by actors on behalf of explicit vested interests. It is rather likely to occur through banal planning processes conducted by actors whose ideas about the future are influenced by prevailing norms, values and practices (Jasanoff & Kim, 2009). Thus, it is the *scope*, or rather the process of *scoping,* that constitutes the incumbency, instead of it being merely an extension of the goals, preferences, aspirations and expectations of incumbent actors.

3. Conceptualising functions of future-making for transformative change in STR

The tendencies described above present a compelling argument for the importance of a thorough examination of the origins and processes through which notions of the future are formed. This is particularly the case for actors interested in transformative change. Although STR is not the only important arena where different ideas about the future are contested, discussed and legitimated, we contend that STR researchers fulfil a politically relevant role in producing and/or selecting and articulating a set of futures that are deemed relevant. We suggest, therefore, that STR plays an important role in the challenging and reproducing of scope incumbency in the forming of ideas about the future. In light of this, it is suggested that being collectively aware of these dynamics and establishing measures to counteract them should be an important project in research that aims to understand and bring about transformative change.

Therefore, we propose a typology of functions of future-making for transformative change to reflect on the extent to which and how hegemonic ideas about the future might be challenged. We draw inspiration from existing typologies which are designed to investigate approaches to future-making and encourage the consideration of the diversity of reasons for their application, as well as their differences as regards underpinning conceptualisations of the future (Mangnus et al., 2021; Muiderman et al., 2020). These distinctions offer a helpful means of inquiry into future-making practices. Yet these defined approaches to anticipation can be utilised by a multitude of actors for a multitude of reasons to reach a multitude of ends. They can be utilised to both challenge incumbent arrangements and reproduce them. We propose an additional layer to this perspective which acknowledges scope incumbency and enables those making futures to reflect on the extent to which and how hegemonic ideas about the future are being challenged and reproduced.

According to this view, approaches to future-making can be differentiated according to two main variables. The first point of differentiation relates to their broader underlying aims as regards challenging scope incumbency. In other words, in what way is it supposed to be performative in the present in terms of challenging hegemonic orders? We thus differentiate between future-making that challenges the incumbent arrangements through destabilising hegemonic futures and future-making that imagines alternatives to the incumbent arrangements through articulating and stabilising counter-hegemonic alternatives. A second point of differentiation can be made based on the different underlying motivations that drive transformation-oriented research. Mangnus et al. (2021) observe that one can differentiate between approaches to future-making which, on one hand, focus on the enquiry into *what the future may hold* (e.g. predicting, defining probabilities, determining plausible scenarios, etc.). On the other hand, others take the *performativity of futures* in terms of influencing action in the present as a starting point to either cocreate and experiment with futures (e.g. to mobilise actors around a common vision) or through the reflexive deconstruction of visions and imaginaries of the future, aiming to "demystify, denaturalize, and historicize imagined futures, showing how ideas about plausibility, desirability, and probability are not self-evident or natural" (Mangnus et al., 2021, p. 5). A similar distinction, useful for considering the transformative or reproductive potential of future-making, can be made in that the former two tend to bring *probability*—the likelihood of something occurring—to the fore, whilst the latter tends to bring *normativity*—the desirability of particular futures coming to be—to the fore. Normativity can relate both to utopian ideas to strive towards and dystopian ideas which should be avoided. This distinction reflects the underlying *analytical* and *normative* motivations of the research community as articulated earlier. It acknowledges that there is research more interested in what *can* happen and research that is more interested in what *should* happen and that for understanding and supporting transformative change, both are necessary.

Type 1 approaches will aim to demonstrate risks and potential problems associated with hegemonic futures should they manifest. A typical example is the extrapolation of the problems associated with the prevailing arrangements or making transparent the implications of hypothetical extrapolations of lofty promises around panacea solutions proposed to extend hegemonic arrangements into the future. This might include warning against overly optimistic expectations and potential negative repercussions of particular technologies and collecting strong and different forms of evidence to demonstrate this. *Type 2* approaches will interrogate and expose hegemonic futures by using future-making to critically engage with hegemonic futures (visions, scenarios, predictions, etc.) to expose assumptions embedded in ideas about the future and reveal hidden power arrangements that underpin them. These approaches bring normativity to the fore in the sense that there is an assumed *un*desirability or problematic dimension to the prevailing arrangements and hegemonic ideas about the future, thus warranting their interrogation. *Type 3* approaches will seek to stabilise alternatives by demonstrating the plausibility of counter-hegemonic futures these might include demonstrating or investigating, often through

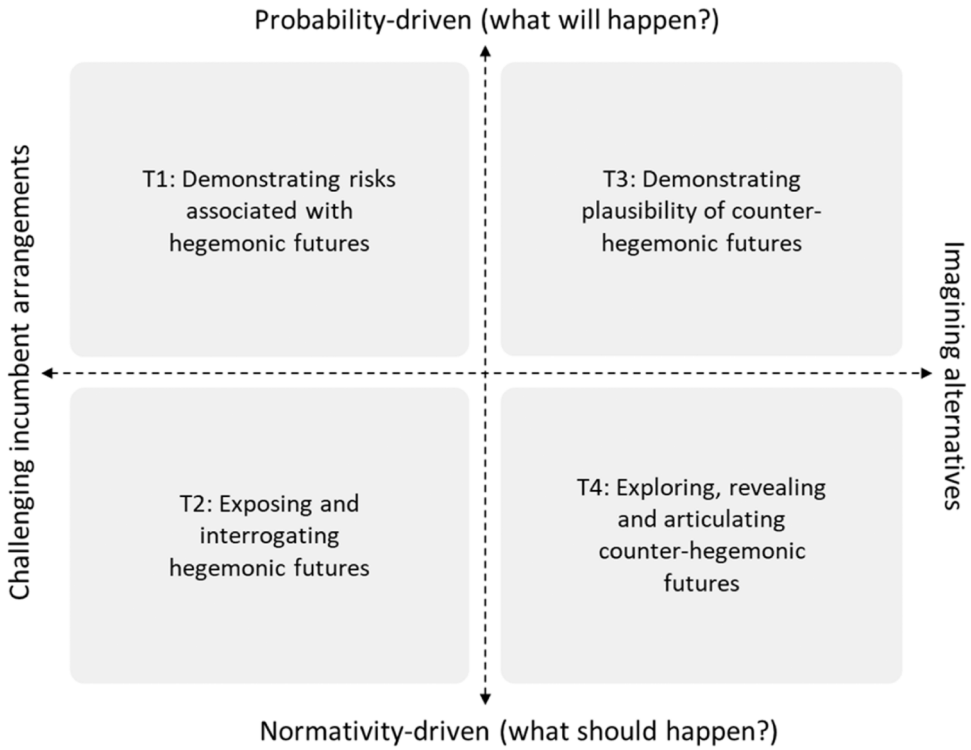

Fig. 3. Four functions of future-making for transformative change.

quantitative methods, the plausibility or desirability of emerging alternatives which are deemed a true break from the incumbent arrangements. *Type 4* approaches will seek to open-up the scope of plausibility by exploring, revealing and articulating counter-hegemonic futures. This could range from the elicitation and articulation of niche imaginaries amongst marginal actors to the (co-) creation of policy mixes to leverage desirable change, and beyond. The four functions are stylised in Fig. 3.

These functions are archetypical and it can be expected that different approaches can serve multiple functions at the same time and with varying degrees of effectiveness. We also recognise the relationality between hegemonic and counter-hegemonic views in particular contexts: the destabilisation of hegemonic futures and future-making can be supported by exposing counter-hegemonic futures and future-making and vice versa. Furthermore, there is no claim here that a purely plausibility-driven future-making practice is possible: normativity is woven into any future-making practice. At the same time, there is no strictly normative future-making practice: those tasked with imagining differently are always bounded by plausibility scopes imposed by prevailing arrangements. Nor can there be an objective understanding of what is considered plausible and desirable. Rather this view of future-making aims to better appreciate the ongoing contestation around these types of issues. We further do not contend that in all cases the dominant ideas about the future should be deemed undesirable and thus challenged. However, taking scope incumbency seriously means that often the dominant ideas about the future might not necessarily be in the best interest of broader publics and future generations. It is thus likely that in many contexts, transformative change will require practices through which these functions are performed. In the following section, we introduce the research design and a case study where we explore the extent to which and how future-making in STR performs these functions when imagining futures focusing on the case of mobility.

4. Case study: exploring the making of mobility futures in STR

To explore the contributions of STR to future-making and reflect on some of the issues discussed above, we focus on the empirical field of mobility. We chose explicitly to focus on future-making through research rather than in forums where future-making brings about more direct instrumental repercussions and is thus subject to more obvious examples of political influence (e.g. through investigating national foresight activities or formal policy-making). Through focusing on academic future-making—as a space supposedly freer of direct political influence—we hope to expose some of the less obvious underlying political dynamics that underpin future-making. Finally, we also do not claim that there is consensus in the transitions community about the directionality, speed and means of transformative change. It is rather to investigate the extent to which a transformation-oriented research community is collectively able to expand the scope of plausibility and question the prevailing power arrangements embedded in hegemonic ideas about the future.

To get a grasp on incumbency in our case and consider which mobility futures can be deemed hegemonic, we can look to the significant work done in conceptualising a regime of automobility (RoA). Böhm (2006, p. 3) defines a RoA as "a set of political

institutions and practices that seek to organize, accelerate and shape the spatial movements and impacts of automobiles, whilst simultaneously regulating their many consequences." Socio-technical regimes comprise complex assemblages which can be considered according to a range of dimensions (e.g. industry, markets and user preferences, culture, technology and policy) (Geels, 2012). Exploring a RoA requires going beyond the tangible and measurable system elements to investigate the "deep structure" behind such elements (Geels, 2012, p. 473). At the heart of the RoA is the artefact of the 'car' or personal motorised vehicle (PV), but the regime extends deeply into diverse areas of human and non-human life:

"It is also a (…) discursive formation, embodying ideals of freedom, privacy, movement, progress and autonomy, motifs through which automobility is represented in (…) discourses (…), and through which its principal technical artefacts – roads, cars etc. - are legitimized. Finally, it entails a phenomenology, a set of ways of experiencing the world (…)" (Manderscheid, 2014, p. 5 citing Böhm, 2006).

This view of the mobility system allows for the consideration of the significant work conducted to understand the multitude of ways through which this RoA is constantly being reproduced (e.g. Manderscheid & Cass, 2022). This breadth of knowledge helps identify the embedded assumptions that are often taken for granted when thinking about mobility futures. Previous work has also demonstrated the unsustainability and persistence of this regime in the face of massive social, environmental and economic consequences (Böhm, 2006; Paterson, 2007). The obduracy of a RoA in the face of these consequences suggests it to be an example of a case to study incumbency par excellence.

Mobilities studies can also function as a comprehensive frame of reference, aiding in reflection on the various mobility futures broadly deemed possible amongst wider publics. Manderscheid (2020) differentiates between 1) a *drive-train transition*, focusing on the decarbonisation of the mobility system through the substitution of propulsion technologies; 2) a *modal transition*, focusing on shifts between different modes of transportation; and 3) a *mobility transition* avoiding trips altogether and integrating arguments of sufficiency. Similar differentiations have been made elsewhere (Kivimaa & Virkamäki, 2014; Nykvist & Whitmarsh, 2008; Ruhrort, 2022). Despite some 'cracks' in the regime of automobility (Geels, 2012), it can thus be hypothesised that hegemonic mobility futures and future-making will be those that perpetuate this regime. The logical extrapolation of this could be business-as-usual (BAU): an ongoing internal combustion engine car-dominated system. However, as a transformation-oriented research community, BAU scenarios will likely at most be used as a counter-point to exemplify normative alternatives. Therefore, in light of this prevailing change-imperative, a logical extension of a RoA would be system optimisation and a drive-train transition (Geels, 2012). Such a transition would undoubtedly bring about significant socio-technical change on the production side, but the changes regarding behaviour, values and perceptions on the user side would remain relatively limited (Kemp & van Lente, 2011). However, we take the question of what futures should be deemed hegemonic as an empirical one, allowing for consideration of non-material dimensions of a RoA (such as the "ideals of freedom, privacy, movement, progress and autonomy" as articulated above) to emerge in other sociotechnical arrangements.

5. Methods

We seek to investigate the questions of the extent to which and how a regime of automobility is challenged and reproduced through future-making in STR. Our approach is not a literature review per se in that it does not synthesise evidence or summarise an empirical field. Rather it treats peer-reviewed articles as manifestations of future-making. We designed a search strategy to develop a data corpus that offers a broad overview of the explicit attempts at making futures in STR. To target papers within the STR community, we built on the search string developed by Markard et al. (2012) and updated by Ertelt et al. (2023). To integrate the future-making perspective, we added as search terms the names of diverse foresight tools and methods referred to in a range of articles exploring future-making activities (Dolez et al., 2019; Muiderman et al., 2020; Oomen et al., 2021). We also added keywords to reflect the focus on mobility. The search was run through SCOPUS—a database which captures the key STR journals (Zolfagharian et al., 2019)—and results were limited to peer-reviewed articles (N = 337). We applied a qualitative review approach to included articles (N = 94) following Saldaña (2016) and Zolfagharian et al. (2019). In the first step, we scanned the abstracts in the data corpus applying inclusion/exclusion criteria. In the second step, we developed categories inductively responding to the research question and retuning to the data set in iterations. Details of the search strategy and corpus development can be found in the annexe. The approach integrated mechanisms which help address single-coder bias by establishing moments of integration and reflection amongst coders before returning to previously coded contributions. We do not claim to have captured all examples of making mobility futures in STR. Nor do we claim that the contributions to mobility future-making in STR are particularly representative of mobility future-making in transformative research globally. There are clear limitations regarding the focus purely on (English-language) journal articles. However, any biases that can be seen in our approach are a reflection of those prevalent in the research community more broadly. We have nevertheless developed a data corpus which captures a somewhat representative sample of the broad range of approaches to future-making utilised in this particular research community.

6. Findings

6.1. Seven types of future-making for transformative change

To account for the plurality of the approaches to future-making observed in the data corpus, contributions were clustered based on similarities according to their apparent role in light of the functions of future-making for transformative change articulated in Section 3. In the first part of the following section, we introduce the types elicited from the data set one by one, illustrating where suitable with some examples from the data corpus. We chose to explicitly mention contributions through which automobility futures are questioned

and delegitimated and mobility futures beyond a RoA are articulated and legitimated. The second part synthesises the observed ways through which future-making led to the projection of a RoA as the only plausible mobility future, responding to the question of how a RoA is reproduced in the observed contributions. The seven types are stylised in relation to the four functions of future making for transformative change in Fig. 4.

6.1.1. *T1 investigating and supporting the emergence of a niche innovation*

This approach takes a particular emerging social or technical innovation at its centre and will inquire into possible trajectories through a range of both qualitative and quantitative methods. This might be through the exploration of possible or likely emergence trajectories, evaluation and alignment of actor expectations, the development of policy mixes, etc. Although at times these contributions recognise multiple future socio-technical arrangements, imagined futures are limited to those centred on the focal innovation. Typically, there is an implicit or explicit assumption that supporting this particular niche would be a positive intervention which often is used to justify the research.

6.1.2. *T2 sketching a scope of plausibility*

T2 recognises the plurality of possible futures and sketches a range of futures, which can be deemed plausible. Many will sketch scopes of plausibility for future socio-technical arrangements around a particular technology. There are thus often overlaps with T1. These approaches can call into question the sustainability of future trajectories if they move beyond assuming potential opportunities to also consider possible threats and explore the plausible developments on both sides, such as those related to autonomous vehicles (AV) (González-González et al., 2020; Marletto, 2019). Others will aim to sketch scopes of plausibility of the future mobility system more generally. A limited number of examples demonstrated the ability to envision change and acknowledge the existence of multiple perspectives according to deeper regime dimensions, including institutional and cultural aspects. These examples specifically highlight certain dimensions of the prevailing system, extending beyond the technological to examine their interplay with other dimensions of the system. Truffer et al. (2017), as an example, investigate the potential future dynamics of institutional dimensions by contrasting multiple scenarios: one where the existing institutional dimensions persist and another where these underlying institutional aspects have shifted away from a RoA (also see Schippl et al., 2022).

6.1.3. *T3 co-creating a different future*

This approach typically brings various actors together to facilitate the collective envisioning of a desirable alternative future. These endeavours commonly employ qualitative approaches such as the backcasting methodology, which involves working backwards from the envisioned future to the present. By adopting this approach, a transformative future is imagined which should fundamentally depart from current arrangements. Auvinen and Tuominen (2014) as one example, report on a process whereby a different socio-technical arrangement is articulated. Through integrating a long-term scope and ensuring broad stakeholder engagement a mobility system with different norms placed at its centre (human safety and wellbeing) can be imagined. Another example is Müller and Reutter

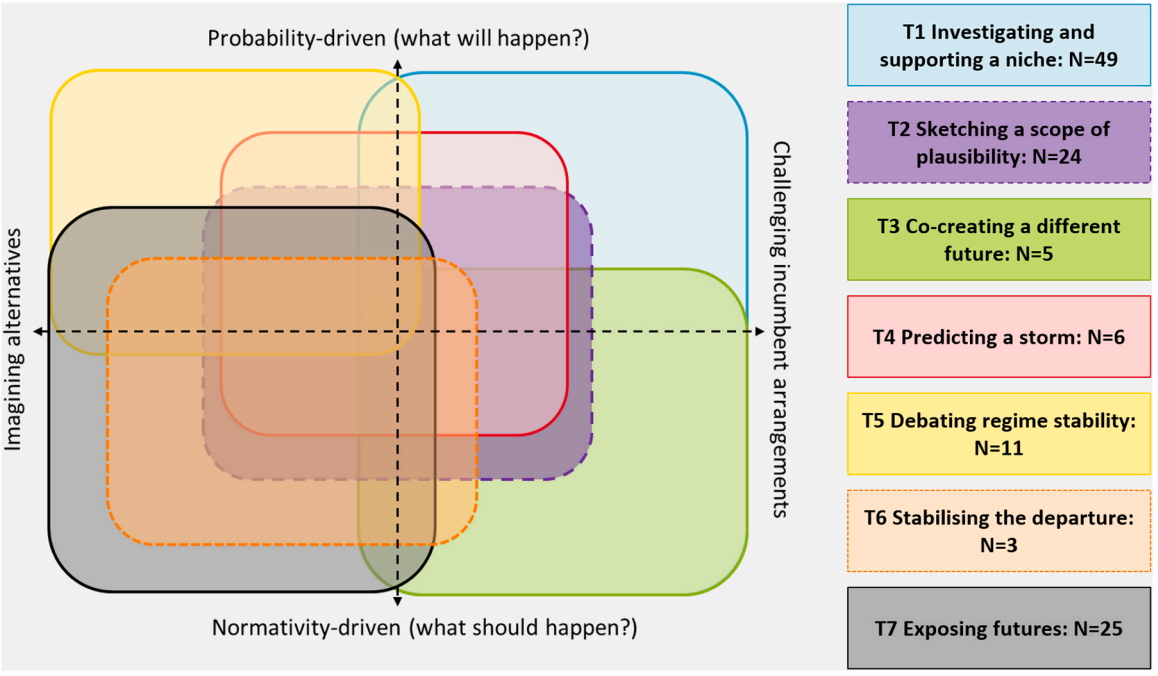

Fig. 4. Mapping types according to functions of future-making for transformative change.

(2017) who report on a regional vision development process in Germany. This approach is tied to shorter-term strategic planning in the region and is accompanied by the development of a sustainability strategy for that region. Through establishing a consensus on the need for transformation amongst key stakeholders, they can establish a concrete, agreed-upon goal which would mean the PV would play a minor role (at least in terms of modal split) in the mobility system in the relatively near future (2030).

6.1.4. T4 predicting a storm

T4 investigates emerging trends to warn of potentially emerging undesirable futures. These approaches take the niche as is done in T1 and extrapolate possible futures but from a more critical stance. For example, Augenstein (2015) highlights the potential problems regarding the sustainability of the drivetrain transition quelling hopes of techno-fixes. Other contributions identify possible under-appreciated consequences or risks associated with future rollouts of drivetrain technologies (e.g. van Wee et al., 2012). Contributions can also interrogate new emerging innovations which are supposed to present an alternative to the car-dominated transportation system. Pangbourne et al. (2020), for example, provide a critical exploration of Mobility as a Service (MaaS) presenting an analysis of the rhetoric surrounding the concept.

6.1.5. T5 debating regime stability

T5 investigates the degree of stability, the sources of stability and signs of cracks in the incumbent arrangements. Approaches are often used to articulate the likelihood of ongoing path dependency in response to optimistic claims that change is just beyond the horizon, such as through warning against techno-optimism (Cohen, 2012), or demonstrating that external system shocks are not automatically going to destabilise a RoA as some have hoped (Wang & Wells, 2020). They can also demonstrate the obduracy of a RoA and warn against emerging hopes of a natural departure from a RoA (Marletto, 2010). Such approaches will often draw on systemic factors reproducing the regime through a range of approaches (Moradi & Vagnoni, 2018; Morton et al., 2017; Rees et al., 2017). These contributions will typically highlight that interventions need to be made to destabilise the regime beyond merely supporting alternatives.

6.1.6. T6 stabilising the departure

T6 explores and stabilises potential pathways of departure away from prevailing arrangements. Their main point of differentiation from others is that they seem to take the desired discontinuation of particularly sociotechnical arrangement at the centre of the approach and aim to stabilise pathways around this. Examples include, Kivimaa and Virkamäki (2014) use the concepts of the walking city, cycling city and auto city, proposing a policy mix to facilitate a modal shift away from the auto towards the walking or cycling cities: considering the push and pull factors from the relative perspectives and assessing and reconfiguring the prevailing policy mix. Some will utilise existing typologies which cover a broad scope of possible interventions to justify considering futures beyond RoA. Examples include push/pull, carrot/stick dichotomies, or more frequently, the ASI (avoid, shift, improve) framework is applied. Müller and Reutter (2021) go one step further with the ASI and focus explicitly on ‘avoid’ and ‘shift’ to compensate for the bias of research focusing on ‘improve’.

6.1.7. T7 exposing futures

T7 interrogates futures to expose underlying assumptions and political implications. These contributions serve an important function in questioning and delegitimising a RoA through deconstructing the assumptions often bound up in a RoA and reproduced through future imaginaries. This can be through critical analysis of futures made such as the example from Bergman et al. (2017) which investigates how people, behaviour and mobility are imagined in a range of visioning documents about the future around car-clubs and electric mobility. They demonstrate the perpetuation of a RoA in the envisioning of allegedly transformative innovations. These contributions can also interrogate future-making practices themselves. Richter & Haas (2020) examine the political dynamics of defining the future of German transport, focusing on the National Platform for Electric Mobility (NPE), a high-level political forum that aimed to accelerate the run-up of the electric mobility market in Germany. They demonstrate how the activity is captured by incumbent interests limiting the scope of plausibility to the interests of private firms.

6.2. How is a RoA reproduced through future-making in STR?

Transitions researchers utilise a multitude of approaches to make mobility futures. Whether an approach will challenge or reproduce a RoA appears to be less dependant on which method is chosen than it is on the broader framing of the project and the intentions behind it. Through the analysis, three general pitfalls could be identified: 1) Incumbency-friendly methodological design principles; 2) Narrow problem definitions; and 3) Dominance of automobility-compatible technology-oriented approaches.

6.2.1. Incumbency-friendly methodological design principles

Which actor perspectives are integrated into the approach is particularly relevant in determining the extent to which transformative futures can be elicited. Firstly, by solely incorporating the viewpoints of incumbent actors—particularly those who have a strong vested interest in maintaining their position in a future sociotechnical arrangement—the likelihood of imagining futures beyond a RoA is minimal. This is not to say that incumbent actors are unable to imagine radically different futures. Even if a fundamentally different socio-technical arrangement is articulated, the criteria used to form or judge the plausibility or desirability of future scenarios are often bound up in those which underpin a RoA (such as speed, privacy, automation, cocooning, seamlessness etc.). Those designing approaches should also be wary of tokenism. Apparently aware of the need to integrate a breadth of perspectives into the methodology,

approaches will typically integrate a small number of NGOs or similar critical voices for 'balance' against the powerful regime actors. These voices are likely to remain in the periphery if methodological considerations are not made. In the same sense, relying solely on the expectations of lay people, such as citizens, is unlikely to yield radically different futures unless integrated into a comprehensive methodology that aims to expand the realm of plausibility and challenge prevailing arrangements.

6.2.2. Narrow problem definitions

Another important factor is the formulation of problem definitions. The scope of the problem being addressed directly influences the breadth of possible futures. Despite a good understanding of the diversity of social and environmental problems associated with the transportation system, problems still tend to be narrowly defined around tailpipe emissions. The resulting future will thus likely have a bias towards drive-train technologies. Similarly, if the problem is framed around something so overtly incumbent-friendly such as the uncertainty surrounding the future market for firm products, the envisioned futures will unsurprisingly align with the continued dominance of that firm. However, a different outcome can be achieved by those who frame the problems they address in a manner that encompasses the broad spectrum of social and environmental issues associated with the current car-dominated transportation system. By adopting such an approach, they are more likely to arrive at futures that transcend automobility and offer transformative alternatives.

6.2.3. Dominance of automobility-compatible technology-oriented approaches

An important distinction can be made between approaches which explore mobility futures more broadly and those where futures are built around specific technologies. Around two-thirds of the contributions place a particular technology at the centre of their explored futures. Technology-oriented approaches might range from those which aim to explore plausible socio-technical relationships with a particular technology, to identifying barriers or highlighting potential problems and risks associated with its emergence. Technological-oriented approaches thus cover the full spectrum of types of future-making for transformative change. The technologies differ in terms of their compatibility with a RoA: some would be more easily integrated than others. At the same time, the stance of the contributions as regards the assumed desirability of the emergence of the technology also differs greatly. Some assume its emergence would be an unquestioned positive development whilst others see its emergence as a potential threat. Others take a more impartial stance, assuming the possibility of both utopian and dystopian future relationships with the technology. For investigations into technologies which are considered potentially more 'disruptive' (such as AVs and MaaS), it is often deemed necessary to take an impartial stance and also consider possible negative outcomes. For investigations into drivetrain technologies (which are by far the most common technological-oriented contribution in the data corpus), consideration of possible negative future socio-technical arrangements appears to be frequently deemed unnecessary (see annexe).

7. Discussion and conclusions

Whilst the future might be inherently nebulous, the way we engage with it matters: Researchers engaged with future-making can consciously or unconsciously challenge and/or reproduce prevailing regimes. We have reflected on how different approaches found in STR engage with mobility futures and how they challenge and reproduce scope incumbency with significant implications for automobility in the present and the future. Scope incumbency as a notion can, on one hand, be utilised for critical inquiry into future-making as researchers can orientate scenarios, pathways, and visions according to their relation to the hegemonic ideas about the future. On the other hand, we assume it can help provide insights into *likely* futures by embedding an appreciation of the influence that powerful regime actors have over defining what is collectively considered desirable and plausible. It thus recognises a tendency to bend what is collectively considered 'probable' into the direction of 'favourable for incumbents', without this implying a cognitive process or necessarily intentionality. We thus see the forming of collective expectations as another mechanism through which incumbent arrangements can be reproduced (and therefore also challenged). However, considering scope incumbency should contribute to projects which aim to 'pluralise incumbencies' (Turnheim & Sovacool, 2020). While incumbents can come and go, underlying systems of power are far more obdurate: the maintenance of a RoA extends far beyond the incumbent actors who have a vested interest in its reproduction into the future.

Although we observed examples where transitions researchers challenge a RoA and articulate alternatives, there is a strong tendency towards techno-optimism and a lack of critical reflection of the potential implications of technologically-driven transitions. Looking at the types of mobility futures articulated in STR demonstrates a dominance of imaginations around substitution pathways, or drive-train transitions, whose sustainability credentials are highly questionable (Brömmelstroet et al., 2022; Huber & Schwedes, 2021; Manderscheid, 2020). This confirms similar findings articulated elsewhere (Wells & Nieuwenhuis, 2012). Such a bias is not likely the result of a collective conscious decision to choose this pathway as the most plausible. Rather, it is likely the product of diverse decentralised future-making activities deployed for various purposes, with a baseline assumption that the future mobility system will be built around some form of the personal motorised vehicle. The 'creeping normality' (Diamond, 2011) of the car in everyday life during the 20th century despite its immense negative social and environmental implications thus seems to extend into the practices through which the future of mobility is imagined. Figuring out which drivetrain technologies will drive the vehicles of tomorrow is no doubt an important field of investigation. However, there are likely practical implications of drivetrain transition imaginaries dominating academic discourse. Based on the approaching of peak oil, as well as a diversity of additional enabling conditions, it has been clear for over a decade that electric mobility has reached a 'critical threshold' (Dijk et al., 2013). Furthermore, optimism around substitution technologies (such as biofuels) has been proven unfounded in the past and can even amplify sustainability problems (Goetz et al., 2018; Jeswani et al., 2020; Oliveira et al., 2017). Despite this, compared with critical investigations into emerging and

potentially disruptive technologies (e.g. AVs and MaaS), there have been surprisingly limited examples of future-making that call substitution pathways into question. These biases will inevitably legitimise transitions embodying these dimensions at the expense of others and thus encourage the realisation of substitution pathways over deeper systemic change.

In the realm of envisioning transformative change within a given regime, certain dimensions such as technology, policy, and user preferences are more amenable to our imagination compared to others such as everyday practices, discourse, norms, and culture. These latter aspects, often attributed to the landscape level or the underlying foundations of the regime, exhibit greater resistance to change and tend to evolve slowly, especially in the absence of significant external disruptions. However, it is important to recognise that these seemingly immutable aspects are not immune to change; they have transformed in the past and continue to do so. Failing to acknowledge this dynamic nature inadvertently reinforces and perpetuates the prevailing conceptions that limit the potential for transformative change. The research thus suggests, like other contributions, that academic discourses play an important role in locking-in unsustainable mobility regimes (Schwanen et al., 2011).

7.1. Limitations and future research

Our contribution is a first attempt at a reflexive exploration of the relationship transitions researchers form with the future and the possible implications of this considering the broader objectives of the research community. While we investigated the example of mobility futures, we see the potential for building on our contribution with future research beyond this. Firstly, we were able to make this reflection based on the significant work invested in defining a 'regime of automobility' and understanding its complex mechanisms of reproduction. This allowed the notion of 'incumbency' to take a form that could be used for enquiry for our approach. We would suggest, however, that incumbency and its mechanisms of reproduction could look very different if different object of investigation were to be considered. Future research could, therefore, explore how the future is mobilised to challenge and reproduce incumbency in other empirical fields. We would also suggest drawing on the critical bodies of literature that focus on these respective fields to understand the nuanced faces of incumbency that might be relevant for their investigation. Secondly, doing true justice to the notion of *deep* incumbency (Stirling, 2019), would require consideration of underlying forces such as capitalism, modernity, coloniality or patriarchy (Stirling et al., 2023). These dimensions of incumbency lie deeper than the scope of observation we have applied in our approach but are important for understanding the reproduction of hegemonic orders. Finally, our approach explicitly looked to future-making in an academic context in an attempt to better understand the unconscious biases that might be at play, even in spaces often assumed free of political influence. However, research building on our approach could compare the future-making outcomes of forums that are more overtly influenced by powerful actors and future-making in academic contexts. This could help to establish a clearer grasp of the overtly hegemonic futures that are being perpetuated in a particular empirical field, such as future-making practices deployed strategically for commercial reasons. These could be presented as a counterpoint to the future-making that strives to engage in inclusive future-making and work against scope incumbency, which as we have argued is an important task of future-making in transformation-oriented research.

7.2. Implications for STR

If we take the role of transitions scholars seriously in defining legitimate, credible, plausible and desirable articulations of the future, more reflexivity around the implications of future-making is warranted. This makes a strong case for those working on STR to improve their 'futures literacy': this means being reflexive about the plurality of ways to engage with the future; about the potential implications of different approaches for future-oriented action; and about the power structures that underpin engagements (Mangnus et al., 2021). Therefore, approaches to future-making must be *fit-for-purpose* (Mangnus et al., 2021)—ensuring a fit between the problem at hand and the future-making deployed to address it. This necessitates the utilisation of a broad array of future-making approaches with diverse ontological and epistemological positions (Mangnus et al., 2021; Muiderman et al., 2020).

Beyond broader calls for more reflexivity in STR, some insights can be drawn from the research. A single contribution cannot fulfil all the functions of future-making to effectively open-up the plausible, destabilise the undesirable and close-down around the desirable (however these might be defined). Furthermore, it is not clear how much of one type or the other is required to effectively support desirable transformations. However, our findings suggest that researchers developing mobility futures could benefit from understanding their role in these processes to potentially integrate mechanisms into their methodologies that work against the reproduction of scope incumbency.

Researchers are continuously navigating the territory between insignificance and conformity: running the risk of their research losing relevance in the pursuit of expanding ideas about the possible on one hand, or reproducing highly plausible yet non-transformative futures on the other. Similarly, there are often tensions between the making of *plausible* and *desirable* futures. The former is typically framed in a way that suggests the researcher has no interest in articulating what the future *should* bring but rather aims to articulate plausibility, based solely on the likelihood of a particular future arrangement coming to be. Although approaches were identified that mix plausible and desirable futures, the majority of the contributions appeared to assign themselves (at least unconsciously) to one camp or another. It seems that some researchers shy away from articulating preferable futures, opting instead for making only likely futures. Such futures are treated as more plausible than their normative counterparts, reproducing, in turn, their plausibility. Yet considering the important function that imagining radical alternative futures has in transition processes, it is not an option to simply retreat to safe academic spaces where highly plausible futures are interacted with to deliver impartial prognoses of what is likely to come: through remaining in the realm of the highly plausible, tensions with the radical prevail.

At the same time, probable futures are important as they serve as a warning and can catalyse action in the present. For researchers

who prefer to avoid explicitly normative terrain, the community could benefit from more contributions which further expose emerging "cracks" in a regime of automobility (Geels, 2012; Haas, 2020; Ruhrort, 2022). This could be through the creative articulation of what will likely happen under an ongoing regime of automobility and the questioning of the lofty promises associated with particular technologies: particularly those which can be easily incorporated into incumbent arrangements. However, researchers should acknowledge the performativity of futures and that normativity is always bound up in assumptions which inform all future-making practices. It is not sufficient to merely reflect on these embedded normative assumptions of specific future-making approaches if collectively most approaches embed the same assumptions. In this regard, researchers should be aware of, and dare to challenge, 'myths' about future mobilities (Fletcher et al., 2019; Peeters et al., 2016); exaggerated promises of technologies bound up in 'hype cycles' (Borup et al., 2006; van Lente, 2012; van Oers et al., 2020) as well as the dominance of neoliberal discourses which embed assumptions around economic growth and its association with individual car use (Bergman et al., 2017).

Given the legitimating power academia has, researchers should be wary of how this power is wielded. The STR community, in its pursuit of addressing grand societal challenges, recognises these challenges cannot be "addressed by incremental improvements and technological fixes, but require *radical shifts* to new kinds of socio-technical systems" (Köhler et al., 2019, p. 3 emphasis added). This will often require liberation from dominant imaginaries and institutions to propose *radically* different futures beyond the prevailing arrangements (see e.g. Beck et al., 2021; Loorbach, 2022). If researchers (consciously or unconsciously) limit futures they deem plausible to those aligned with prevailing logics and socio-material arrangements, they inevitably risk reproducing, rather than challenging, the status quo. This would crucially undermine the proclaimed objective of instigating such 'radical shifts'.

Funding

Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - GRK2725 - Projektnummer 445103843.

CRediT authorship contribution statement

Tom Hawxwell: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing. **Abe Hendriks:** Conceptualization, Data curation, Formal analysis, Validation, Writing – review & editing, Methodology. **Philipp Späth:** Conceptualization, Formal analysis, Supervision, Validation, Writing – review & editing.

Declaration of Competing Interest

None.

Annexe

Data corpus development

N = 337 (search string applied to scopus on 12.12.2022)
N = 276 (after inclusion/exclusion criteria applied to abstracts)
N = 94 (after inclusion/exclusion criteria applied to full-text)

Search string

Dimension	Operationalisation
Sustainability	TITLE-ABS-KEY (sustainab* OR environmental* OR bio* OR renewable OR socio-technical)
Transition	TITLE-ABS-KEY (transition OR transform* OR "system innovation" OR "radical innovation" OR shift OR change)
Foresight tools	TITLE-ABS-KEY - Building on lists of foresight tools from Muiderman et al. (2020),Oomen et al. (2021) and Dolez et al. (2019)
Mobility	TITLE-ABS-KEY (Transport OR mobility)
Sustainability transitions literature	Following Markard et al. (2012) and updated by Ertelt et al. (2023)
Peer-reviewed journal contributions	Selection in SCOPUS

Abstract screening: Inclusion/exclusion criteria (all inclusion criteria must be met).

Criteria	Include	Exclude
Future orientation	Clear future orientation: trying to make statements about plausible, possible, desirable, etc. futures; make some sort of prediction/ develops future scenarios/ visions etc.	Past or present orientation: Purely analyses past trends or only assesses present situations.

(*continued on next page*)

(*continued*)

Criteria	Include	Exclude
Long term futures	Future-making practices which interact with longer-term futures → years, decades, centuries	Future-making practices which are aimed to interact with short-term futures (hours, days, weeks, months) in the future
The presence of an articulation of a future state of affairs (vision, scenario, etc.)	Some manifestation of an activity brings a "future" to the present to make it actionable. This could be the article itself, or the article might be reporting on the development of some other activity that brings a future or futures to the present.	No example of such a manifestation
Empirical examples	Empirical papers that develop statements about futures in a particular case or a limited selection of cases.	Conceptual papers which develop theory
Reviews		Reviews of multiple cases
Papers	Journal articles	conference proceedings; book contributions etc.

The relationship between technological compatibility with automobility and the assumed desirability of the technology.[1]

		Technology's likely compatibility with automobility		
		Compatible with automobility (e.g. drive-train)	Borderline (e.g. autonomous vehicles, MaaS, …)	Alternative to automobility (e.g. cycling, public transport, …)
Stance concerning the technology	Promoting	18	6	11
	Impartial	8	9	2
	Problematising	5	1	0
	Total	31	16	13

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[1] Some articles focus on (A) substitution technologies (e.g. electric vehicles and alternative fuels etc.) while others focus on (C) technologies beyond the PV that might be seen to challenge automobility (e.g. public transport, soft modes etc.). Another group, (B) includes technologies which could either challenge or reproduce a RoA depending on how they are deployed (e.g. autonomous vehicles, Mobility-as-a-Service, etc.). They can be further differentiated according to the contribution's stance concerning the technology. A (1) *promoting* stance assumes the desirability of the technology and explores factors around its emergence. *Promoting* approaches appear neither to consider a range of plausible future relationships with the technology nor human agency to influence it. Rather, the desirability of the technology is assumed and the purpose of the contribution is to support its uptake, such as through developing policy recommendations or identifying barriers to be overcome. (2) *Impartial* contributions recognise a plurality of possible future relationships with the technology (some desirable, others not). A central purpose of these contributions is typically to ensure that the future relationship of the technology is a desirable one. Contributions with a (3) *problematising* stance explicitly aim to call the technology into question and warn about possible development, demonstrating the problems which could occur in the future in the context of its unchecked expansion.

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