



Working to align energy transitions and social equity: An integrative framework linking institutional work, imaginaries and energy justice

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ABSTRACT

Recent academic evidence suggests that, in contrast to what is often thought, the introduction of renewable energy infrastructures often leads to negative, not positive, social equity outcomes. Against this background, this paper aims to develop and empirically illustrate an integrative framework for analysing the work – or ‘agency’ – exercised by actors operating within and across different global contexts to align renewable energy and social equity. To this end, the paper first reviews three generative conceptions of agency in the energy transitions literature: institutional work, imaginaries and energy justice. In reviewing their explanatory power as well as their shortcomings, the paper concludes that these different conceptions of agency can be integrated meaningfully in an expanded conceptualisation of institutional work that spans three distinct domains: i) ‘reimagining’, ii) ‘recoding’ and iii) ‘reconfiguring’. This article demonstrates that the three domains can be understood to reiteratively feed into each other in what we call the ‘triple re-cycle’. These iterations produce either bolstering effects that strengthen the potential for positive social equity outcomes or evaporative effects that diminish or undermine this potential. We empirically illustrate the framework in case studies from Germany and South Africa. Overall, we argue that the triple re-cycle, as a heuristic, can provide new insights by conceptually connecting multiple domains of agency in energy transitions, including discursive and material aspects, across different global contexts. Our hope is that identifying potential agency in this way supports work to improve the social equity outcomes of energy transitions globally.

1. Introduction

The global transition from fossil to renewable energy infrastructures and escalating social inequities within and between countries are two of the most significant contemporary challenges in the shift towards a more sustainable world. In recent research, it is commonly argued that renewable energy developments have the potential to decentralise power and contribute positively to social equity [1–6]. However, empirical evidence suggests that the opposite effect is also a distinct possibility, meaning that the deployment of renewable energy infrastructure might have negative impacts on social equity [7–10]. This research stream describes how infrastructures for alternative energy sources, such as solar power and wind, are often built as megaprojects

[11,12] and characterised by highly financialised ownership structures [13]. It also demonstrates that new energy projects often lack appropriate structures for public participation [14,15], miss opportunities to meaningfully engage local and regional actors, and run the risk of further centralising socio-political and economic power [16,17]. Given the expected investment of trillions of euros in renewable energy infrastructures in the coming decade [18], we seek to answer the question of how, taking these sobering findings about structural conditions into account, renewable energy and social equity might be realigned by actors operating across different global contexts.

In studies of societal transitions, infrastructures are often seen as ‘socio-technical configurations’ embedded within institutions, networks and social practices and therefore subject to agency and politics [19,20].

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Yet understanding how actors exercise agency in socially constructing, opposing and redirecting socio-technical configurations is a research problem that seems difficult to resolve [21]. In the past decade, diverse scholars have developed nuanced perspectives on the agency of, and struggles between, actors in transition dynamics. A number of authors explore the ‘institutional work’ undertaken to change the ‘rules of the game’ [22,23]; multi-actor and multi-scalar interactions in transition processes [24,25]; how actors engage with and aim to transform power embedded in policy regimes [26–28]; the transformative power of imagined futures [29,30]; and the struggles between actors and institutional dynamics [31,32]. Within this varied body of work, there are multiple fruitful conceptions of agency, each of which stresses important aspects of the interactions between actors, material artefacts, institutional structures, and exogenous trends. Indeed, as Hoffman and Loeber [33] demonstrate, at least three distinct domains of agency at play in transformation dynamics can be distinguished in relation to the i) articulation of imagined futures, ii) shaping of rules for socio-technical change and iii) consolidation and transformation of material infrastructures. Hence, to capture the work entailed in aligning energy transitions and social equity, it is important to crystallise how the different conceptions of agency relate and interact to shape energy transitions for positive social equity outcomes.

To address this research gap, this paper offers an integrative framework that draws from complementary theoretical approaches to agency in energy transitions research. Given the diversity of perspectives on agency in the literature, more can be gained from integrating multiple perspectives than from adding entirely new theoretical perspectives [34]. Developing an integrative framework is a generative approach to this issue, as it seeks to combine multiple theoretical perspectives and identify new points of contact between them. To this end, we discuss the literature pertaining to three conceptions of agency, namely, institutional work, imaginaries and energy justice. In this paper, constructing the integrative framework entails integrating these perspectives on the mechanisms through which the introduction of new infrastructures and related changes in energy demand can lead to positive social equity effects (‘bolstering effects’), as well as the mechanisms through which this potential may evaporate (‘evaporative effects’).

The paper has three aims. Firstly, we aim to explore the explanatory power and shortcomings of these multiple perspectives, articulated through the concept of institutional work, imaginaries and energy justice, that focus on agency and its mechanisms. Secondly, we aim to operationalise these different conceptions of agency into an integrative framework that connects multiple domains of agency in energy transition dynamics with a specific focus on their potential for bolstering positive social equity effects as well as on the mechanisms resulting in evaporative effects. Thirdly, we aim to illustrate the heuristic and explanatory value of the integrative framework in two case studies from Germany and South Africa.

Together, these steps lead us to a framework that we call the ‘triple re-cycle’, a cyclical framework that integrates three domains of institutional work – ‘reimagining’, ‘recoding’ and ‘reconfiguring’ – and which emphasises its iterative and recursive nature. For each domain of institutional work in the triple re-cycle, specific mechanisms are identified that lead to the bolstering or evaporation of the potential for aligning energy transitions with positive social equity outcomes. The integrative framework of the triple re-cycle, and our operationalisation of it, allows for a newly differentiated yet integral view of the work of aligning energy transitions and social equity.

2. Developing an integrative framework: The approach

The integrative framework draws on a review of discussions of agency in energy transitions in five journals: *Energy Research & Social Science*, *Applied Energy*, *Energy Policy*, *Research Policy* and *Environmental Innovation and Societal Transitions*. In this section, we describe our methodological approach by first defining the key concepts for our

review (energy transitions, social equity and agency) and then explaining how we have employed the three different bodies of literature to develop our integrative framework.

2.1. Defining key terms: Energy transitions, social equity and agency

Energy transitions can be understood as shifts from one mode of producing and consuming energy to another (cf. [35,36]). This includes the replacement of sources and infrastructures as well as shifts in energy demand. Moreover, beyond just the substitution of one energy system for another, a significant body of energy transitions research is interested in the broader socio-political reordering implied [37]. In this article, we follow this broader understanding of transitions, which are sometimes called ‘transformations’ [38] but which we will refer to here simply with the term ‘transition’. Finally, because there are multiple energy transitions possible across geographical areas and over time [39], we deliberately talk about energy transitions in the plural.

Such a broader perspective on energy transitions supports our understanding of the two other key concepts, namely, social equity and agency. Social equity is a broad concept employed to investigate many different aspects of social life, from education to environmental conservation (cf. [40]). In theory, it would be possible to include all these in an analysis of energy transitions; however, like other researchers, we suggest a pragmatic approach to identifying social equity outcomes that can be directly linked to groups affected by an energy transition (cf. [41]). We purposely choose the notion of equity rather than equality because the former includes a moral assessment of whether or not the situation, and the structural elements that lead to a certain outcome, are fair [42,43]. Social equity is often explicitly seen as a social construct, subject to discursive and normative struggles about what counts as fair and what background conditions need to be addressed to arrive at more equitable outcomes [44,45]. This view also implies a sensitivity to differences in interpretation of (un)fairness across geographic and cultural contexts. In addition, it moves beyond a focus on the distributive aspect alone, providing a more expansive understanding that includes social, cultural, spatial, political and other structural inequities.

Whether energy transitions lead to social equity outcomes depends on agents actively fostering their alignment. Here we engage with ‘agents of change’ in the broadest sense, referring to diverse coalitions of actors, from incumbent players to households, implicated in animating, contesting and advocating for energy transition processes. In general terms, we define agency here as the ‘capacity to do things otherwise’ [46]. This ‘otherwise’ can mean different things: to struggle to maintain *existing* privileges and other social equity provisions in the process of infrastructural replacement (e.g., access to legal protection in planning) but also to create *new* social equity outcomes, such as enhanced autonomy of local communities. Following Emirbayer and Mische’s [47] discussion of agency, we see it as important to investigate agency not in a vacuum but rather as embedded in ties to multiple social environments and in different orientations to time. Specific actions, such as realising a new energy plant, always have effects on multiple scales and structures. In addition, actions, from articulating future visions to transforming existing infrastructures, have different orientations to time. While some are more future-oriented and others focused on changing existing conditions, they can be equally agentic.

2.2. Methodological approach

To develop the integrative framework, we draw upon three angles from complementary bodies of literature for investigating agency in processes of socio-technical transitions. A ‘body of literature’ can be understood as a set of academic writings from a certain period that engage a shared set of concepts to investigate similar topics. While the individual writings involved may significantly differ in their approaches, they can be said to form ‘a body’ because of their shared ways of conceptualising empirical realities. According to Sovacool et al. [37],

such bodies of literature can be seen as carriers of ‘epistemic communities’ with shared norms, beliefs and practices, defined by them as ‘an academic community of experts’ ([37]: 2). Such a view can be criticised, however, for assuming coherence and social integration between academics that is often absent. Indeed, for the bodies of literature we draw upon, as well as those studied by Sovacool et al. [37], the coherence across the world views of the academics involved is questionable, as is whether they engage with each other sufficiently that they can be said to form a community. We argue here that, while their coherency and social integration cannot be assumed, bodies of literature are useful for aligning conceptual constructs. Therefore, we focus on the specific constructs of agency that bodies of literature provide.

Our method is as follows. First, in the next section, we identify three bodies of literature that provide key conceptions of agency and explore their explanatory power and their shortcomings for investigating the work of aligning energy transitions and social equity. In section four, we employ the findings from this exploration to operationalise a more refined framework: the triple re-cycle. Important to developing the integrative work was a physical meeting between the co-authors in Freiburg, Germany, in May 2019, in which we collaboratively constructed a first version of the framework and tested its explanatory power, rigour and coherency in a field trip to EWS Schönau, a community-energy initiative in the neighbouring village of Schönau. In section five, we illustrate the triple re-cycle in two short case studies, one about EWS Schönau and one about an energy policy shift in South Africa. These case studies are based upon a secondary analysis of peer-reviewed sources. The case study from Germany also draws on insights from a workshop with members from EWS Schönau during the field trip.

3. Three conceptions of agency in energy transitions literature: Institutional work, imaginaries and energy justice

Based on our literature review, three conceptions of agency from distinct bodies of literature were identified: institutional work, imaginaries and energy justice. Drawing on different disciplines, analytical foci and conceptual histories (see Table 1), the perspectives provide a complementary outlook on different aspects of agency in societal change and, when combined, stimulate a more comprehensive approach.

In this section, we investigate the bodies of literature in terms of i) the key ideas within each perspective and ii) their respective strengths and weaknesses for investigating agency.

3.1. Institutional work

Background: Responding to the ‘institutional turn’ in transition studies [32], various authors have set out to investigate agency in energy transitions employing the concept of ‘institutional work’ (IW)

[23,54,55]. IW provides a lens on the practices in and through which actors create, maintain and disrupt institutional structures. Originally, Lawrence and Suddaby ([48]: 215) defined IW as ‘the purposive actions of individuals and organisations aimed at creating, maintaining and disrupting institutions’. By foregrounding the ‘work’ that is exercised in building supportive coalitions, negotiating rules and mobilising resources, this concept helps us to understand how efforts to change institutional structures take on particular forms.

The explanatory power of the IW concept is multiple. Firstly, as others [32,56] have observed, the concept of IW helps in investigating how actors contest and cooperate around the direction and pace of socio-technical transitions. Rather than seeing institutional change as a quasi-natural evolutionary process, it highlights the fluid and contested agency to maintain or challenge institutional structures. Secondly, the concept of IW helps us to understand how the dynamics in socio-technical configurations play out differently across geographic and cultural contexts: while specific socio-technical configurations are always rooted in local contexts, rules and discourses can travel between them. Such transportation requires a re-contextualisation in dialogue with existing structures [23,57]. Thirdly, the notion of IW helps to conceptualise how actors can exercise agency to challenge fundamental ‘rules of the game’ of energy transitions. Fourthly, what IW adds to the study of institutional change, compared to the related concept of institutional entrepreneurship [58], is the analysis of actors who actively defend and maintain current institutions [49]. In this respect, the IW framework fits well with transitions studies, taking into account the strategies of both challengers, niche innovators and regime incumbents as well as the interplay between them [33,59].

A number of shortcomings can be observed in how IW has been applied. Firstly, the literature on IW does not adequately engage with competitions between ideational differences, world views, discourses and future visions [49]. As Weik argues [60], it fails to see discursive elements as the outcome of social processes. This means that the literature links concepts like visions and frames to IW but that it does not explain *how* outlooks on the world and the future become shared and collectively held nor the work that goes into creating such collective performances. Secondly, IW scholarship often lacks attention to materiality [61]. In its original formulation, the conceptual apparatus in the IW literature focused on the role of humans in institutional change [62]. This has led to a stronger call for re-integrating the role of material artefacts in creating, mediating and sustaining courses of action (cf. [63]). Thirdly, the emphasis that IW literature puts on ‘purposive actions’ has been criticised for downplaying the role of unconscious routines and emerging dynamics, which, besides purposive actions, significantly co-constitute institutional change. According to Weik [60], the focus on purposive, individual action leads many IW scholars to overlook the ‘collective efforts, failures and repeated attempts, loops, feedbacks and interdependencies that the history of institutions is so rich in’ ([60]:

Table 1
Overview of the three literatures and their perspective on agency (modelled after Sovacool et al. [37]).

Literature	Disciplinary grounding	Analytical object and focus	Key concepts	Views on agency	Key references
Institutional work	Organisational theory and sociology	<i>Object:</i> formal and informal institutions <i>Focus:</i> work to create, maintain and disrupt institutions	Actors, institutions, fields, practices, rules of the game	Emphasis on work and the rules of the game. (predominantly present-oriented)	Lawrence and Suddaby [48], Beunen and Patterson [49]
Imaginaries	Science and technology studies, anthropology, political science	<i>Object:</i> Cultural and political practices as well as society writ large <i>Focus:</i> Collective performance and stabilisation of images of possible and desirable futures	Imaginaries, materiality, images, expectations, performance, collectives	(predominantly future-oriented)	Jasanoff and Kim [50]; Beckert [51]
Energy justice	Political science, geography	<i>Object:</i> Social interaction with energy infrastructures <i>Focus:</i> The production of diverse just and unjust social outcomes of energy systems	Practices, ‘tenets’ of justice (distribution, recognition, procedural, cosmopolitan)	Normatively oriented, problematising and overcoming inequities. (predominantly past-oriented)	Jenkins et al. [52]; Sovacool and Dworkin [53]

472). To overcome this obstacle, Beunen and Patterson ([49]: 23) redefine IW as ‘those actions through which actors attempt to, or in effect do, create, maintain, or disrupt institutional structures’. Defining IW so comprehensively, however, requires more rigour in differentiating and substantiating forms of IW.

3.2. Imaginaries

Background: the social sciences have a long-standing interest in how imaginaries shape social life (cf. [64]). Recently, this focus has been complemented with stronger attention to the struggles involved in ensuring that imaginaries are collectively adopted [50]. Jasanoff and Kim define imaginaries as ‘collectively held, institutionally stabilised, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order’ ([50]: 4). In recent years, the concept of imaginaries has been effectively applied in energy transitions research to investigate how underlying world views and visions of the future shape actions on the ground [65,66]; how imaginaries of fossil energy persist [67]; and how imaginaries and their public performances are actively contested or transformed and replaced by new ones [29,68,69]. These works show that conceptualising imaginaries as being actively produced helps to investigate how conceptions of possible, desirable and equitable energy futures come about and how these are collectively adopted and circulated and, in turn, shape how actors perceive possibilities for action.

The explanatory power of imaginaries for energy transitions research has multiple dimensions. First and foremost, this body of literature emphasises a key aspect of agency that is often overlooked: its future orientation [47]. Many social science studies narrowly define visioning and framing as strategic activities confined by given purposes and ambitions [70,71]. In contrast, the literature on imaginaries contributes an analytical sensitivity to the precariousness and instability of shared ways of seeing and experiencing, as well as the moments of discursive contestation, actual performances and material mediations that make collective ways of perceiving, thinking and acting possible. Next, an important strength is the link between imaginaries and complex, non-linear change, which is key to the relationship between energy transitions and social equity dynamics. Through the identification and circulating of imaginaries, actors can establish shared meanings across disparate local dynamics in energy transitions, notwithstanding the differences between contexts and the influences of different societal trends [72].

The shortcomings of the conceptualisations of imaginaries stem mainly from their theoretical abstraction. A weakness of this literature is that, thus far, it has focused mainly on analysing how the structuring effects of imaginaries come about rather than explaining where, exactly, the imaginaries originate. Hoffman et al. [73] address this shortcoming by drawing explicit attention to the act of *futureing*, which they define as ‘attempts at shaping the space for action by identifying and circulating images of the future, a process by which relationships between past, present and future are enacted’ ([73]: 3). Moreover, while the more recent literature on socio-technical imaginaries explicitly includes the role of social-material arrangements [50], the study of imaginaries tends to privilege the investigation of grand narratives and political efforts to maintain certain discourses (cf. [67]) over the nitty-gritty of (re)organising material infrastructures and their social equity outcomes in specific ways.

3.3. Energy justice

Background: A key literature for conceptualising agency in fostering or resisting efforts to improve social equity outcomes of energy transitions is the literature of energy justice. This novel literature has taken a prominent place in problematising the politics of energy transitions. Over the past decade, energy justice scholarship has identified multiple approaches for investigating and informing energy politics from a

pluralistic perspective on social justice [74]. Energy justice frameworks have predominantly conceptualised social equity in energy in relation to three key tenets of justice: distributive justice, procedural justice and justice as recognition [41,75]. Distributive justice relates to the distribution of wealth and other resources, procedural justice to planning and decision-making processes, and justice as recognition as that of socio-cultural identities. These tenets of justice also inform principles governing energy policy, such as availability, affordability, due process, transparency and accountability, sustainability, intergenerational equity, intra-generational equity, and responsibility [53]. In recent years, this set has been expanded, with restorative and cosmopolitan justice gaining importance [75].

The explanatory powers of energy justice all relate to the specific focus it contributes to the normative and moral dimensions of agency as well as the everyday lived experiences of energy transitions [76,77]. A first core strength of the energy justice literature is its capacity to observe the disparate ways in which social systems impact everyday activities and lived realities. In doing so, it enables an unpacking of the specific ways in which energy systems intersect with social systems to produce, potentially, unjust outcomes; the ‘agents of change’ that play a role in producing and resolving injustices; and potential ‘touch points’ for policy interventions. Secondly, it helps to identify the potential objectives of agency. Where the energy transitions literature offers a narrower ‘outsiders’ view around the development of energy systems, the energy justice literature enables a refined analysis of what drives people in practice, allowing for more nuanced and subtle analyses of agency and politics [78]. Thirdly, a specific strength lies within the interpretations of energy justice from a capability approach [79], originally introduced by Amartya Sen [43]. The capability approach draws attention to the structural conditions in which people conduct their lives and how these conditions are unevenly distributed – which provides a promising angle from which to investigate social equity in energy transitions.

The shortcomings of the literature on energy justice can be understood as follows. The most apparent shortcoming in the literature is that energy justice itself has a limited conceptualisation of agency, politics and change. In its consideration of ‘who’ brings about just change, most of the energy justice literature, in the end, turns to a broad notion of applying principles of fairness in policy frameworks [80]. This omission can be partly understood from the origin of energy justice and its close ties to social advocacy groups, from where, in the words of McCauley et al. ([81]: 321), the ‘[e]nergy justice literature has prioritised the influence of civil society organisations as the drivers for change’. Another important shortcoming is its empirical elaboration. In past years, various scholars have developed comprehensive typologies rooted in the diverse philosophies discussed above. Yet to be developed are more empirically oriented investigations of how specific notions are understood and acted upon in practice, in particular in relation to global contexts other than Europe and Northern Europe [82,83].

4. Operationalising the triple re-cycle framework

The preceding review brings together three distinctive vantage points on ‘the work’ entailed in animating, contesting and directing energy transition processes and their social equity outcomes. It highlights that the IW literature, along with displaying many strengths, suffers from multiple shortcomings that can be traced back to a narrow reading of IW in the literature that overlooks discursive and material aspects. We have also seen that the imaginaries and energy justice literatures may help to overcome these shortcomings. Here, we build on the identified explanatory powers and shortcomings in the presentation of our integrative framework. To bridge these perspectives in a generative manner, we organise our integrative framework around three distinct domains of IW, related to i) ‘reimagining’, ii) ‘recoding’ and iii) ‘reconfiguring’. We refer to this framework as “the triple re-cycle”. We intentionally use verbs to highlight the active character of work and consistently add *re-* to stress its iterative and recursive nature. Moreover,

we see these domains of work as actively feeding into one another, together constituting a range of mechanisms with the potential to realise positive social equity outcomes (bolstering effects) or to evaporate this potential (evaporative effects). Below we explore and visualise these constitutive domains of IW.

4.1. Reimagining the direction and outcome of energy transitions

The first domain of IW, *reimagining*, refers to the stabilisation, displacement and transformation of existing imaginaries. It highlights that creating, maintaining and disrupting institutions is always based upon shared worldviews, or imaginaries, that give meaning to the world and future possibilities, including a normative commitment to desirable outcomes [50,84]. In Section 3.1, we observed that how imagined futures are collectively adopted, performed and institutionalised, and the work involved, has been largely overlooked. With the addition of this conceptual category, we address this shortcoming and explicitly incorporate into our integrative framework a focus on the agency involved in collectively adopting a vision of the future that actually shapes actions in the present – what is usually called their ‘performativity’ [85].

The agency in reimagining the social equity outcomes of energy transitions is understood here in terms of the work that goes into the collective adoption of shared ways of looking at the world and the future. We see reimagining as the work that goes into shaping possibilities for action by identifying and circulating images of the world and the perspectives on possible and desirable futures embodied within them. We refer in particular to the process by which such images are turned into ‘collectively held and performed visions of desirable futures’ [50]. The challenge for researchers, as well as for agents engaging in IW in the energy transition, is to capture precisely how some images of the future, as opposed to others, become collectively held and how they become ‘performative’ in shaping actions in the present.

Analytically, research could consider how certain images of the future and interpretations of social equity are identified, performed, institutionally stabilised, and circulated and who is positioned to do so. Oomen et al. [84] stress the particular ‘dramaturgy’ through which images become collectively adopted and performative through the developed storylines, the staging of events, and the practices and structures the actors involved navigate. In a related fashion, research could investigate the discursive struggles and conflicting narratives in the formation of discourses around energy infrastructures. From a perspective on imaginaries, a relevant question is how actors ‘staging’ alternative performances in practice might enable the imagination of radically different futures that, over time, displace and transform dominant imaginaries.

4.2. Recoding the rules guiding energy transitions

The second domain of IW is what we call *recoding*. This domain pertains to the rule sets, artefacts, and instruments that make up institutional structures. With this terminology, we follow Easterling’s [86] generative metaphor of seeing rules guiding the realisation of infrastructure as a form of ‘spatial software’ that, like any operating system, can be coded to shape particular infrastructure spaces and their social equity outcomes. Recoding refers to the work that goes into shaping stable ‘codes’ for actors working on specific infrastructure configurations. The work of recoding neatly covers the different activities in the IW literature related to the creation, disruption and maintenance of institutions. Recoding can refer to the disruption and creation of new institutions but also the active maintenance of institutions that promote social equity. Indeed, in transition processes, institutions actively need to be adapted and reinscribed, and often fought for, to continue to exist.

Defining IW in terms of *recoding* helps to comprehensively define how agency in socio-technical transitions is mediated by material artefacts, a point that is often missed in the IW literature. The notion of *recoding* helps to see how rules ‘travel’ to specific sites of materialisation

and how these ‘codes’ mutate and manifest across diverse contexts, shaping, for example, the building, financing, operation and maintenance of material infrastructures. Of relevance here, for example, is how wind energy parks are built and operated in particular ways, privileging some socio-economic activities and discouraging and disclosing others (cf. [10]). This means that understood in this way, IW in energy transitions can be effectively conceptualised as processes and social struggles over the *recoding* of infrastructure realisation, where ‘recoding’ refers both to the active re-inscription of existing institutions into new infrastructures as well as to the inscription of alternative institutions for social interaction.

In addition to including a stronger perspective on agency and materiality, this framing helps to overcome other shortcomings. By explicitly including the ongoing interaction between institutions, infrastructure configurations and their social equity outcomes, it creates a perspective on how IW builds up and changes over time as specific ‘codes’ are adopted or contested. This helps to overcome the limited focus on specific episodes for which Beunen and Patterson [49] criticised the IW literature. Moreover, it incorporates the understanding that IW is premised upon specific ideas and imaginaries about desirable futures and normative commitments that, in the process, are creatively translated from abstract notions and images into concrete codes that actors can leverage in practice.

Analytically, there is no one specific locus for investigating this kind of work besides the shared concern with the coding of rules and other institutional elements. An investigation of recoding can be locally oriented towards the work involved in developing organisational structures and procedures to foster social equity; it can also focus on the national and transnational routines and norms that guide investors across contexts. One of the main analytical challenges – widely identified in the IW literature – is to explain how, and under which conditions, actors succeed in socially, politically and materially stabilising certain codes and undermining others. Drawing on the literature on policy instruments (cf. [87]), another analytical perspective could investigate how and where particular policy instruments are promoted and recalibrated and how they impact the configuration of energy infrastructures [88]. Lastly, the work of recoding enables the investigation of the structuring of financial processes in energy transitions. The ‘codes’ identified and circulated, in the words of Bridge ([89]: 17), ‘do the work of material differentiation so that electrons, fuels or consumer durables in these markets are no longer the same, allowing investors and consumers to allocate capital based on this information with the goal of driving changes in patterns and rates of use’.

4.3. Reconfiguring infrastructure in energy transitions

The third building block of our integrative framework is *reconfiguring* socio-material infrastructures. This last domain of work highlights that the IW around *recoding* is premised on, and constantly interacts with, how actors on the ground act upon institutions in practice, such as the building, operating, maintaining and recycling of energy infrastructures. Whereas IW is typically understood to engage with changing and maintaining rules that govern everyday action ‘at a distance’ [90], *reconfiguring* refers to the work exercised in infrastructural configurations themselves: developing technical and financial know-how, building capacity, and the work involved in the active repair and maintenance of infrastructures [91,92]. While this ‘down to earth’ work is easily overlooked, it is crucial for the social equity outcomes of energy transitions. The actual meaning of formal and informal rule sets in practice will be determined by how and when they are acted upon in practice, for example, how actors learn to adopt and work with rules. By linking the work of *recoding* to the work of *reconfiguring*, we include a focus on the agency that people have in practice *vis-a-vis* the formal and informal codes that come to them via policy rules, industry standards models, incentives, targets and so on.

Analytically, the focus here is both related to the design and

materialisation of energy infrastructures and the shaping of energy use. Research can focus on how infrastructures are socially and spatially embedded, including how they are owned and operated and how actors build capacity in and through horizontal networks. From the energy justice literature, we learn that the social practices around infrastructures, such as household activities, are an important analytical entry point. Here, an important analytical challenge is to conceptualise how the realisation of energy infrastructures and their social equity outcomes relate to broader social dynamics, such as shifting cultures of consumption and social engagement. Another pertinent concern is how reconfiguring relates to energy demand, the vast inequities between countries in this respect, and the possibilities for alternative, low-carbon lifestyles.

4.4. Visualising the triple re-cycle

Having elaborated the conceptual foundations of our integrative framework, we now move to describe and visualise the triple re-cycle. We argue that the three manifestations of IW described above – reimagining, recoding and reconfiguring – need to be investigated in their mutual interaction. In Fig. 1, we represent this visually, first showing the ‘cyclical’ relation between reimagining, recoding and reconfiguring. A particular imagination is inscribed in a particular coding, which subsequently leads to a material effect, the configuration of renewable energy infrastructures. Yet this cycle is reiterated, as the manifestation in particular material configurations plus its outcomes leads, depending on political activism or other ‘work’, to new reimaginings that, depending on IW, lead to further recoding.

This framework can be employed to identify the mechanisms through which the deployment of renewable energy infrastructures can coproduce positive social equity effects (which we call ‘bolstering effects’). An example might be the development of a code that creates a local chain of value added, ensuring that financial investments benefit local residents. Moreover, we seek to identify the mechanisms that undermine these potential effects (which we call ‘evaporative effects’). In the latter case, the cycle is broken, and the potential ‘evaporates’, as in the case of private equity investment in renewable energy projects exploiting public subsidy schemes that are paid for by domestic consumers. As such, the framework helps to capture how over time, through multiple iterations, IW gradually can create a socio-material context more conducive to social equity.

5. Empirical explorations of the triple re-cycle

To illustrate and test the triple re-cycle framework, we first discuss the prominent and pioneering case of a local energy cooperative, EWS Schönau in Germany, that emerged as the country began leading the way in the global renewable energy revolution. Thereafter, we explore South Africa’s utility-scale renewable energy programme and problematise the efforts to configure the ‘rules of the game’ in this competitive auction scheme to respond to the country’s national development imperatives. These cases emerge out of different phases in the evolution of the global energy transition, and, despite their social, political and spatial distinctions, they demonstrate the explanatory and heuristic value of the triple re-cycle in grappling with the alignment between energy transition processes and social equity concerns.

5.1. EWS Schönau, Germany: A pioneering energy cooperative in the Black Forest

The small town of Schönau in the Black Forest has risen to prominence as a pioneering example of a community-led energy initiative in Germany. It has its roots in a movement of parents from the region following the Chernobyl disaster in 1986 who then formed the association ‘Parents for a Nuclear-Free Future’ [93]. The Schönau group pursued several avenues of IW to materialise their vision. Through their

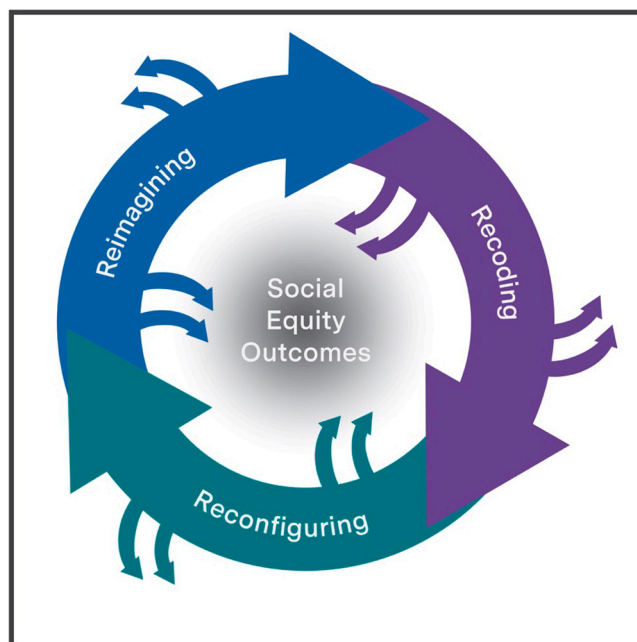


Fig. 1. The triple-re framework for investigating the alignment between the energy transition and social equity, with inward arrows indicating bolstering effects and outward arrows indicating evaporative effects.

sustained efforts, in the weeks and months that followed the melt down, an imaginary of a nuclear-free future through an ecological, efficient and decentralised energy system emerged. This imaginary gained traction and has served as an example for community-energy initiatives that have evolved in other parts of Germany. In retrospect, the case of Schönau can be viewed as a turning point in the community-based movement against nuclear energy that drove the early phases of the renewable energy revolution.

Initially, recoding work focused on overturning the Energy Industry Act. This Nazi-era act was problematised as an anachronistic construct that justified monopolies through the military logic of the Third Reich (ibid). In the context of a bundled electricity market, it enabled grid operators (also sole electricity suppliers) to supply primarily nuclear electricity. However, the Schönau group concluded that there was no political will to overturn this law (ibid). In response, the Schönau group sought to ‘take matters into their own hands’. For five years, the group worked to reconfigure local electricity consumption practices through a successful electricity savings campaign designed in the form of a competition. The campaign mobilised around 140 households, the local gymnasium, and a hospital. It resulted in a 20 percent average reduction of electricity consumption within the first year and drew media attention to the ‘Schönau electricity rebels’ (ibid).

Soon after, the Schönau group realised that the shift to nuclear-free electricity required local autonomy over the grid itself. This marked a moment of rearticulation of the broader imaginary of a nuclear-free future, which was stabilised into a new code: the local energy cooperative as an alternative to the nuclear-based corporate model of the energy system. To materialise the vision of an efficient, green, locally owned and citizen-financed system of energy distribution and provision, the Schönau initiative set out to establish a cooperative and buy back the distribution grid from the private grid operator (ibid.). The initiative saw a window of opportunity in the approaching deadline for the renewal of the concession contract. Anticipating that the municipal council would vote to retain the existing concessionaire, the recoding work of the Schönau group this time built on the instrument of the referendum. To cut a long story short: in July 1997, after a set of further political and administrative struggles, extensive networking and cooperation with sympathetic energy-market and technical experts, and a

national crowdfunding campaign, the grid was returned to the hands of citizens (ibid).

Multiple aspects of social equity were inscribed in the energy-cooperative code and have been bolstered through continued institutional work. Firstly, mitigating the intergenerational and spatial inequities caused by nuclear energy has been seamlessly adopted with respect to fossil-fuelled electricity generation in the cooperative's engagement for climate justice. Secondly, the cooperative exercises control over the procurement and supply of electricity from renewable and cogeneration plants. Thirdly, local ownership of the grid ensures that revenues remain in the hands of cooperative members. Currently, EWS Schönau has over 5,000 cooperative shareholders and multiple subsidiaries specialising in the design, funding and building of onshore wind farms, PV systems, small hydropower plants and combined heat and power systems. Specific rules to subsidise renewable electricity and smaller cogeneration units have also been set in place [94]. From its headquarters in the small Black Forest town, the Schönau cooperative continues to engage in political work at federal and European levels to promote a transition to an equitable, decentralised, nuclear-free and climate-friendly energy system.

5.1.1. REIPPPP: Economic development in South Africa's utility-scale renewable energy programme

Faced with a supply-side electricity crisis in the late 2000 s, and in response to global climate change commitments, the South African government in 2009 initiated a process to design a policy instrument for the procurement of utility-scale renewable energy [13]. Initially, these explorations focused on the design of a feed-in tariff; however, by this time, competitive auction mechanisms had become the globally dominant modality for utility-scale renewable energy procurement [88]. In South Africa, instead of a feed-in tariff, the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) was conceptualised as a competitive auction mechanism favouring utility-scale infrastructure, one that maintained the centrality of Eskom (the national utility) and reinforced the dominance of national governance of the energy sector [59]. In short, the imaginary shaping the introduction of renewable energy into the country's socio-technical electricity system was congruent with, rather than disruptive of, the country's political economy of energy, entrenched in the 'Minerals Energy Complex' [13,59].

Institutional work is evident in how the competitive auction mechanism was coded. Alive to the country's unique socio-economic context and responsive to the state's political directives and the efficacy of trade union and civil society lobbies, policymakers coding the REIPPPP recognised that the RE infrastructures that would inevitably materialise would be landing in spaces with major socio-economic development challenges [95]. The coding of the REIPPPP took into consideration a social equity agenda by including several economic development (ED) targets within the price-competitive auction mechanism. Independent Power Producers (IPPs) are required to fulfil criteria related to job creation, local content, ownership, management control, preferential procurement, enterprise development and socio-economic development. Importantly, these ED criteria were balanced with price competitiveness in a 30:70 ratio, signifying a departure from the standard requirement in public procurement of a 10:90 split – an innovation for which the REIPPPP has been widely recognised [96].

Speaking to its configuration, since its inception in 2011, the REIPPPP has attracted unprecedented investment through a transparent and competitive procurement mechanism and contributed to South Africa's climate mitigation efforts. By 2021 the REIPPPP had attracted more than R200 billion in investment and materialised around 100 utility-scale renewable energy projects dispersed across the country [13]. Much of the success of the procurement framework has been attributed to its stringent and comprehensive design, together with ongoing adjustment and improvement. Overall, early bid windows were largely oversubscribed, but the programme demonstrated continual

learning and iteration [96]. Recoding has been evident through adjustment and refinement, including pre-defined capacity caps and ceiling prices that were not disclosed to bidders to ensure competition [96].

The implications for social equity outcomes of encoding specific ED requirements have been multifaceted, particularly with respect to the governance of place-based investments by IPPs in local communities. Enacting the 'rules of the game' has resulted in various unintended consequences, many of which have evaporated the potential for meaningful local participation and economic development. For example, while local communities within a 50 km radius of renewable energy projects are eligible for a minimum of 2.5 % ownership therein and have discretion over how dividends are spent, this does not equate to commensurate decision-making power within the project's management [95]. Another example of the tension induced by the encoding of ED requirements is that IPPs direct socio-economic and enterprise development investments into rural communities that often lack critical infrastructure services [95]. In this case, local communities adjacent to renewable energy projects might benefit from enterprise development training but remain disconnected from reliable and affordable energy services.

Through the design and implementation of the REIPPPP, and because of responses from diverse actors within the electricity sector, a process of reimagining has been triggered. A decade into the programme, the REIPPPP has begun to chip away at the century-old imaginary of how and where electricity is produced and consumed. The laudable concession by policymakers to include ED criteria in the configuration of the REIPPPP that exceeded the conventional targets for public procurement programmes demonstrates the iterative nature of the domains of institutional work at play in transition processes as well as the ever-looming risk of evaporating the potential for enhanced social equity.

6. Conclusion

This paper began with the observation that it is not a foregone conclusion that energy transitions will lead to positive social equity outcomes; the question is, indeed, one of agency. We started by evaluating three generative conceptions of agency in energy transitions: institutional work, imaginaries and energy justice. We demonstrated that the literature on IW provides a useful conceptualisation of agency that takes seriously the active shaping of structural contexts but that it has important shortcomings regarding discursive, material and normative dimensions. Thereafter, we demonstrated that the literatures on imaginaries and energy justice provide elements to overcome these shortcomings. Based on this exploration, we concluded that the work necessary to align energy transitions and social equity could be well understood by a more comprehensive understanding of IW that spans three distinct domains: i) 'reimagining', ii) 'recoding' and iii) 'reconfiguring'. Together, the three domains provide both a more comprehensive and refined understanding of agency in socio-technical transitions. We presented them as a cyclical framework, 'the triple re-cycle', in which these domains feed into each other reiteratively. These iterations, illustrated in the two cases, produce either bolstering effects that strengthen the potential and realisation of positive social equity outcomes or evaporative effects that diminish or undermine this potential.

The construction of the triple re-cycle framework offers a range of insights for researchers and practitioners. Firstly, we demonstrate that IW in energy transitions should entail far more than the literature usually refers to and that this enriched view comprises linked but discrete identifiable activities. Moreover, we show that these discrete domains of IW can be effectively combined into one heuristic framework, the triple re-cycle, and still be operationalised. This integrative framework demonstrates that it is meaningful to identify connections between the agency exercised by diverse agents of change (transnational investors, social movements, local initiatives, etc.) at different scales and with

different time frames. Indeed, whether the work of these actors leads to bolstering or evaporative effects will depend on the resonance between the three domains of IW. As the case study of the REIPPPP demonstrates, the success of an energy initiative will often depend upon simultaneous work to continually calibrate and change policy rules.

Secondly, and relatedly, the paper demonstrates that adding a discursive perspective to IW enables a more dynamic understanding of agency in energy transitions. We make this point by presenting the shaping of rules, and the materialisation of infrastructures, as processes that constantly and actively interact with the ongoing construction of narratives about desired futures – as we so convincingly witnessed in the case of Schönau. As such, the work of recoding policy rules and reconfiguring infrastructures can be directly connected to the discourses that inform them, which, in turn, are constantly renewed. Hence, we also draw particular attention to the actors involved in the work of making discourses, codes and expertise ‘travel’, mutating and manifesting across diverse contexts.

Lastly, the explicit connection between materiality and IW shines a new light on the discussion about ‘purposiveness’ in IW, which has been critically discussed by various authors [49,60]. The analysis in this paper demonstrates that agency in energy transitions can be effectively understood in terms of the coding of values, ideas and principles into the material and spatial construction of energy infrastructures. While actors can reflexively shape coding processes, they are interspersed with unintended outcomes and surprises, as well as unconscious factors such as implicit rules and routines. Often, actors will only gradually and reflexively become aware of the way in which energy infrastructures shape social equity outcomes and of the need to change the way they are imagined and coded in policy rules – hence the emphasis on the iterative and recursive ‘loops’ of the cycle. Nevertheless, the way actors collectively experience material artefacts and their social and spatial impact is key to actors’ sense of agency and purposiveness in aligning energy transitions with positive social equity outcomes.

The triple re-cycle framework provides new tools and insights for researchers and professionals but comes with its own limits and shortcomings as well. The framework is intended mainly as a modest heuristic framework that can be critically interrogated and further refined. The approach – with its focus on agency – can potentially be complemented by an analysis of related concepts like ‘politics’ and ‘power’, which we have touched upon only lightly. Yet, we believe, the real value of this framework will have to follow from in-depth empirical investigations and transdisciplinary engagements with stakeholders across different global contexts. An important focus should be mechanisms that create bolstering and evaporative effects specific to certain socio-political, economic and geographic contexts. We also see an important challenge for research to identify and engage all relevant agents of change, including financial actors, who are often overlooked in studies of social-technical transitions. In the end, they will need to do the hard work of aligning energy transitions and social equity outcomes in a structural way across diverse contexts.

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

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