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Acceptance dynamics of innovation diffusion: A heuristic framework for analysing actor reorientations in sustainability transitions

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ABSTRACT

The accelerated decarbonisation of energy systems entails a drastic increase in the diffusion rate of renewable energies. The adoption of ambitious policy mixes to this end faces a number of key challenges related to the resistance of multiple actors against the disruptive changes that such an acceleration entail. Policy-driven innovation diffusion efforts will thus require the sustained support and commitment from numerous stakeholders holding conflicting positions over disruptive processes of renewables' innovation diffusion. Yet despite its multistakeholder and processual character, empirical analyses on the social acceptance of renewables' innovation remain skewed towards static examinations of one specific actor group anchored in one particular point in time and location, omitting the interrelations across acceptance dimensions inherent in multistakeholder processes of innovation diffusion. To address these shortcomings, this paper introduces a novel heuristic framework on the acceptance dynamics of innovation diffusion processes as a key element to guide the examination of actor inertia and reorientation dynamics – depth, breadth, speed and directionality – over the diffusion of environmental innovations. Based on suggested framework applications, the paper outlines several implications for future research cutting across social acceptance and actor reorientations within sustainable energy transitions.

1. Introduction

Net-Zero objectives by mid-century will require an unprecedented acceleration of the pace of system decarbonisation across various sectors including energy, transport, industry, and buildings [1]. This entails a drastic increase in the diffusion of renewable energy (RE) and other environmental innovations at a speed and scale consistent with increasingly ambitious climate and energy targets to stay within a 1.5C° global warming threshold [2]. This will in turn demand a comprehensive set of ambitious policy mixes, the adoption of which faces numerous key challenges related to the resistance of various actor groups against the disruptive changes that such an acceleration entail [3]. Examples are plentiful. They include, for instance, energy utilities litigating against RE support schemes [4,5], or energy-intensive consumers lobbying against carbon pricing schemes due to regressive distributional effects undermining industrial competitiveness [6]. Opposition from market incumbents is coupled with contestation from other mainstream actors. These include neighbourhood associations protesting against disruptive landscape changes from the deployment of ever-bigger wind farms [7], town residents confronting local government authorities against mandatory installation of building-integrated solar thermal heating due to high acquisition costs [8], labour unions of coal mining/power workers demonstrating against phase-out policies for fear of massive job losses [9,10], or policymakers backtracking from banning internal combustion engine vehicles due to overwhelming pressure from car manufacturers [11].

These examples illustrate how the policy-driven decarbonisation of national economies will require the sustained support, commitment, and 'buy-in' from a wide range of actors holding disparate and, at times, conflicting positions over disruptive processes of socio-technical system transformation [12]. As such, they all point to the notion of 'acceptance' as a common underlying factor characterising the various positions and strategies adopted by different actor groups holding a stake in the policy-driven diffusion of renewables' innovations. Just transition policies will therefore need to strike a delicate balance between *disruptiveness* and *acceptance* in the *acceleration* of sustainability transitions [13].

On this note, the mobilisation of different disciplinary literatures has

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been highlighted as an important leverage point to systematically examine reorientation processes of different actor groups[1] towards the diffusion of environmental innovations and broader system reconfigurations [14–16]. As elaborated by Geels and Turnheim [17], 'reorientation' refers to substantive shifts of an actor's views, perceptions, preferences, attitudes, intentions, behaviours, practices, resources, and/or support from the existing system towards emerging niche innovations. Their definition closely resonates with the notion of social acceptance as "a favourable or positive response (including attitude, intention, behaviour and – where appropriate – use) relating to a proposed or in situ technology or socio-technical system, by members of a given social unit (country or region, community or town and household, organization)" [18]. Given the significant overlap in the characterisation of *reorientation* and *acceptance* across literatures, a systematic examination of actor reorientation dynamics – depth, breadth, speed and directionality – would demand greater analytical attention to the changing roles (i.e. positions, strategies) of actors in their attempts to shape innovation trajectories in line with their respective interests [19–21]. This would in turn require to systematically map and trace qualitative shifts in their relative acceptance as the diffusion process unfolds.

To address these considerations, this article mobilises key insights from the literature on the social acceptance of RE innovations, a research area cutting across the diffusion of technological innovations and the study of energy and policy from various social scientific standpoints [22]. Acceptance phenomena have been examined through multiple disciplinary perspectives to address different aspects of the 'social side' of renewables' innovations [23]. Yet despite this multidisciplinary repertoire, there have been limited efforts to operationalise the concept of 'social acceptance' from a systems-level, socio-technical transitions perspective [24]. The resulting gap reflects one important shortcoming. That is, with abounding 'snapshot' analyses of individual preferences, behaviours, and responses captured at one specific point in time and location, empirical analyses tracing the dynamics of multiple actor responses and positions co-evolving over time with respect to processes of renewables' innovation diffusion remain comparatively scarce [25,26]. Notwithstanding a small number of analyses addressing shifts in individual perceptions within delimited timeframes – typically involving different phases of a project development or policymaking procedure – the literature has mostly consolidated around empirical studies forwarding a rather individualised and static treatment of acceptance phenomena [27]. Despite calls for more longitudinal studies showcasing the temporalities of dynamic (i.e. changing) acceptance processes over longer timelines [28,29], little efforts have been invested thus far to capture the inherently processual character of acceptance phenomena – particularly as a historical progression of energy system transformation enacted through bundles of renewables' innovation diffusion processes[2] [30,31].

To address this shortcoming, this article introduces a novel heuristic framework to guide empirical analyses on the temporal dynamics of changing acceptance positions from different stakeholders. This stands as a key element to better understand actor inertia and reorientation processes over the diffusion of environmental innovations[3] and broader sustainability transitions. By incorporating the scarcely addressed elements of 'time' and 'change' in the examination of dynamic acceptance phenomena, the framework provides a more rounded appreciation of the often-omitted interrelations between acceptance dimensions. In doing so, the temporal character of social acceptance is brought to the forefront as a constitutive element of actor reorientation processes shaping the diffusion trajectories of environmental innovations.

The remainder of this article is structured as follows: Section 2 reviews a selective number of conceptual premises on the social acceptance of RE innovation and derives a number of key insights. These are then mobilised in Section 3 to inform the development of a novel heuristic framework addressing the acceptance dynamics underlying actor reorientation processes over the diffusion of environmental innovations. Section 4 outlines the advantages from potential framework applications and suggests a number of implications for future research at the intersection between social acceptance and actor reorientations within sustainable energy transitions. Section 5 concludes.

2. Social acceptance of renewables' innovation: an overview of conceptual contributions

This section provides a 'narrative' review of various conceptualisations on the social acceptance of renewables' innovation. From this, a number of key insights are elaborated, which are then repurposed as the building blocks of the heuristic framework introduced later on. The choice to conduct a 'narrative' review is motivated from its reported superiority in providing a concise and targeted synthesis of a literary corpus, or a subset of it, within a particular research area [32,33]. This stands in contrast to a 'systematic' review, the aim of which is to provide a comprehensive and replicable summary of the state of the art on a well-defined issue or research topic [34]. A narrative review thus lessens the need for an exhaustive and replicable approach to article sampling, allowing instead to elaborate more in-depth qualitative insights [34]. This does not necessarily undermine its validity or usefulness, particularly when conducted with the objective to synthesize concepts from a variety of disciplines and distil them into inductive conjectures [32,33].

2.1. Acceptance dimensions and levels of aggregation

As a research area, social acceptance emerges as an attempt to better understand the seemingly contradictory relationship between a) the ample and consistent societal support for RE technologies (RETs), and b) the recurrent opposition from local constituencies against actual project developments [35]. To better understand this 'social gap' [36], this multidisciplinary research area investigates the various preferences, motivations, attitudes, and behaviours shaping different actors' (re)actions towards the development of renewable energies and related infrastructure[4] [37]. While numerous empirical studies have captured different aspects of acceptance phenomena, the literature has been greatly influenced by Wüstenhagen et al.'s [38] three-dimensional conceptualisation of community, market, and socio-political acceptance. The so-called acceptance 'triangle' has provided conceptual grounding and empirical tractability to the complex relationships between RE innovations and their societal embeddedness [24]. Each dimension implicitly sharpens the scope of analysis by delimiting the samples of relevant stakeholders and their responses under a specific level of aggregation – e.g. operating unit,[5] geographic scale,[6] governance level,[7] market segment,[8] etc. [39].

The 'community' dimension of social acceptance typically demarcates the level of analysis within localised settings, with empirical

[1] E.g., incumbent firms, policymakers, mainstream consumers, wider publics, etc.

[2] See [84] for an exception.

[3] While typically focusing on renewable energy technologies (RETs) and related energy infrastructure, social acceptance research also examines other sustainability challenges and environmental innovations such as waste management practices, climate change adaptation strategies, or water treatment processes, among others [88]. The term 'environmental innovations' captures this wider range of technology/practice innovations.

[4] E.g., overhead transmission lines, underground power cables, electrical substations, etc.

[5] Household, firm, project, etc.

[6] Micro, meso, macro.

[7] Neighbourhood, municipality, province, region, country, etc.

[8] Niche, early adopters, mass consumption, etc.

examinations covering the responses of individual citizens (e.g. town residents, farmers), local authorities (e.g. municipalities), and other community organisations (e.g. neighbourhood associations, local wildlife conservation trusts) to specific RE project developments and their distributive impacts across local constituencies [40]. The 'market' dimension tends to broaden the analytical scope to consider a wider set of financial and end-use characteristics of a RET in general and for more geographically dispersed subsets of market actors. Correspondingly, market acceptance addresses the various drivers influencing the adoption patterns of RETs by a wider mass of end-users, as well as factors shaping energy-related investments from different market actors such as utility companies, financial institutions, or project developers [41]. Market acceptance can therefore be disaggregated into a demand-side (consumer acceptance) and a supply-side (investor acceptance).

Alike its market counterpart, socio-political acceptance can be disaggregated into a 'public' and a 'policy' component. Public acceptance captures acceptance phenomena "on the broadest, most general level" of aggregation [38]. It showcases the state of public opinion from the wider population in a country over different RETs and/or policies promoting their uptake. On the other hand, policy acceptance targets more explicitly the contestations of different stakeholders with political salience over the policymaking process – e.g., consumer/industrial associations, labour unions, regulatory authorities, political parties, lobbyists, etc. Policy acceptance thus reflects "the politics behind policies" promoting the uptake of RETs across national jurisdictions [39].

2.2. Narrowing the scope towards actor-centric perspectives: objects, subjects, and acceptance as a precursor of purposive action

This tri-dimensional framework has been progressively complemented by other conceptualisations targeting specific accepts of renewables' acceptance more exclusively. Within the market dimension, Hampl and Wüstenhagen [42] elaborate a conceptual framework to capture the cognitive elements of 'risk perceptions' and 'return expectations' shaping investment decision-making on utility-scale wind projects. Their framework provides a theoretical basis to elucidate the influence of subjective assessments shaping investor acceptance, which they define as "financiers' decisions to invest in innovative technologies or projects" (p. 574). Importantly, their conceptualisation foregrounds the notion of 'acceptance' as a necessary precondition to willingly engage in the development of a RE innovation. As such, it forwards a specific understanding of *acceptance as a prerequisite for purposive action*. In their use case, this translates into the 'willingness to invest' in the development of a wind power project driven by an expected financial return and reflecting different perceived risk factors.

Similarly, within the socio-political dimension Dermont et al. [43] outline an analytical framework targeting the acceptance of political actors over the design and implementation of specific RE policies across different stages of the legislative process. From this, they elaborate a step-wise analytical protocol to specifically examine policy acceptance. This consists of: i) explicitly determining the unit of analysis or *object of acceptance* (e.g. investment subsidy, phase-out programme), ii) identifying the relevant actor groups or *acceptance subjects* holding a stake in the design of the policy in question as well as on the outcomes from its implementation (e.g. energy utilities, RE developers, consumer associations, labour unions), and iii) specifying actor strategies to reveal their stance of support/contestation – that is, their *acceptance positions* – along different stages of the legislative cycle. Importantly, the authors align with Hampl and Wüstenhagen's [42] notion of 'acceptance' as a prerequisite for purposive action by defining it as an "antecedent condition" for successful policy realisation (p. 361).

Both propositions resonate with Kraeusel and Möst's [44] conceptualisation of acceptance as an actor's positive stance towards an issue, object, or procedure which predisposes it to enact a corresponding behaviour of endorsement, approval, or support. An actor's attempts to influence the policymaking process therefore reflect its level of acceptance over the specific policy in question as well as over the policy's target RET [45,46]. Its policy-shaping efforts represent the outcome of a prior decision to act or respond in a certain way. The decision to act/respond is itself the outcome of a previously defined position adopted over a particular process – namely the policy-driven diffusion of an environmental innovation[9] [47]. *It is this predefined position what embodies an actor's actual acceptance towards the diffusion of an environmental innovation, which is then manifested through certain actions, strategies, and behaviours.* Hence, elucidating an actor's level of acceptance (and its corresponding reorientation) towards an environmental innovation entails appraising the various (re)actions, strategies, and behaviours manifested in relation to the policies shaping its diffusion.

2.3. Broadening the scope towards system-level perspectives: conditionality and comparability

Complementing these more focalised frameworks, other contributions have broadened the conceptual lens to capture a wider range of macro-level factors underlying acceptance phenomena. While maintaining the tri-dimensional logic, Sovacool and Lakshmi-Ratan [48] introduce the notion of 'acceptance conditions' as a set of key criteria required to support the uptake of RETs across national jurisdictions. They note that such factors need to be met holistically – that is, across different contexts and by multiple actor groups – in order to engender supportive environments that accelerate RET diffusion across national energy systems. On this note, Upham et al. [18] outline various 'acceptance levels' through which to compare different actor responses based on the scale of aggregation (macro, *meso*, micro level) and the object under consideration (RET, energy infrastructure, on-site application). Their framework resonates with that of Bout et al. [49], as they both emphasize the cross-scalar nature of acceptance dimensions operating across different layers of governance. When taken together, these conceptualisations shed light on the qualities of 'conditionality' and 'comparability' characterising the widespread acceptance required to uphold disruptive processes of socio-technical system transformation.

'Conditionality' refers to the fact that while some characteristics of a RET might be welcomed and endorsed by any given individual or actor group (e.g. clean energy at low prices, high investment returns, potential for self-consumption), the energy infrastructure required to enable the on-site application of the RET in question might be at the same time discredited or rejected by that same stakeholder (e.g. shadow flickering from wind turbines, property devaluation) [49]. This can result in partial acceptance and potentially limited uptake [49]. The notion of conditionality thus points towards a wider range of acceptance positions existing between the binary extremes of support-rejection.

'Comparability' reflects the fact that while some market actors and/or policymakers might strongly support the deployment of RETs, this might be an insufficient lever to foster mass-scale deployment when juxtaposed against the positions of resistance, contestation, or outright rejection commonly held across numerous local constituencies against utility-scale project developments [50,51]. The conditional acceptance from different stakeholders therefore needs to be made comparable in order to aggregate an overall societal acceptance within any given national jurisdiction.

'Conditionality' and 'comparability' highlight the fact that support from some actor groups within a specific dimension or governance level is a necessary yet individually insufficient lever to promote the accelerated uptake of renewables on its own merit. Only if a substantial level of acceptance is obtained by a sufficient number of actors and across all acceptance dimensions can the system-wide diffusion of RE innovations

[9] The focus example used here is the diffusion of environmental innovations. However, other focal processes instrumental in purposive system change towards sustainability (e.g. phase out of carbon-emitting energy technologies) could also be used to illustrate the same line of argument elaborated here.

unfold at a pace and scale consistent with today's energy decarbonisation challenge [48]. From a sustainability transitions perspective, this entails addressing the persistent resistance of regimes against niche innovations such that a critical mass of support is obtained; which can in turn facilitate societal tipping points and accelerate the diffusion process [52,53]. It entails steering a sufficient number of incumbent and mainstream actors to reorient their behaviours, strategies and resources towards a jointly held stance of endorsement, support, and proactive participation [17,31,54].

Empirically, investigating actor inertia and reorientation dynamics would demand to systematically map, trace, and compare changes in their acceptance positions along the diffusion curve of the environmental innovation under consideration. Conceptually, it would require more comprehensive frameworks that can better capture (beyond merely noting) technology-policy interdependence as perceived through the singular standpoints of different actor groups over time. This could in turn facilitate longitudinal comparisons of different acceptance processes unfolding in parallel yet at different speeds and in disparate directions.

3. Acceptance dynamics of innovation diffusion: a framework for analysing actor reorientation processes

Based on the insights elaborated above, this section introduces a novel heuristic framework to capture the temporality and interdependence of dynamic acceptance phenomena. Building on the notion that acceptance stands as a precursor of purposive action, the framework provides a conceptual resource to guide and structure the empirical examination of actor inertia and reorientation processes over the policy-driven diffusion of environmental innovations. It does so by facilitating an operational interface to map, trace, and compare qualitative shifts in the acceptance positions of different actor (groups) co-evolving over time. The framework is therefore most useful when employed as an 'ordering device' [55] for the systematic examination of actor reorientation dynamics – depth, breadth, speed and directionality – towards the diffusion of environmental innovations.

3.1. Depth: to what extent?

Depth refers to the level or degree of reorientation realised by any given actor(s) under consideration. It is the answer to the question: "to what extent (or how much) has an actor(s) reoriented its acceptance position(s)?". As noted in Section 2.3, different actors often showcase a partial level of acceptance for – and thus a limited depth of reorientation towards – an environmental innovation due to the fact that some of its characteristics are readily endorsed while others are discredited. Correspondingly, all other things being equal, *the greater the level of acceptance, the deeper the depth of actor reorientation.* Opposedly, *the lower the level of acceptance, the further the extent of actor inertia.* When aggregated at the regime- or industry-level of analysis, *the deeper the depth of incumbent/mainstream actor reorientations, the greater the extent of regime reconfiguration and potential for system transformation* [15,56].

To reflect and operationalise this axiom, the framework moves past binary assessments of single object support/rejection and instead allows to calibrate a more granular scale of *acceptance positions*. At one extreme, an actor's position can be drastically *in favour* of an environmental innovation. Arguably, this would be manifested as a strategy to proactively *support* its diffusion and act accordingly. This can include seeking out communities of like-minded actors to establish experimental niches and foster entrepreneurial ecosystems around it [57], orchestrating marketing campaigns that highlight the innovation's environmental attributes to different publics [58], or calibrating municipal ordinances that facilitate localised diffusion [59], among many other strategies. On the other extreme, an actor's acceptance position may be radically *against* the diffusion of that same innovation, resulting in a decision to *reject* it and motivating the actor in question to e.g. collude with equally-minded actors to jointly hinder market entry for the innovation [60], promote legislation limiting the number of issued licences for new project developments [61], or ameliorating the public image of existing unsustainable practices and/or legacy technologies [62].

However, rarely do we only encounter such clearly-defined positions and logically-consistent (re)actions in the empirical examination of the acceptance of innovation diffusion processes [63,64] – there are "shades of grey". In between these two clear-cut extremes, we can expect to observe a continuum of acceptance positions reflecting a more nuanced gradient of support/rejection towards any given environmental innovation. This results in a more granular palette of acceptance positions or 'degrees of reorientation' towards the innovation's diffusion. The extent or *depth* of reorientation from any given actor is therefore contingent upon the specific acceptance position adopted relative to the cumulative uptake of an environmental innovation at any given point in time. Furthermore, such acceptance positions (and by extension, the depth of reorientation) are not necessarily static, but presumably co-evolve along with the innovation's ongoing diffusion [65]. This is schematically illustrated in Fig. 1 below.

3.2. Breadth: how many?

Breadth denotes the number of actors undergoing a reorientation process. As such, it reflects the scope of system reorientation occurring within any given unit of aggregation (e.g. an industry or end-use sector, a market segment, a socio-technical regime). It is the answer to the question: "how many actors have reoriented their acceptance positions?". All other things being equal, *the greater the number of acceptance processes, the broader the breadth of actor reorientations.* Opposedly, *the smaller the number of acceptance processes, the narrower the breadth of actor reorientations and the more limited the scope of regime reconfiguration.* When aggregated at a higher analytical level, the broader (or narrower) the breadth of actor reorientations, the greater (or the more limited) the scope of regime reconfiguration [66].

The proposed framework operationalises this second precept by outlining two core *acceptance objects*. First, it captures the renewable or environmental innovation under consideration. This does not necessarily circumscribe the analytical focus only to 'core' innovations,[10] as the framework may also encompass any energy infrastructure or 'complementary' innovations required to facilitate RE uptake[11] [67]. Second, the framework includes any direct/indirect policy steering the innovation's diffusion in either direction (i.e. promoting or hindering its roll-out and end-user uptake). These two interdependent acceptance objects – innovation and policy – 'navigate' through a bi-dimensional acceptance continuum insofar they are separately perceived by different stakeholders affected with ongoing deployment efforts and thus concerned with legislative/regulatory developments influencing the innovation's diffusion. The interactions between these various *acceptance subjects* with respect to the two core acceptance objects results in the emergence of four idealised *acceptance spaces*, each reflecting a distinct *acceptance gradient of innovation ↔ policy interaction* and positioning different acceptance subjects in function of their dual stance with respect to both acceptance objects.

Given the abundance and diversity of actors concerned with the deployment of any given environmental innovation and/or with policies shaping their diffusion, the framework allows to capture the scope or *breadth* of actor reorientations within any given regime or industry, as it facilitates the mapping and comparison of qualitative shifts in the acceptance positions of multiple actor groups under one same operating interface. As such, it showcases one possible way to operationalise more holistic analyses addressing cross-dimensional interrelations between market ↔ socio-political ↔ community acceptance subjects underlying

[10] E.g., wind or solar power, biogas, heat pump, electric vehicle, etc.
[11] E.g., biomass digestor, charging stations, smart meters, etc.

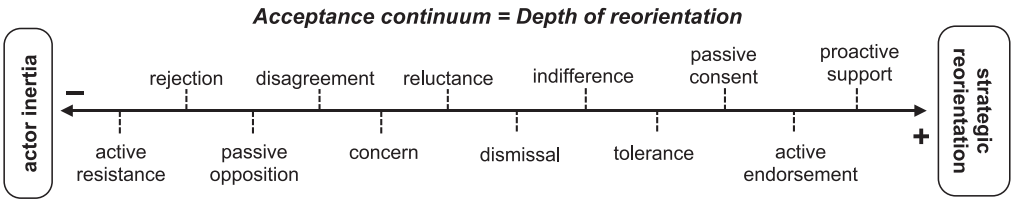


Fig. 1. Continuum of acceptance positions determining the depth of actor reorientation over the diffusion of an environmental innovation. (Source: Own elaboration.)

interdependent acceptance objects. Fig. 2 showcases a conceptual illustration depicting a static view of the heuristic framework over the policy-driven diffusion of renewables' innovation.

3.3. Speed: how long?

Speed captures the velocity at which an actor's reorientation process occurs. As such, it reflects the temporal component most often omitted in the conceptual treatment and empirical examination of dynamic acceptance phenomena. It is the answer to the question: "how long has the actor(s) in question taken to reorient its acceptance position(s)?". All other things being equal, *the swifter the pace at which an actor changes its acceptance position, the faster the speed at which it reorients towards the diffusion of an environmental innovation. The faster the speed of actor reorientations, the more expeditious (and presumably more disruptive) the velocity of regime reconfiguration* [19,68].

The static view of the heuristic framework, while useful for mapping and comparing the positions of different acceptance subjects with respect to interdependent acceptance objects, does not however reflect the actual temporality characterising changes in acceptance over the diffusion trajectory of renewable energies and other environmental innovations. Instead, it provides a 'snapshot' of a particular acceptance phenomenon at one specific point in time without due consideration to the innovation diffusion process unfolding throughout socio-technical systems. Actor reorientation, which by definition implies change over time, is therefore not well-captured.

To address this limitation and reflect the speed of actor reorientation processes, the framework is refined to incorporate the often-omitted variable of 'time' in the conceptualisation of acceptance phenomena. In this way, the processual character and temporality inherent in the social acceptance of renewables' innovation diffusion is made explicit without compromising the framework's suitability for mapping and comparing different actors' respective acceptance levels. This in turn serves to guide and structure the operationalisation of longitudinal appraisals capturing the co-evolution of dynamic acceptance positions throughout diffusion trajectories over longer timelines [28]. In doing so, the framework helps to empirically trace the *speed* at which different reorientation processes occur, as well as the *direction* in which they unfold. Fig. 3 (left) and 4 (right) below showcases a conceptual illustration of the heuristic framework incorporating the 'time' variable and thus depicting a dynamic view on the social acceptance of renewables' innovation diffusion.

3.4. Directionality: where to?

Finally, *directionality* reflects the degree of dispersion observed in the acceptance positions of different actor groups, and therefore the disparity of reorientation processes. It is the answer to the question: "in what direction (or where) has the actor(s) reoriented its acceptance position(s) towards? All other things being equal, *the more disparate actor*

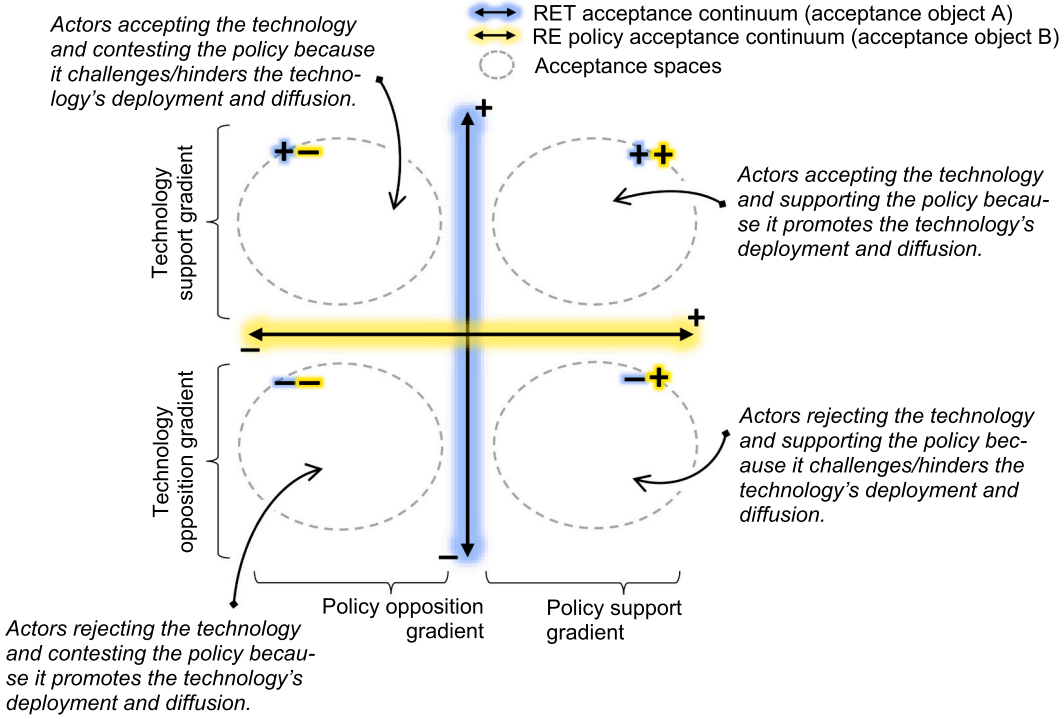
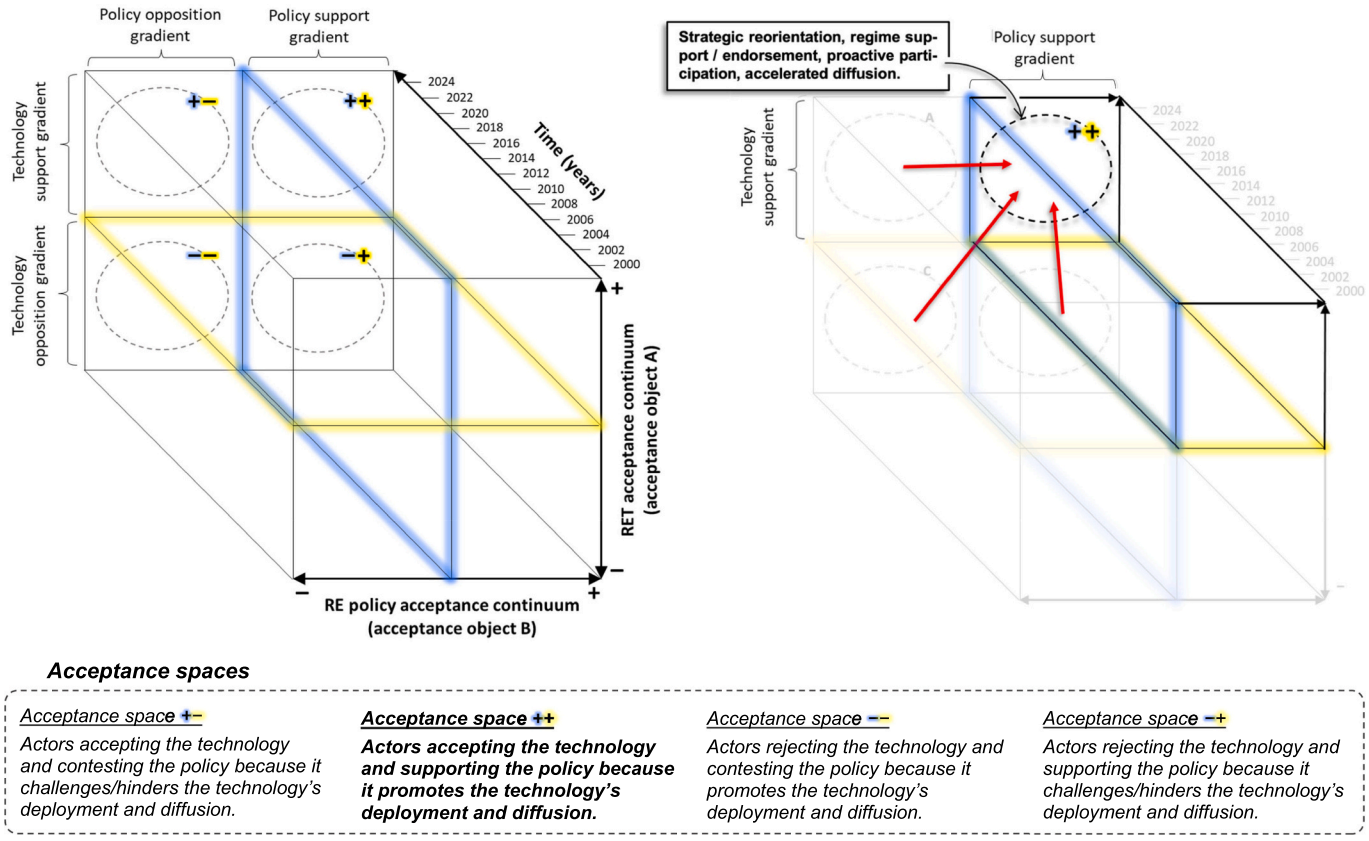


Fig. 2. Conceptual illustration of a heuristic framework depicting a static view on the social acceptance of renewables' innovation diffusion. (Source: Own elaboration.)



Figs. 3 (left) and 4 (right). Conceptual illustrations of the heuristic framework depicting a dynamic view on the social acceptance of renewables' innovation diffusion; and incorporating the normative question of mainstream actor reorientations towards a jointly-held acceptance position of technology-policy support (red arrows).
Source: Own elaboration.

reorientations are, the less coherent (and the more unlikely) regime reconfigurations are. Put differently, the more unidirectional actor reorientations are, the more likely regime reconfigurations are [69]. A socio-technical regime with multiple actor groups holding highly dispersed acceptance positions and disparate reorientations will showcase a higher degree of robustness and inertia impairing the likelihood for an accelerated diffusion of niche innovations. Hence the importance of policy mixes in nudging different stakeholders to reorient their strategies for promoting the diffusion of functionally superior yet highly disruptive innovations [70]. This latter point underlines the *normative directionality* characterising the governance of sustainability-oriented transitions, which in turn places the issue of policy adaptability and applicability at the forefront of any empirical enquiry holding policy prescriptive potential [14,71].

From a transitions perspective, the framework's policy suitability relates to the question of: how can institutional frameworks and other selection environments (e.g. markets, regulations, consumer preferences, public opinion) be readjusted such that they reorient a critical mass of incumbent and mainstream actors into actively supporting the mass-scale deployment of environmental infrastructure and the accelerated diffusion of renewables' innovations? Put differently, how can policy mixes be (re)calibrated to reorient diverse sets of actor groups towards a collective acceptance position of regime support and proactive participation for the systemic diffusion of niche innovations? Fig. 4 below showcases a conceptual illustration of the heuristic framework reflecting these normative considerations into its *dynamic view*.

4. Practical considerations and implications for future research on sustainable energy transitions

4.1. Framework advantages and use complementarities

The proposed framework should not be conceived as an all-encompassing 'grand theory' that provides a generalisable outlook or explanatory synthesis endowed with predictive capacity [72]. Instead, it should be understood as a disciplinarily-neutral and methodologically-flexible 'ordering device' used to structure and organise multidimensional empirical enquiries on the acceptance and ensuing reorientations of different actors towards the diffusion of environmental innovations [55]. One advantage of this conceptualisation stems from its lack of disciplinary affiliation, allowing to accommodate disparate ontological premises assumed by different literatures under an overarching operational interface. The framework thus offers one possible means to establish cross-overs between different literatures without necessarily compromising its core purpose as an ordering device to guide and structure multidisciplinary empirical analyses within a context of sustainable energy transition.

A second advantage stems from the framework's adaptability to a wide range of different social acceptance contexts. The framework can be tailored to map, compare, and trace changes over time on the acceptance positions of a diversity of actor groups conceptually embedded within different acceptance dimensions and therefore involving different acceptance objects in interaction, simultaneously. This stands as a particularly salient characteristic given the principle of *interdependence* between entangled acceptance dimensions recurrently recognised across numerous conceptualisations [18,31,38,39]. At the same time, the framework forwards a response to ongoing calls for

capturing the temporal aspects of dynamic (i.e. changing) acceptance phenomena unfolding over longer time periods beyond project development timelines or legislative cycles [24,27].

A third advantage is that the framework is not constrained by the use of a single method but rather admits methodological pluralism. It offers the possibility to combine different qualitative/quantitative methodologies depending upon the case or phenomena under scrutiny. For instance, process tracing or discourse analysis can be employed in longitudinal case studies for examining the co-evolution of different actors' acceptance positions over historical timelines – following a recurrently employed formula within sustainability transitions research [73]. Alternatively, the analytical outputs from more positivist methodologies (e.g. qualitative comparative analysis, conjoint analysis) can be equally accommodated in such a way as to calibrate a more measurable estimation of different regulatory drivers shaping various acceptance subjects' preferences for interrelated choice sets [74,75]. Both examples reflect the salience of the heuristic framework's amenability to more open and plural processes of enquiry, a central characteristic for advancing policy agendas around energy democratisation, actor diversity, and knowledge co-creation shaping ongoing sustainability transitions [76].

A fourth advantage is that while being based on the conceptual constructs of the social acceptance of renewables' innovation, the proposed framework accommodates an aggregate set of generalisable principles on the various dynamics underlying actor reorientation processes into a coherent operational interface that facilitates their empirical appraisal. As such, it can serve as a useful aid to other more comprehensive transition frameworks conceptualising actor reorientation processes. These have tended to focus rather explicitly on *depth* and *speed* as the most salient dynamics, yet tended to lessen the attention on *breadth* and *directionality* as other equally relevant features of actor and industry reconfiguration processes. For instance, Geels and Turnheim [17] develop a conceptual framework to uncover different depths of reconfiguration based on changes across actors' cognitive, behavioural, and resource dimensions. Geels [77] elaborates a more processual appreciation of various reorientation depths based on different stages unfolding along a chronological timeline. This resonates with the five-phase model of industry reconfiguration from Geels and Gregory [68], which consists of a time-wise concatenation of various reorientation depths. While the notion of 'time' is acknowledged on both instances, no explicit elaboration of the *speed* at which such stages unfold is explicitly conceptualised. Similarly, the notions of *breadth* and *directionality* are implicitly acknowledged yet no explicit treatment is provided. The proposed framework could therefore support more balanced appraisals of multifaceted reorientation processes from different actor groups using a common 'umbrella' heuristic.

4.2. Research implications at the intersection between social acceptance and actor reorientations towards the diffusion of environmental innovations

In light of the framework's advantages, this section outlines a number of suggestions for future research cutting across social acceptance and actor reorientations within sustainable energy transitions.

First, future research efforts should move past isolated enquiries of single acceptance object-subject. The heuristic framework could be mobilised to empirically elucidate how different stakeholders with disparate interests and reorientation propensities 'navigate' across different acceptance dimensions. To do so, empirical analyses should clearly demarcate the acceptance objects under consideration and the contexts where acceptance phenomena are manifested. Furthermore, future research could move past snapshot-type examinations and elucidate how interactions between the acceptance positions of different stakeholders influence the diffusion trajectories of environmental innovations.

Second, analyses of technology-policy interactions could pay particular attention to the co-evolution of different acceptance positions manifested by different actors, each with a specific interest in shaping the diffusion trajectory of the environmental innovation under consideration [78]. This could include investigating whether specific patterns of interaction result in qualitatively distinct innovation trajectories or into the emergence of singular transition pathways. Furthermore, the analytical outputs could support the development of prognostic socio-technical system assessments. These could in turn inform pre-emptive policy mixes tailored to foster the acceptance positions of different stakeholders and 'steer' them to reorient towards a collective stance of regime support/endorsement and proactive participation [79,80].

Third, longitudinal analyses tracing different interaction patterns could serve to reveal different 'stages of acceptance' along a particular transition pathway. Acceptance stages could be elucidated from the co-evolving interactions played out between the acceptance positions of various actors holding a stake in the innovation's diffusion. Here inspiration could be drawn from prior empirical work on the use of organisational change management tools such as the 'change curve' [81], which outlines the stages an organization goes through when confronted with an episode of significant disruption or upheaval (e.g. having to reorient its corporate strategy in response to the successfull diffusion of a disruptive niche innovation). Future transitions research could build upon the strategic corporate management literature and leverage the proposed framework to couple different actor reorientation phases with different acceptance stages following the cumulative uptake of the environmental innovation under examination.

Fourth, multi-actor reorientation analyses could target the power dynamics playing out between different stakeholders with unequal resource endowments for influencing the acceptance of an environmental innovation's diffusion. For instance, established market incumbents will strategically reorient their acceptance positions towards a strategy of conditional support and participation when they have assessed a sufficient gain from the niche innovation under consideration, and as long as its diffusion is co-managed by them [82,83]. While this can potentially expedite the innovation's diffusion, it can at the same time result on its selective appropriation by a reduced number of larger market players at the expense of a more diverse set of smaller local actors with more socially accepted but risk-exposed business models [84,85]. This may leave niche-based newcomers overly exposed to the dictates of more powerful regime incumbents while at the same time contribute to a more widespread sentiment of rejection across local constituencies [12]. This could have far-reaching implications regarding the pace of the innovation diffusion process itself.

Future research efforts could therefore elaborate a more refined appreciation of the power relations mediating between e.g. market reorientation processes and community acceptance outcomes regarding the accelerated diffusion of environmental innovations. On the one hand, this would demand the mobilisation of novel literatures – for instance, on the political economy of sustainable energy transitions [86] – which have thus far received little attention for examining the social acceptance of renewables' innovations [87]. On the other hand, this would require a methodological shift from cross-sectional to longitudinal empirical enquiries – a shift which has not been comprehensively reflected in the empirical examination of social acceptance phenomena thus far [24]. Given its methodological and disciplinary neutrality, the proposed framework stands as a conceptual resource to guide – in this case – longitudinal enquiries on the power dynamics of social acceptance and actor reorientation processes regarding the policy-driven diffusion of environmental innovations.

5. Conclusion

This paper has introduced a novel heuristic framework on the acceptance dynamics underlying actor reorientation processes over the diffusion of environmental innovations and broader sustainability transitions. On the one hand, the framework allows to incorporate the

scarcely addressed elements of 'time' and 'change' in the examination of dynamic acceptance phenomena. In doing so, it foregrounds the temporal character of social acceptance as a constitutive element of actor reorientation processes shaping the diffusion of environmental innovations. On the other hand, the framework allows to move past binary assessments of single object support/rejection and instead calibrates a more nuanced acceptance gradient of innovation ↔ policy interaction between different actor groups. Finally, the framework accommodates an aggregate set of generalisable principles on the underlying dynamics of depth, breadth, speed, and directionality characterising actor reorientation processes, into a coherent operational interface that facilitates their empirical appraisal. When utilised in tandem with other more comprehensive conceptualisations on incumbent and mainstream actor reorientations, the framework can serve as a useful 'ordering device' to enhance the analytical traction of existing frameworks for investigating different reorientation dynamics more comprehensively.

In light of these and other noted advantages, the paper outlines various research venues for addressing a) the co-evolution of different acceptance positions in shaping the diffusion trajectories of environmental innovations; b) the emergence of interaction patterns into qualitatively distinct 'stages of acceptance' characterising a particular transition pathway; or c) the power dynamics between different stakeholders with unequal resource endowments to influence the acceptance of an innovation's diffusion across national jurisdictions. Through these and other suggested lines of enquiry, future research could mobilise the proposed framework to contribute a more refined understanding of the acceptance dynamics underlying actor reorientation processes over the accelerated diffusion of environmental innovations across different domains of application including electricity, transport, buildings, or heating sectors.

CRediT authorship contribution statement

Cristian Pons-Seres de Brauwer: Conceptualization, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The Author declares no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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References

[1] A.D. Andersen, F.W. Geels, L. Coenen, J. Hanson, M. Korsnes, K. Linnerud, et al., Faster, broader, and deeper! Suggested directions for research on net-zero transitions, Oxford Open Energy [Internet]. 1 (2) (2023) 1–7. Feb. Available from: https://doi.org/10.1093/ooenergy/oiad007.

[2] IRENA, World Energy Transitions Outlook 2023: 1.5°C pathway [Internet], International Renewable Energy Agency 1, 2023, pp. 1–258. Abu Dhabi. Available from: https://www.irena.org/Publications/2023/Jun/World-Energy-Transitions-Outlook-2023.

[3] J. Markard, F.W. Geels, R. Raven, Challenges in the acceleration of sustainability transitions, Environmental Research Letters [Internet]. 15 (8) (2020) 081001. Aug 11. Available from: https://iopscience.iop.org/article/10.1088/1748-9326/ab9468.

[4] D. Lee, D.J. Hess, Incumbent resistance and the solar transition: changing opportunity structures and framing strategies, Environ Innov Soc Transit [Internet]. 1 (33) (2019) 183–195. Nov. Available from: https://doi.org/10.1016/j.eist.2019.05.005.

[5] G. Kungl, F.W. Geels, Sequence and alignment of external pressures in industry destabilisation: understanding the downfall of incumbent utilities in the German energy transition (1998–2015), Environ Innov Soc Transit [Internet]. 1 (26) (2018) 78–100. Mar. Available from: https://doi.org/10.1016/j.eist.2017.05.003.

[6] Baranzini A, van den Bergh JCJM, Carattini S, Howarth RB, Padilla E, Roca J. Carbon pricing in climate policy: seven reasons, complementary instruments, and political economy considerations. Wiley Interdiscip Rev Clim Change [Internet]. 2017 Jul 1;8(4):e462. Available from: https://wires.onlinelibrary.wiley.com/doi/10.1002/wcc.462.

[7] Kirkegaard JK, Rudolph DP, Nyborg S, Solman H, Gill E, Cronin T, et al. Tackling grand challenges in wind energy through a socio-technical perspective. Nature Energy 2023 8:7 [Internet]. 2023 Jun 19;8(7):655–64. Available from: https://www.nature.com/articles/s41560-023-01266-z.

[8] P. Huang, When government-led experimentation meets social resistance? A case study of solar policy retreat in Shenzhen, China, Energy Res Soc Sci [Internet]. 1 (75) (2021) 102031. May. Available from: https://doi.org/10.1016/j.erss.2021.102031.

[9] J. Baran, A. Szpor, J. Witajewski-Baltvilks, Low-carbon transition in a coal-producing country: a labour market perspective, Energy Policy [Internet]. 1 (147) (2020) 111878. Dec. Available from: https://doi.org/10.1016/j.enpol.2020.111878.

[10] M. Scislowska, Polish miners, power workers, protest shift away from coal, AP News [Internet]. (2021). Jun 9; Available from: https://apnews.com/article/europe-government-and-politics-environment-and-nature-business-be04247b5ffd9967fd096161e9456b21.

[11] Kottasová I. EU was set to ban internal combustion engine cars. Then Germany suddenly changed its mind | CNN Business. CNN [Internet]. 2023 Mar 27; Available from: https://edition.cnn.com/2023/03/24/cars/eu-combustion-engine-debate-climate-intl/index.html.

[12] Pons-Seres de Brauwer C. The Politics of Market Change towards Sustainability: Revisiting Germany's Policy Support Framework for Renewables. Energies 2022, Vol 15, Page 3898 [Internet]. 2022 May 25;15(11):3898. Available from: doi:https://doi.org/10.3390/en15113898.

[13] Newell PJ, Geels FW, Sovacool BK. Navigating tensions between rapid and just low-carbon transitions. Environmental Research Letters [Internet]. 2022 Apr 8;17(4):041006. Available from: https://iopscience.iop.org/article/10.1088/1748-9326/ac622a.

[14] J. Köhler, F.W. Geels, F. Kern, J. Markard, E. Onsongo, A. Wieczorek, et al., An agenda for sustainability transitions research: state of the art and future directions, Environ Innov Soc Transit [Internet]. 1 (31) (2019) 1–32. Jun. Available from: https://doi.org/10.1016/j.eist.2019.01.004.

[15] F.W. Geels, From leadership to followership: a suggestion for interdisciplinary theorising of mainstream actor reorientation in sustainability transitions, Environ Innov Soc Transit [Internet]. 1 (41) (2021) 45–48. Dec. Available from: https://doi.org/10.1016/j.eist.2021.10.021.

[16] I. Stalmokaitė, B. Hassler, Dynamic capabilities and strategic reorientation towards decarbonisation in Baltic Sea shipping. Environ Innov Soc Transit [Internet]., [cited 2023 Sep 27];37:187–202, Available from (2020), https://doi.org/10.1016/j.eist.2020.09.002. Dec 1.

[17] F.W. Geels, B. Turnheim, Conceptualising socio-technical system reconfigurations, in: The Great Reconfiguration [Internet], Cambridge University Press, 2022, pp. 22–41. Available from: https://www.cambridge.org/core/books/great-reconfiguration/conceptualising-sociotechnical-system-reconfiguration/57BE5969C6554BDBF0C1A42FEC2ECF05.

[18] P. Upham, C. Oltra, À. Boso, Towards a cross-paradigmatic framework of the social acceptance of energy systems, Energy Res Soc Sci [Internet]. 1 (8) (2015) 100–112. Jul. Available from: https://doi.org/10.1016/j.erss.2015.05.003.

[19] A.D. Andersen, J. Markard, D. Bauknecht, M. Korpås, Architectural change in accelerating transitions: actor preferences, system architectures, and flexibility technologies in the German energy transition, Energy Res Soc Sci [Internet]. 1 (97) (2023) 102945. Mar. Available from: https://doi.org/10.1016/j.erss.2023.102945.

[20] P. Bögel, K. Pereverza, P. Upham, O. Kordas, Linking socio-technical transition studies and organisational change management: steps towards an integrative, multi-scale heuristic, J Clean Prod [Internet]. 20 (232) (2019) 359–368. Sep. Available from: https://doi.org/10.1016/j.jclepro.2019.05.286.

[21] P. Upham, P. Bögel, E. Dütschke, Thinking about individual actor-level perspectives in sociotechnical transitions: a comment on the transitions research agenda, Environ Innov Soc Transit [Internet]. 1 (34) (2020) 341–343. Mar. Available from: https://doi.org/10.1016/j.eist.2019.10.005.

[22] J. Gaede, I.H. Rowlands, Visualizing social acceptance research: a bibliometric review of the social acceptance literature for energy technology and fuels, Energy Res Soc Sci [Internet]. 1 (40) (2018) 142–158. Jun. Available from: https://doi.org/10.1016/j.erss.2017.12.006.

[23] S. Batel, P. Devine-Wright, T. Tangeland, Social acceptance of low carbon energy and associated infrastructures: a critical discussion, Energy Policy [Internet]. 1 (58) (2013) 1–5. Jul. Available from: https://doi.org/10.1016/j.enpol.2013.03.018.

[24] G. Ellis, N. Schneider, R. Wüstenhagen, Dynamics of social acceptance of renewable energy: an introduction to the concept, Energy Policy [Internet]. 1 (181)

(2023) 113706. Oct. Available from: https://doi.org/10.1016/j.enpol.2023.113706.
[25] Clausen NE, Rudolph D, Kirkegaard J, Larsen SV. Where to put wind farms? Challenges related to planning, EIA and social acceptance. In: Jørgensen BH, Madsen PH, Giebel G, Martí I, Thomsen K, editors. DTU International Energy Report 2021: Perspectives on Wind Energy [Internet]. Roskilde: DTU Wind and Energy Systems; 2021. p. 44–53. Available from: https://orbit.dtu.dk/en/publications/where-to-put-wind-farms-challenges-related-to-planning-eia-and-so.
[26] Frantál B. Have local government and public expectations of wind Energy project benefits been met? Implications for repowering schemes. Journal of Environmental Policy & Planning [Internet]. 2015 Mar 15;17(2):217–36. Available from: https://www.tandfonline.com/doi/abs/10.1080/1523908X.2014.936583.
[27] S. Küpers, S. Batel, Time, history and meaning-making in research on people's relations with renewable energy technologies (RETs) – a conceptual proposal, Energy Policy [Internet]. 1 (173) (2023) 113358. Feb. Available from: https://doi.org/10.1016/j.enpol.2022.113358.
[28] S. Batel, D. Rudolph, Contributions, tensions and future avenues of a critical approach to the social acceptance of renewable energy infrastructures, in: S. Batel, D. Rudolph (Eds.), A Critical Approach to the Social Acceptance of Renewable Energy Infrastructures: Going beyond Green Growth and Sustainability [Internet], Springer International Publishing, 2021, pp. 237–257. Available from: https://link.springer.com/chapter/10.1007/978-3-030-73699-6_13.
[29] M. Hitzeroth, M. Jehling, M. Brueckner, Apples and oranges? A multi-level approach explaining social acceptance of renewable energy in Germany and Australia, International Journal of Global Energy Issues [Internet]. 40 (3–4) (2017) 141–165. Available from: https://doi.org/10.1504/IJGEI.2017.086617.
[30] M. Wolsink, Co-production in distributed generation: renewable energy and creating space for fitting infrastructure within landscapes, Landsc Res [Internet]. 43 (4) (2018) 542–561. May 19. Available from: https://doi.org/10.1080/01426397.2017.1358360.
[31] M. Wolsink, Social acceptance revisited: gaps, questionable trends, and an auspicious perspective, Energy Res Soc Sci [Internet]. 1 (46) (2018) 287–295. Dec. Available from: https://doi.org/10.1016/j.erss.2018.07.034.
[32] H.M. Cooper, Synthesizing research: A Guide for Literature Reviews [Internet], 3rd ed., Sage Publications, Thousand Oaks, Calif, 1998. Available from: https://searchworks.stanford.edu/view/3909248.
[33] Fink A. Conducting research literature reviews: from the internet to paper. [Internet]. Los Angeles: SAGE Publications, Inc; 2019. 304 p. Available from: https://books.google.ch/books?id=Dg5zAwAAQBAJ&printsec=frontcover&dq=A.+Fink+Conducting+research+literature+reviews:+From+the+Internet+to+paper&hl=de&sa=X&redir_esc=y#v=onepage&q=A. Fink Conducting research literature reviews%3A From the Internet to paper.
[34] B.K. Sovacool, J. Axsen, S. Sorrell, Promoting novelty, rigor, and style in energy social science: towards codes of practice for appropriate methods and research design, Energy Res Soc Sci [Internet]. 1 (45) (2018) 12–42. Nov. Available from: https://doi.org/10.1016/j.erss.2018.07.007.
[35] M. Segreto, L. Principe, A. Desormeaux, M. Torre, L. Tomassetti, P. Tratzi, Trends in Social Acceptance of Renewable Energy Across Europe—A Literature Review. International Journal of Environmental Research and Public Health 2020, Vol 17, Page 9161 [Internet], et al., 8;17(24):9161, Available from, 2020 Dec, https://doi.org/10.3390/ijerph17249161.
[36] D. Bell, T. Gray, C. Haggett, The 'social gap' in wind farm siting decisions: explanations and Policy responses, Env Polit [Internet]. 14 (4) (2005) 460–477. Aug. Available from: https://doi.org/10.1080/09644010500175833.
[37] P. Devine-Wright, S. Batel, Explaining public preferences for high voltage pylon designs: an empirical study of perceived fit in a rural landscape, Land use policy [Internet]. 1 (31) (2013) 640–649. Mar. Available from: https://doi.org/10.1016/j.landusepol.2012.09.011.
[38] R. Wüstenhagen, M. Wolsink, M.J. Bürer, Social acceptance of renewable energy innovation: an introduction to the concept, Energy Policy [Internet]. 35 (5) (2007) 2683–2691. May 1. Available from: https://doi.org/10.1016/j.enpol.2006.12.001.
[39] P. Devine-Wright, S. Batel, O. Aas, B. Sovacool, M.C. LaBelle, A. Ruud, A conceptual framework for understanding the social acceptance of energy infrastructure: insights from energy storage, Energy Policy [Internet]. 1 (107) (2017) 27–31. Aug. Available from: https://doi.org/10.1016/j.enpol.2017.04.020.
[40] M.A. Petrova, From NIMBY to acceptance: toward a novel framework — VESPA — for organizing and interpreting community concerns, Renew Energy [Internet]. 1 (86) (2016) 1280–1294. Feb. Available from: https://doi.org/10.1016/j.renene.2015.09.047.
[41] J. Curtin, C. McInerney, B. Gallachóir, S. Salm, Energizing local communities—what motivates Irish citizens to invest in distributed renewables? Energy Res Soc Sci [Internet]. 1 (48) (2019) 177–188. Feb. Available from: https://doi.org/10.1016/j.erss.2018.08.020.
[42] Hampl N, Wustenhagen R. Management of Investor Acceptance in wind power megaprojects: a conceptual perspective. Organization, technology & management in construction : an international journal [Internet]. 2012 Dec;4(Special Issue):0–0. Available from: https://hrcak.srce.hr/en/96761.
[43] C. Dermont, K. Ingold, L. Kammermann, Stadelmann-Steffen I. Bringing the policy making perspective in: A political science approach to social acceptance. Energy Policy [Internet], 1;108:359–68, Available from, 2017 Sep, https://doi.org/10.1016/j.enpol.2017.05.062.
[44] J. Kraeusel, D. Möst, Carbon capture and storage on its way to large-scale deployment: social acceptance and willingness to pay in Germany, Energy Policy [Internet]. 1 (49) (2012) 642–651. Oct. Available from: https://doi.org/10.1016/j.enpol.2012.07.006.
[45] K. Ingold, Network structures within Policy processes: coalitions, power, and brokerage in Swiss climate Policy, Policy Studies Journal [Internet]. 39 (3) (2011) 435–459. Aug 1. Available from: https://doi.org/10.1111/j.1541-0072.2011.00416.x.
[46] Hank C. Jenkins-Smith, Daniel Nohrstedt, Christopher M. Weible, Karin Ingold, The advocacy coalition framework: An overview of the research program, in: C. M. Weible, P.A. Sabatier (Eds.), Theories of the Policy Process [Internet], 4th ed., Routledge, 2018. Available from: https://www.taylorfrancis.com/books/9780429962837.
[47] I. Ajzen, The theory of planned behavior, Organ Behav Hum Decis Process [Internet]. 50 (2) (1991) 179–211. Available from: https://doi.org/10.1016/0749-5978(91)90020-T.
[48] B.K. Sovacool, Ratan P. Lakshmi, Conceptualizing the acceptance of wind and solar electricity, Renewable and Sustainable Energy Reviews [Internet]. 16 (7) (2012) 5268–5279. Sep 1. Available from: https://doi.org/10.1016/j.rser.2012.04.048.
[49] Bout C, Gregg JS, Haselip J, Ellis G. How Is Social Acceptance Reflected in National Renewable Energy Plans? Evidence from Three Wind-Rich Countries. Energies 2021, Vol 14, Page 3999 [Internet]. 2021 Jul 2;14(13):3999. Available from: doi:https://doi.org/10.3390/en14133999.
[50] Bidwell D. Thinking through participation in renewable energy decisions. Nature Energy 2016 1:5 [Internet]., 6;1(5):1–4, Available from, 2016 May, https://doi.org/10.1038/nenergy.2016.51.
[51] M. Koelman, T. Hartmann, T.J.M. Spit, It's not all about the money—landowner motivation and high voltage grid development, Journal of Environmental Policy & Planning [Internet]. 25 (3) (2023) 211–224. May 4. Available from: https://doi.org/10.1080/1523908X.2022.2093175.
[52] F.W. Geels, M. Ayoub, A socio-technical transition perspective on positive tipping points in climate change mitigation: Analysing seven interacting feedback loops in offshore wind and electric vehicles acceleration, Technol Forecast Soc Change [Internet]. 1 (193) (2023) 122639. Aug. Available from: https://doi.org/10.1016/j.techfore.2023.122639.
[53] I. Stadelmann-Steffen, C. Eder, N. Harring, G. Spilker, A. Katsanidou, A framework for social tipping in climate change mitigation: what we can learn about social tipping dynamics from the chlorofluorocarbons phase-out, Energy Res Soc Sci [Internet]. 1 (82) (2021) 102307. Dec. Available from: https://doi.org/10.1016/j.erss.2021.102307.
[54] M. Wolsink, Distributed energy systems as common goods: socio-political acceptance of renewables in intelligent microgrids, Renewable and Sustainable Energy Reviews [Internet]. 1 (127) (2020) 109841. Jul. Available from: https://doi.org/10.1016/j.rser.2020.109841.
[55] M. Hajer, D. Laws, Ordering through discourse, in: R. Goodin, M. Moran, M. Rein (Eds.), The Oxford Handbook of Public Policy [Internet], Oxford University Press, Oxford, 2008. Available from: https://academic.oup.com/edited-volume/28180/chapter/213051601.
[56] M.B. Lindberg, J. Markard, A.D. Andersen, Policies, actors and sustainability transition pathways: A study of the EU's energy policy mix, Res. Policy 48 (10) (2019) 103668, https://doi.org/10.1016/j.respol.2018.09.003.
[57] Brem A, Radziwon A. Efficient Triple Helix collaboration fostering local niche innovation projects – A case from Denmark. Technol Forecast Soc Change [Internet]. 2017 Oct 1;123:130–41. Available from: doi:https://doi.org/10.1016/j.techfore.2017.01.002.
[58] A. Kuokkanen, A. Nurmi, M. Mikkilä, M. Kuisma, H. Kahiluoto, L. Linnanen, Agency in regime destabilization through the selection environment: the Finnish food system's sustainability transition, Res Policy [Internet]. 47 (8) (2018) 1513–1522. Oct 1. Available from: https://doi.org/10.1016/j.respol.2018.05.006.
[59] K.Y. Bjerkan, N.M. Bjørge, S. Babri, Transforming socio-technical configurations through creative destruction: local policy, electric vehicle diffusion, and city governance in Norway, Energy Res Soc Sci [Internet]. 1 (82) (2021) 102294. Dec. Available from: https://doi.org/10.1016/j.erss.2021.102294.
[60] L. Westman, C. Luederitz, A. Kundurpi, A.J. Mercado, S.L. Burch, Market transformations as collaborative change: institutional co-evolution through small business entrepreneurship, Bus Strategy Environ [Internet]. 32 (2) (2023) 936–957. Feb 1. Available from: https://doi.org/10.1002/bse.3083.
[61] Gudbrandsdottir IY, Saviolidis NM, Olafsdottir G, Oddsson G V., Stefansson H, Bogason SG. Transition Pathways for the Farmed Salmon Value Chain: Industry Perspectives and Sustainability Implications. Sustainability 2021, Vol 13, Page 12106 [Internet]. 2021 Nov 2;13(21):12106. Available from: doi:https://doi.org/10.3390/su132112106.
[62] C. Roberts, F.W. Geels, Conditions and intervention strategies for the deliberate acceleration of socio-technical transitions: lessons from a comparative multi-level analysis of two historical case studies in Dutch and Danish heating, Technol Anal Strateg Manag [Internet]. 31 (9) (2019) 1081–1103. Sep 2. Available from: https://doi.org/10.1080/09537325.2019.1584286.
[63] G. Torma, J. Aschemann-Witzel, Social acceptance of dual land use approaches: Stakeholders' perceptions of the drivers and barriers confronting agrivoltaics diffusion, J Rural Stud [Internet]. 1 (97) (2023) 610–625. Jan. Available from: https://doi.org/10.1016/j.jrurstud.2023.01.014.
[64] Friedl C, Reichl J. Realizing energy infrastructure projects – a qualitative empirical analysis of local practices to address social acceptance. Energy Policy [Internet]. 2016;89:184–93. Available from: doi:https://doi.org/10.1016/j.enpol.2015.11.027.
[65] I. Stalmokaitė, Hassler B. Dynamic capabilities and strategic reorientation towards decarbonisation in Baltic Sea shipping. Environ Innov Soc Transit [Internet]., 1;37:187–202, Available from, 2020 Dec, https://doi.org/10.1016/j.eist.2020.09.002.
[66] F.W. Geels, Major system change through stepwise reconfiguration: a multi-level analysis of the transformation of American factory production (1850–1930),

Technol Soc [Internet]. 28 (4) (2006) 445–476. Nov 1. Available from: https://doi.org/10.1016/j.techsoc.2006.09.006.
[67] J. Markard, V.H. Hoffmann, Analysis of complementarities: framework and examples from the energy transition, Technol Forecast Soc Change [Internet]. 111 (2016) 63–75. Available from: https://doi.org/10.1016/j.techfore.2016.06.008.
[68] F.W. Geels, J. Gregory, Low-carbon reorientation in a declining industry? A longitudinal analysis of coevolving contexts and company strategies in the UK steel industry (1988–2022), Energy Res Soc Sci [Internet]. 1 (96) (2023) 102953. Feb. Available from: https://doi.org/10.1016/j.erss.2023.102953.
[69] F.W. Geels, F. Kern, G. Fuchs, N. Hinderer, G. Kungl, J. Mylan, et al., The enactment of socio-technical transition pathways: a reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014), Res Policy [Internet]. 45 (4) (2016) 896–913. May 1. Available from: https://doi.org/10.1016/j.respol.2016.01.015.
[70] K.S. Rogge, K. Reichardt, Policy mixes for sustainability transitions: an extended concept and framework for analysis, Res Policy [Internet]. 45 (8) (2016) 1620–1635. Oct 1. Available from: https://doi.org/10.1016/j.respol.2016.04.004.
[71] EEA, Sustainability transitions: Policy and Practice [Internet], European Environment Agency, Copenhagen. Available from: https://www.eea.europa.eu/publications/sustainability-transitions-policy-and-practice, 2019 Sep.
[72] R.K. Merton, Social Theory and Social Structure: [Internet], 3rd ed., The Free Press, New York, 1968, 1–698 p. Available from: https://edisciplinas.usp.br/pluginfile.php/4250035/mod_folder/content/0/Textos/Merton%2C%20Social%20Theory%20and%20Social%20Structure.pdf.
[73] Geels FW. Causality and explanation in socio-technical transitions research: Mobilising epistemological insights from the wider social sciences. Res Policy [Internet]. 2022 Jul 1;51(6):104537. Available from: doi:https://doi.org/10.1016/j.respol.2022.104537.
[74] D.J. Hess, Q.D. Mai, Renewable electricity policy in Asia: a qualitative comparative analysis of factors affecting sustainability transitions, Environ Innov Soc Transit [Internet]. 1 (12) (2014) 31–46. Sep. Available from: https://doi.org/10.1016/j.eist.2014.04.001.
[75] S. Salm, The investor-specific price of renewable energy project risk – a choice experiment with incumbent utilities and institutional investors, Renewable and Sustainable Energy Reviews [Internet]. 1 (82) (2018) 1364–1375. Feb. Available from: https://doi.org/10.1016/j.rser.2017.04.009.
[76] Stirling A. Pluralising progress: from integrative transitions to transformative diversity. Environ Innov Soc Transit [Internet]. 2011 Jun 1;1(1):82–8. Available from: doi:https://doi.org/10.1016/j.eist.2011.03.005.
[77] F.W. Geels, Reconceptualising the co-evolution of firms-in-industries and their environments: developing an inter-disciplinary triple embeddedness framework, Res Policy [Internet]. 43 (2) (2014) 261–277. Mar 1. Available from: https://doi.org/10.1016/j.respol.2013.10.006.
[78] Moritz J, McPartlin M, Tuomisto HL, Ryynänen T. A multi-level perspective of potential transition pathways towards cultured meat: Finnish and German political stakeholder perceptions. Res Policy [Internet]. 2023 Nov 1;52(9):104866. Available from: doi:https://doi.org/10.1016/j.respol.2023.104866.
[79] D. Süsser, N. Martin, V. Stavrakas, H. Gaschnig, L. Talens-Peiró, A. Flamos, C. Madrid-López, J. Lilliestam, Why energy models should integrate social and environmental factors: Assessing user needs, omission impacts, and real-word accuracy in the European Union, Energy Res. Soc. Sci. 92 (2022) 102775, https://doi.org/10.1016/j.erss.2022.102775.
[82] J. Markard, H. van Lente, P. Wells, X.-S. Yap, Neglected developments undermining sustainability transitions, Environ. Innov. Soc. Transit. 41 (2021) 39–41, https://doi.org/10.1016/j.eist.2021.10.012.
[81] Schneider DM, Goldwasser C. Be a model leader of change. Manage Rev [Internet]. 1998 Mar;87(3):41–5. Available from: https://www.proquest.com/scholarly-journals/be-model-leader-change/docview/206692157/se-2.
[82] B.M. Bulah, M. Tziva, C. Bidmon, M.P. Hekkert, Incumbent entry modes and entry timing in sustainable niches: the plant-based protein transition in the United States, Netherlands, and United Kingdom, Environ Innov Soc Transit [Internet]. 1 (48) (2023) 100735. Sep. Available from: https://doi.org/10.1016/j.eist.2023.100735.
[83] K. Ampe, E. Paredis, L. Asveld, P. Osseweijer, T. Block, Incumbents' enabling role in niche-innovation: power dynamics in a wastewater project, Environ Innov Soc Transit [Internet]. 1 (39) (2021) 73–85. Jun. Available from: https://doi.org/10.1016/j.eist.2021.03.004.
[84] Kirch Kirkegaard J, Cronin T, Nyborg S, Karnøe P. Paradigm shift in Danish wind power: the (un)sustainable transformation of a sector. Journal of Environmental Policy & Planning [Internet]. 2021 [cited 2023 Sep 27];23(1):97–113. Available from: doi:https://doi.org/10.1080/1523908X.2020.1799769.
[85] K. Hockerts, R. Wüstenhagen, Greening goliaths versus emerging Davids — theorizing about the role of incumbents and new entrants in sustainable entrepreneurship, J Bus Ventur [Internet]. 25 (5) (2010) 481–492. Sep 1. Available from: https://doi.org/10.1016/j.jbusvent.2009.07.005.
[86] Newell P. Towards a global political economy of transitions: a comment on the transitions research agenda. Environ Innov Soc Transit [Internet], 1;34:344–5, Available from, 2020 Mar, https://doi.org/10.1016/j.eist.2019.10.007.
[87] Wade R, Ellis G. Reclaiming the Windy Commons: Landownership, Wind Rights, and the Assetization of Renewable Resources. Energies 2022, Vol 15, Page 3744 [Internet]. 2022 May 19;15(10):3744. Available from: doi:https://doi.org/10.3390/en15103744.
[88] M. Wolsink, Contested environmental policy infrastructure: socio-political acceptance of renewable energy, water, and waste facilities, Environ Impact Assess Rev [Internet]. 30 (5) (2010) 302–311. Sep 1. Available from: https://doi.org/10.1016/j.eiar.2010.01.001.