



Original research article

# Speeding-up wind energy developments: Exploring notions of acceleration and justice in regions within Germany and the Netherlands

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## ABSTRACT

The rapid expansion of low-carbon energy technologies across European regions has been argued to be essential in tackling climate change, necessitating the transition of energy systems towards renewable energy technologies, including wind energy. To accelerate wind energy developments, policies have been put in place to speed up planning and implementation in several European countries in recent years. However, the impacts of these policies remain uncertain, seeing that historical developments have been characterized by accelerations and slowdowns, including actions against wind energy that point to diverse justice issues. Research examining the relations between acceleration and justice in low-carbon transitions is limited, with some studies highlighting the trade-off between rapid developments and just processes and outcomes. Drawing on qualitative case studies from Brandenburg (Germany) and North Holland (Netherlands), this paper develops a heuristic of spatial and temporal aspects to investigate how accelerations in wind energy developments have played out and how relations with notions of justice have emerged and/or been sustained over time. It underscores the importance of creating nuanced understandings of acceleration and justice while accounting for temporal and spatial aspects to be able to govern towards more just and accelerated energy transitions.

## 1. Introduction

The imperative of combating climate change necessitates the acceleration of the widespread adoption of low-carbon technologies across Europe. Studies have emerged investigating accelerations in sustainability transitions [1] and in transitioning towards renewable-based energy systems [2]. Ambitious policy targets in Europe focus on decarbonizing energy systems to address energy security issues and contribute to broader sustainability transitions [3]. This includes accelerating the expansion of wind energy. Governments have responded with regulatory and legal changes, aligning with industry efforts [4]. Amidst these initiatives, actions against wind energy have emerged and professionalized over time, pointing to diverse social, environmental, and economic considerations [5]. Conventional explanations for such disputes, such as NIMBY arguments and/or low social acceptance framings, have faced criticism for oversimplifying the complex realities on the ground [6,7]. To advance the work, it has been recognized that what is at stake are notions of justice [8].

Given the historical separation of justice and acceleration issues in

low-carbon energy transitions in the academic literature [9], scholarly investigations into their interrelations are limited [10,11]. One prevalent dynamic discussed is the potential trade-off between acceleration and justice, with one jeopardizing the other (ibid.). However, Skjølsvold and Coenen [9] have recently argued for the need to move away from such dualist perspectives for a more nuanced analysis of the interrelation between acceleration and justice. As part of their work, they draw attention to paradoxes that emerge within accelerated transitions and complementarities between acceleration and justice, when considering diverse temporal and spatial aspects of transitions. Building on this work and drawing on the conceptual work of accelerations towards sustainability transitions and notions of justice, the paper aims to answer the following research questions: *How have accelerations in wind energy developments played out, and in particular, how have relations with justice issues emerged and/or been sustained? In how far does an investigation of the temporal and spatial aspects of wind energy allow for a more nuanced understanding of acceleration and justice relations?*

To achieve this aim, we have identified spatial and temporal aspects linked to acceleration and justice issues in sustainability transitions

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through a literature review and empirically investigated their relations within wind energy over time. Employing a qualitative case study approach, we collected new empirical evidence to compare regional wind energy developments in Brandenburg, Germany, and North Holland, the Netherlands. Analyses unveiled how policies and governance, modes of participation and institutional conflicts in wind energy, as well as structural conditions and local histories and experiences with wind energy, have shaped accelerations and slowdowns of wind energy over time, drawing attention to emerging and prevailing justice issues. We argue that acceleration and justice relations have emerged and shifted over time and have rarely been considered in combination when governing wind energy, often perpetuating injustices and institutional and local conflicts rather than addressing them. Our paper contributes to the work on acceleration and justice by moving towards a more nuanced understanding of their relations and by providing a heuristic to investigate them to be able to govern towards more just and accelerated transitions.

The introduction is followed by our conceptual framing (Section 2) and an outline of our mixed methods research design (Section 3). It then tells a chronological narrative and outlines a thematic analysis of wind energy developments in Brandenburg and North Holland (Section 4). We offer a discussion of the cases capturing three themes of wind energy linked to acceleration and justice issues (Section 5) before concluding the paper (Section 6).

## 2. Conceptual framework

Addressing multiple environmental challenges such as climate change and biodiversity loss has been argued to require accelerating transitions towards climate-neutral production and consumption systems. Much scholarly work has gone into researching ways of governing deep and rapid energy transitions towards sustainability [1]. As part of this work, several challenges [12], contradictions, and paradoxes [9] associated with the acceleration of sustainability transitions have been identified. More recently, this work has drawn attention to justice issues, including aspects of participatory governance and resistance [10,12]. Notions of justice, including different foci such as energy justice, climate justice, or environmental justice, have gained popularity over the past decade, often drawing on analysis of environmental justice movements [13]. Based on the multidimensional aspects of just transitions, a framework including distributional, recognitional, restorative, inter-generational, and procedural dimensions has been developed for energy justice work [8]. Much research has gone into better understanding and improving the modes of participation and distribution of benefits and burdens of renewable energy to make wind energy developments more just [14,15].

Links have only recently been forged between literature on the acceleration of transitions and notions of justice, shedding light on the multiple ways in which they may interrelate [9–11]. Scholars have argued that although participatory processes can facilitate more just transitions, they might also impede the acceleration of sustainability transitions. Participatory processes might for example be jeopardized, and accelerations emphasized, potentially fostering anti-democratic tendencies that favor elites while limiting the access of vulnerable communities to decision-making processes. The acceleration of sustainability transitions might also entail favoring large-scale projects that promise short-term returns on investments, but neglect pathways aimed at promoting just transitions. Implementing participatory processes could also be a strategy for state leaders to deflect responsibility for unpopular acceleration decisions to citizens and delay and/or avoid decisions.

Arguing for more responsible acceleration, Skjølsvold and Coenen [9] have drawn attention to the need to develop less dualistic perspectives and more nuanced approaches to understanding acceleration and justice. To do so, they turn to two types of discussions, the temporal and spatial aspects of transitions [16]. Such aspects have also been

considered crucial for understanding the social dimensions of wind energy such as social acceptance and protests against wind energy [17–19]. For instance, Gailing et al. [18] (p. 1) have highlighted several overarching spatial dimensions within energy, including a) energy infrastructures having their specific socio-materialities and spatialization, b) energy policymaking being shaped by diverse territorial governance boundaries (such as local and regional), and c) energy transitions being reconfigured by different spatial patterns of social, cultural, and economic developments and everyday practices. Such dimensions have material consequences for landscapes and infrastructures and can result in uneven and contested spatial developments (see also [20,21]). Scholars have worked with concepts such as energy periphery [26] and space related stigma [24], highlighting the co-production of uneven geographical developments and structural conditions linked to low-carbon energy. Literature on the temporal aspects of energy has been more dispersed but its importance is recognized [22]. Temporal aspects include a) past events, processes and experiences shaping and influencing developments in the here and now, b) temporal narratives linked to social and technological developments such as speed and slowness, c) temporal aspects linked to the governance, construction and distribution of technologies, and d) broader socio-political processes intersecting with technological expansions over time. History shapes current and future social orders and trajectories, notably in the realm of advancing energy transitions. The concept of temporality encompasses both material elements, like the temporal frameworks embedded within various technologies and infrastructures, and relational aspects, such as the emotional urgency instilled in issues like climate change (ibid.). These temporal considerations intersect with the broader socio-political landscape, impacting the pace and direction of societal change, particularly in response to pressing challenges like transitioning to low-carbon energy technologies. Spatial and temporal aspects have played a key role in the reconfiguration and reproduction of social, cultural, and economic developments, allowing for a deeper understanding of structural dynamics and relations of how inequalities and vulnerabilities are created and maintained over time and space [9,21]. Based on reviewing this work, we developed a heuristic of spatial and temporal aspects (see Table 1) to investigate acceleration and justice relations within wind energy developments and create more nuanced understandings of these relations over time.

Building on the spatial and temporal aspects of low-carbon energy transitions and associated justice issues outlined above, the results section presents chronological narratives of wind energy developments in two regions over the past 15–20 years. It examines key empirical data that allow for an investigation of the interplay between acceleration and justice over time, leading to a more nuanced understanding of these relations.

## 3. Methodology

To answer our research question, we explored wind energy developments in two European regions: Brandenburg, Germany, and North Holland, the Netherlands. We focused on these regions and countries due to their long history in wind energy to be able to study changing acceleration and justice relations over time. Moreover, they were chosen due to their key differences in terms of geographical location and energy governance and due to recent efforts to accelerate the expansion of wind energy after periods of slowdown.

The fieldwork was carried out between January 2023 and December 2023 as part of an EU-funded research project investigating wind energy governance in Europe. This resulted in comprehensive, country/region-specific case study reports, outlining the emergence and developments of wind energy since the 1990s and its governance over time [38,39]. In total, 15 in-depth interviews were carried out with policymakers, majors within municipalities, wind energy developers, wind energy planners, and citizen initiatives such as energy cooperatives, and fellow academics (see Appendix A). We gained an overview of key organizations through

**Table 1**  
Spatial and temporal aspects linked to low-carbon energy transitions and related justice issues.

Short description of spatial and temporal aspects	Dimensions linked to the spatial and temporal aspects	Relations to justice issues in wind energy	Example articles
Spatial governance:	1) Spatial organization of political power and political control of space (e.g. regional governments).	* How is political power organized and exercised linked to the spatial arrangements of wind energy?	[5,18,23]
Spatial aspects associated with regulating, planning, and constructing low-carbon energy projects and their politics.	2) Political decisions and processes that have spatial consequences (e.g. spatial targets, planning).	* How is space allocated for wind energy: Who decides and how? What is compromised and/or prioritized in these processes?	
Spatial distributions:	1) Geographical distribution of low-carbon energy infrastructure, including also issues of material size, proximities of infrastructures to settlements, and relations between the spatial allocation of the consumption and production of energy.	* Where are turbines and infrastructures being constructed, or not (and how, e.g. what types of participatory processes exist)?	[5,23–25]
Spatial aspects linked with the distribution of energy infrastructures and their impacts such as benefits and burdens in more-than-human worlds (from local to global).	2) Distributions of burdens and benefits linked to wind energy and associated participatory processes that determine some of this distribution.	* How are burdens and benefits of wind energy spatially distributed and through which processes? How and in how far have more-than-human actors a voice in these processes?	
Spatial conditions and structures:	1) Uneven spatial developments between territories linked to low-carbon energy with the potential to perpetuate existing spatial differentiations, territorial power dynamics, and uneven social and economic resources.	* How have uneven spatial developments and vulnerabilities in territories influenced the development of wind energy (e.g. where wind turbines have been built, whether participatory processes have been made use of?).	[9,19,23,24,26–30]
Uneven past and future geographical developments linked to resources, vulnerabilities, and low-carbon energy (from local to global).	2) Existing and potential future vulnerabilities in territories linked to low-carbon energy (e.g. capacities to participate in these developments, change one's situation by moving away).	* What types of new patterns of uneven spatial developments between territories have emerged over time?	
Spatial narratives and identities:	1) Place identities (their histories), spatial narratives and territorial stigma enacting certain behavior and materialities in processes and decision-making about energy.	* How have space identities, narratives, and stigmas played a role in the just development of wind energy (e.g. where wind turbines have been built, acceptance of wind energy has emerged)?	[18,23,24,27]
Spaces and their associated narratives, stigmas, and identities.		* How do actors make use of these identities, narratives, and stigmas to accelerate (or not) wind energy? How are justice issue implicated in these developments?	
Governance time:	1) Temporalities associated with political processes of creating strategies, regulations, etc. linked to low-carbon energy.	* How do the temporal aspects linked to planning and permitting wind energy influence justice issues?	[9,11,17,19,22]
Temporal aspects associated with regulating, planning, and constructing low-carbon energy projects and their politics.	2) Temporal agendas of politicians for and against building low-carbon energy.	* How do political processes across governance levels and their temporalities influence decision-making around wind energy? Who has the power to influence these processes and who benefits and bears the burdens?	
Participatory time:	3) Setting temporal targets to achieve certain low-carbon energy aims.		
Temporal points in time where actors are invited to participate in low-carbon energy developments and/or lobby, protest, etc. to make their perspectives and interests heard and attempt to achieve their aims.	4) Bureaucratic time that impacts, e.g. the planning of low-carbon energy	* How are participatory processes conducted in wind energy (who can participate, at what time, etc.)?	[9,17]
	1) Participatory and democratic processes linked to low-carbon energy (from protests to attending information events) and points of engagements.	* How do temporal agendas of stakeholders influence participatory processes in wind energy?	
	2) Temporal agendas of wind developers and citizens for and against building low-carbon energy and finding ways and strategies for these agendas being heard.		
Infrastructure time:	1) Physical time that it takes to plan, built, and maintain low-carbon energy.	* Who benefits or bears the burdens from the lifecycle impacts of wind energy turbines from extraction to end of life over time?	[2,22,31,32]
Temporal aspects linked to the materiality of the lifecycle of low-carbon energy infrastructures (from local to global).	2) Material commitments and resources linked to the construction of low-carbon energy.	* How does the materiality of wind turbines determine the temporalities of wind energy developments with what implications for justice issues?	
	3) Lifetimes of low-carbon energy infrastructures.		
Historical time:	1) Daily experiences of living with low-carbon energy.	* How have daily, past experiences and memories with wind energy developments co-shaped existing practices and experiences (including, e.g., ownership models, value creation, human/nature relations)?	[19,22,33,34]
Temporal aspects associated with daily, past, and intergenerational energy experiences and memories (from local to global).	2) Past experiences and memories of low-carbon energy, including intergenerational relations.		
Transition time:	1) Narratives linked to the need for rapid and urgent transitions due to the impacts of climate change including discussions on possible influences on democratic processes.	* What are the impacts of urgency narratives on the just development of wind energy? How can these impacts be addressed?	[1,2,11,16,17,35–37]
Temporalities linked to the dynamics of transitions towards sustainability and narratives linked to its urgency due to climate change.	2) Relations and learnings derived from (often slow and gradual) historical and low-carbon energy transitions.	* How do the temporalities of sustainability transitions influence the just development of wind energy?	

preliminary internet searches and informal talks with gatekeepers. Next to the data from the in-depth interviews, we carried out a media analysis and supplemented it with literature reviews, and observational data. Previous scholarly work on the topic derived from Web of Science, Scopus, and ScienceDirect databases was analyzed, as well as practitioner reports, press releases from relevant organizations, and government documents. In total, the document review encompassed 50–60 documents per case study. The media analysis aided the process of gaining an initial understanding of the historical developments surrounding wind energy. LexisNexis was used to select relevant newspaper articles relating to wind energy in the case study regions. This included 1284 articles between 1994 and 2023 in Germany and 386 articles between 2014 and 2023 in the Netherlands.

In terms of analysis and validation, in-depth interviews were fully transcribed and/or summaries also including direct quotes were sent to the interviewees to verify what they have said during the interviews. Afterwards, the interviews were coded and analyzed using qualitative software tools. Based on the case study reports, a literature review on temporal and spatial aspects of low-carbon energy transitions was conducted. Special attention was given to the relation between spatial and temporal lenses and narratives of acceleration and justice within the selected papers. Insights from this review have been used to develop the heuristic of spatial and temporal aspects for investigating the relation of acceleration and justice in wind energy development (see Table 1). Empirical evidence from the Brandenburg and North Holland case studies has been synthesized and mapped onto these aspects.

**Table 2**  
Highlighting temporal and spatial aspects linked to acceleration and justice in wind energy in Brandenburg.

Social/temporal aspect	Exemplary empirical description	Illustrative evidence
Historical time	Lack of acknowledgement of past experiences with energy systems during transition processes: As a result of the German reunification, the non-competitive coal sector of the former German Democratic Republic collapsed and more than 90 % of employees lost their jobs, which often brought sociocultural devaluation and status-related downgrading [46]. These experiences led to a widespread sentiment that certain voices are not heard or misrepresented, which continue to affect the region [46].	“Instead of a union [between East and West Germany] ... there was only an accession. The results for the East are well known: 70 % deindustrialization... four million unemployed...” [47] (p. 51).
Spatial conditions and structures	Limited adoption of community-based approaches to wind energy due to spatial conditions and structures: Energy cooperatives, seen as an important approach for increasing regional value creation, have been established in several regions in Germany but faced stagnation in the new federal states during the German Democratic Republic era. Furthermore, differences in income structure and available capital resources persist between the new and old federal states, posing investment challenges for residents and communities. Inheritance in the new federal states is only half as prevalent as in the old states, contributing to substantial wealth disparities.	“And what is less common in Brandenburg compared to Schleswig-Holstein, for example, are energy cooperatives, because wind energy is, of course, expensive. It involves sums of money that require a certain level of courage. And we simply have a lower density of wealth here. First, due to the population density and also due to income and wealth levels. This is indeed a fundamental problem or challenge” (Interviewee 1).
Spatial distribution	Uneven geographical distribution of wind energy and associated costs: With significantly more wind energy being developed in North/East Germany compared to the South/West, there is an uneven geographical distribution of wind energy in Germany. This has led to financial burdens for residents in areas with larger amounts of wind turbines as high electricity prices driven by escalating grid expansion charges are being passed on to consumers in the regions.	“Because looking at Germany as a whole, the countries that are far ahead in the expansion of renewables have high electricity prices. It’s a paradox at first, because renewables produce cheap electricity. But to complete and connect the wind energy parks, lines must be laid everywhere, and these expansion costs are not distributed nationwide, but regionally. And that this is unfair, and this perception is extremely widespread” (Interviewee 1).
Participatory time	Professionalization of actions against wind energy over time: Most wind parks have mainly been built and operated by international wind companies without legal obligations to offer financial participation since the 1990s. Anti-wind energy groups have played a role in delaying and stopping projects early on based on diverse issues. Over the past decade, actions against wind energy have become more professionalized [48]. Recently, a levy for municipalities has been enshrined in the Renewable Energy Act (EEG). Still, this might not be enough, with some residents claiming “they just want to buy us” (Interviewee 5).	“When it comes to renewable energies, the main thing is that resistance has become much more professional over the last ten years. Whereas in the beginning there were individual initiatives, there are now nationwide initiatives. Brandenburg is at the forefront with the initiative ‘Rettet Brandenburg’, which has a bundling function: it provides networks, also expert networks and argumentation aids” [49].
Spatial governance	Decreasing lack of support for wind energy at regional and local governance levels: Reservations towards wind energy grew at the municipal level, as exemplified by the 2018 Bernau Declaration which called for halting wind turbine construction in forests and ensuring a minimum distance from settlements [50].	“If local politicians reject wind turbines for whatever reasons, that sentiment tends to spread among the population. These narratives circulate publicly, such as claims that the community gains nothing from the turbines, can’t do anything to oppose them, or doesn’t want them in protected landscapes. [...] I believe that local decision-makers play a crucial role in shaping public opinion” (Interviewee 3).
Transition time	Tension between federal government wind energy acceleration measures and federal state level restrictions: The ambitious federal government’s Easter Package, aimed at accelerating wind energy arrived in Brandenburg amid the ongoing moratorium, highlighting tensions between federal government acceleration measures and federal state level restrictions. Brandenburg currently faces a transitional phase with no regional plans in place. This creates uncertainties for municipalities, as well as a feeling of being overwhelmed by the many new regulations.	“On the one hand, the climate crisis is escalating. On the other hand, the Russian invasion highlights the importance of phasing out fossil fuels and consistently promoting the expansion of renewables. We are doing this boldly and consistently” [51].
Governance time	Shortage of skilled labor to fulfil federal government wind energy expansion ambitions: The introduction of the Easter Package (2022) requires regional planning communities to identify ‘wind priority areas’ where wind energy takes precedence over other interests. While some interviewees argued that this could potentially simplify planning, these changes occurred during a time when plans were declared invalid by past court rulings, and now must be re-drawn based on a different approach. The process is anticipated to be lengthy and legally intricate due to unaddressed challenges such as shortages of skilled labor in permitting authorities and lengthy process time. This particularly affects smaller municipalities.	“Wind power tends to occur where smaller communities are located, simply due to distance regulations and so on. This has implications for several things but particularly with regards to approval procedures and participation processes. In these municipalities, there are often individuals assigned to these tasks, who might have ten-tenths of a position which in other communities ten different individuals, each specialized in their field, would handle” (Interviewee 1).

Regarding the methodological approach, this paper has certain limitations when considering the heuristic of spatial and temporal aspects. The empirical data collection focused primarily on the historical wind energy developments in the two regions, drawing attention to local, regional, and national relations but less so to global justice issues linked to, for instance, the material lifecycle of low-carbon energy. For the analysis of the paper, we therefore focused on comparing spatial and temporal aspects that were most relevant to answering our research questions.

#### 4. Results

This section presents our results which are first organized as a chronological narrative of wind energy developments in each region over the past 15–20 years, pointing to key changes and policy developments. Second, we make use of the heuristic of spatial and temporal aspects (see Table 1) to highlight key empirical data that enable us to investigate acceleration and justice relations over time (see Tables 2, 3) based on an analysis of the case studies. To highlight changes over time, we structured Tables 2, 3 based on the historical narrative of the cases rather than using the structure of Table 1, outlining first the spatial aspects after tuning to the temporal aspects.

##### 4.1. High expansion rates and slowdowns, including recent attempts to accelerate wind energy in Germany: a Brandenburg narrative

Brandenburg is one of Germany's new federal states and is situated in the northeast of the country surrounding Berlin. The region is known to be an energy-exporting federal state, producing more energy than it consumes, initially due to extensive lignite coal mining. After the German reunification, the federal state government developed a pilot program for financially supporting renewable energy production in Brandenburg, leading to the installation of the first wind turbines in 1991 [40]. From the onset, most wind turbines in Brandenburg have been owned by international wind companies. Although business models differ, they are often investment-based and open for (trans-)national investments, so most of the profits do not stay in the region [41]. Anti-wind energy initiatives have played an important role in Brandenburg. Early on actions against wind energy emerged and from 2012 onwards, protests have intensified in the federal state, while the federal government pushed ahead with the expansion of renewable energy [42,43].

Due to increasing disputes over wind energy among various stakeholders, a phase of cautious reorientation began in 2018 regarding the wind energy development in Brandenburg. Political parties increasingly recognized the need to address social acceptance issues through local value creation. This need was raised by residents but also municipalities, anti-wind initiatives, local businesses, etc. This sparked the pivotal introduction of the 6-Point Plan by the federal state government [38]. The plan led to a series of legislative developments such as a special levy for municipalities near wind turbines and an expansion of the regional assembly to include municipalities with fewer than 10,000 residents in wind energy decision-making. Alongside these developments and following objections regarding the designation of wind energy areas in regional plans, the Higher Administrative Court of Berlin-Brandenburg invalidated the regional plan from Havelland-Fläming due to formal errors, followed by numerous other regional plans in subsequent years. Consequently, a wind energy moratorium came into force in May 2019, halting the authorization of wind turbines in affected planning regions for two years [44].

Following a period of relative stagnation in wind energy development after 2017, the topic regained momentum during the federal election in September 2021. A new coalition government came into power with the aim to accelerate the expansion of wind energy in Germany, culminating in the adoption of the so-called Easter Package in summer 2022. Deemed the most substantial legislative overhaul in

energy policy in decades [45], it represented a critical moment of change that paved the way for far-reaching changes in wind energy developments in Brandenburg [38]. Besides raising the renewable energies target to 80 % in gross electricity generation and introducing/modifying several legislations, the aim was also to ease planning and permitting processes. Consequently, municipalities have had to adjust their planning and permitting processes, including ensuring compliance with the defined wind energy areas targets of 2 % (Interviewee 1, 2).

##### 4.2. Resistance, decentralization, and turning towards the sea: a narrative from North Holland

North Holland, a province in the northwest of the Netherlands, ranks fourth in installed onshore wind capacity among the Dutch provinces, with 1800 MWh of wind energy generated in 2022 [52]. Home to the capital Amsterdam and a large swath of rural areas, North Holland was an early adopter of onshore wind technology in the 1990s. However, increasing resistance stemming from past experiences has stalled onshore wind energy development (Interviewees 8, 12). The 2013 Energy Agreement introduced a target of 685.5 MW in installed onshore wind capacity by 2020 for North Holland and placed decision-making power for onshore renewable energy development within the jurisdiction of the provincial government (Interviewee 10; [53]). After the provincial government attempted to institute a moratorium on wind energy development, these targets were treated with "authoritative reluctance" [53] (p. 9), leading to an estimated 50 proposed turbines being turned down between 2013 and 2019 [54]. In the meantime, anti-wind opposition was further fueled by plans for the largest Dutch onshore wind park, located in the northeast of the province [55].

In 2019, the Climate Agreement reoriented onshore renewable development with the introduction of a national target of 35 TWh in installed capacity by 2030 [56]. Moreover, decision-making power was shifted from the provincial to the sub-provincial and municipal level with the Regional Energy Strategy (RES) regions. 30 RES regions were devised, each responsible for setting regional targets and plans in a bottom-up manner. In the two RES regions of North Holland, local participation and a fair distribution of impacts were selected as guiding principles for onshore development [57]. To achieve 2030 RES targets, project permitting should be completed by 2025. However, permitting is currently hampered by multi-year delays in updating national legislation to account for a more decentralized energy system, ongoing resistance to onshore wind, and grid capacity issues [56,58,59]. This has led the Dutch government to shift attention offshore, doubling its offshore targets in 2022 to realize 38 and 72 GW of installed capacity by 2027 and 2050, respectively [60]. To this end, the North Sea Programme was launched to serve as the basis for allocating offshore wind development sites that balance efficiency, safety, and a healthy ecosystem [61].

#### 5. Discussion

Our empirical investigations point to more nuanced understandings of acceleration and justice relations in wind energy developments. In this context, acceleration can refer to phases of rapid expansions in wind energy and policy narratives and measures that aim to overcome slowdowns and/or support rapid expansions. Justice often remains a conceptual lens to study wind energy developments rather than making up policy narratives and measures, seeing that such issues are frequently framed around the acceptance of wind energy. Acceleration and justice relations have emerged and shifted over time and have rarely been considered in combination when governing wind energy [10,11]. Three themes have emerged from our analytical work pointing to differing acceleration and justice relations: 1. Processes of periphery creation: Notions of acceleration justice going beyond wind energy; 2. Shifting and co-shaping acceleration and justice relations within wind energy over time, and 3. Whose responsibility is acceleration? Notions of justice in governing wind energy. These themes are discussed in turn in the

**Table 3**  
Pointing to the temporal and spatial aspects linked to acceleration and justice in wind energy in North Holland.

Social/temporal aspect	Exemplary empirical description	Illustrative evidence
Historical time	Governments navigating between support and resistance for wind energy development over time: North Holland was an early and eager adopter of modern wind turbines in the 1980s with a local energy cooperative-led development [62]. With the liberalization of the Dutch energy market in 1998, corporate interests prevailed and larger developers arrived using a top-down approach leading to local conflicts in the early 2000s [63]. The ensuing wind energy development mainly occurred in rural areas, and resistance in these areas grew as development accelerated. On the other hand, residents of urban area searched for opportunities for citizen-led wind energy developments [53,64]. Resistance in rural areas was a motivating factor for the introduction of restrictive wind energy zoning ordinances by the provincial government in the 2010s, blocking many proposed projects stemming from urban areas [54].	“Energy distributors were inexperienced in the planning of decentralized facilities and often used a top-down planning approach ignoring public discussions on the local governmental level. These discussions concerned aspects such as landscape value, beliefs about interference such as noise hindrance, and financial benefits. Ignoring these local interests created conflicts at the community level.” [62], p. 404
Spatial conditions and structures	Structural constraints impeding financial participation in wind energy: While there is increasing attention to financial participation in onshore wind projects, financial constraints in economically impoverished areas provide barriers to this kind of participation, with limited planning capacity in municipalities, and constraints in investment resources on behalf of residents to ‘buy-in’ to projects (Interviewee 8). With onshore development stalling, a focus on top-down offshore developments has increased over time, depoliticizing wind energy developments in doing so.	In reference to the degree of local participation in RES projects: “The larger municipalities (in terms of organization and economic strength) do that and the smaller municipalities don’t” (Interviewee 8).
Spatial distribution	Urban-rural divide within wind energy developments: The development of onshore wind turbines is more prevalent in rural areas, while much energy is being consumed in urban areas, leading rural areas to feel that they do not benefit from wind energy development. For example, the national government-led development of the Wieringermeer wind park led to massive protests, as local residents felt inadequately considered, with benefits instead flowing to the international developer and allegedly to newly built Microsoft data centers nearby ([55]; Interviewees 8 and 12).	“No new windmills in the tip of North Holland... We look at it [Wieringermeer] and we don’t receive the energy. We don’t get the money. We do suffer” (Interviewee 12).
Spatial governance	Increased autonomy and responsibility to govern wind energy at sub-national levels: Under the 2013 Energy Agreement, to expand renewable energy production, national control of offshore wind tendering was increased, while provinces were assigned onshore targets and made responsible for most wind energy developments – directly opposing provincial plans in North Holland to curb those. Further acceleration of renewable energy development was to be reached by the Climate Agreement and the ensuing introduction of the RES regions in 2019 [65] where also the role of municipalities increased, shifting both increased autonomy and responsibility to the (sub)regional level (Interviewee 8, 10).	Since 2019, municipalities play an increasingly important role: “The RES has designated search areas, and it has now reached a stage where municipalities much investigate those search areas in order to come up with concrete proposals. Those municipalities must determine how they want to do this in their own local regulations and rules. If you don’t record anything, then citizen participation is a losing game as soon as project developers come in [...] [Energy cooperatives] lack the financial resources and decisiveness to record this. [Financial participation] is only possible if it is guaranteed by a government ruling that required 50 % or 100 % local ownership” (Interviewee 8).
Participatory time	Professionalized participation processes and resistance against wind energy: The introduction of the RES, with its extensive participatory process, resulted in the designation of search areas for development, regional targets and guiding principles with regards to participation and a fair distribution of benefits and burdens [57]. While participation is gaining traction onshore, it is largely absent in offshore wind development processes (Interviewee 10). In addition, over time anti-wind sentiments have professionalized, exemplified by the establishment of Wind Alarm in 2020 to systematically prevent the inclusion of wind in RES search areas by pointing to other alternatives (Interviewee 12).	“... these [Wind Alarm] were highly educated people [...], who partly work at NGOs, for example at environmental organizations. That means they know how to campaign very well. And the enormous counter-campaign against what in my view was a careful search process of the [Amsterdam] municipality. [...] that has really heated up the discussion; development was delayed at least a year” (Interviewee 12).
Transition time	Increasing renewable energy production targets and move to a focus on offshore development: National targets for renewable energy development have been increasing from the 2013 Energy Agreement to the 2019 Climate Agreement and the 2022 transposition of the REPOWER EU plans – all to accelerate renewable energy development. Especially in 2022, driven by persistent resistance to onshore wind energy projects and increasing support for offshore alternatives, the energy crisis due of the Russian-Ukrainian war, exacerbated by the overloading of the onshore electricity grid, the Dutch government doubled its offshore wind energy targets.	“[The 2022 energy crisis] has led to two interesting developments. Fossil fuels [prices] have skyrocketed, increasing the business case for renewable energy. Secondly, driven by high energy prices, sustainability has accelerated. Citizen and parties want to use less energy and more renewable energy. But that means they want to use more electricity, less gas, which leads to grid congestion. We don’t have a silver bullet for that yet” (Interviewee 11).
Governance time	Tension between the definition of search areas for wind energy and multi-year delays in national legislation: Agreeing upon search areas has proved difficult, with the 2022 energy crisis and local protests demanding the expansion or contraction of search areas, respectively (Interviewees 8–12). The legal binding of search areas is anticipated for late 2024, after which permitting for all wind turbines and solar panels is to be completed by early 2025 [66]. Also, there are multi-year delays in the implementation of renewed national legislation (Environmental Act, Energy Act) meant to account for a more decentralized energy system [58,59]. Their unclear status means that RES boards currently hesitate to solidify permits to avoid double work down the line to adhere to new legislation (Interviewee 12).	“Timing issues are also present [in the RES], which are an obstacle. The timescales associated with obtaining a connection to the grid, granting subsidies and issuing permits – for projects for [...] wind energy on land – are not or poorly coordinated” [56].

following three sub-sections.

### 5.1. Processes of periphery creation: notions of acceleration and justice going beyond wind energy

As highlighted in the spatial justice literature, regional developments can be in themselves (in)just as well as be the processes that create (in) just outcomes [67]. Consequently, low-carbon energy transitions (including wind energy and their accelerations) as regional developments can perpetuate and/or alleviate social (in)justices linked to variations in geographical characteristics and their histories. Although such perpetuations and alleviations have been studied and pointed out in the spatial justice literature, they are often neglected in the literature on wind energy. Both cases show how wind energy developments can be analyzed as processes of creation of peripheries [29,68].

Brandenburg is exemplary as a case of resource periphery, as it represents an area that possesses abundant energy resources but has relatively poor economic, social, and political power. Resource peripheries have limited influence over decision-making processes and retain minimal economic profits from investments [69]. An important context for understanding wind energy developments in Brandenburg has been the German reunification and the subsequent decline of industries in the region [46]. These experiences continue to shape the region today, where ways to enable local value creation have only been recently implemented for wind energy and there is a marginal cooperative movement to diversify governance and ownership approaches (ibid.), often perpetuating and creating new patterns of uneven development based on wind energy over time. Addressing procedural and distributional justice issues might not be enough as these often do not account for structural dimensions and historical inequalities (see also [19]) i.e. underlying causes of injustices [21].

More recently, understandings of peripheries have been broadened to also include process perspectives, while considering them as being dynamic and fluid over time [70,71]. In North Holland, we see that developments of and resistance towards wind energy have historically stemmed from rural areas, while in recent years the shift towards a focus on Dutch offshore wind energy is a development that demonstrates changing processes of peripheralization. This shift by the national government placed the interests of onshore resistance over the risks to human and more-than-human actors in the North Sea, transforming the periphery of the coastline into an energy periphery by putting wind turbines out of sight from local residents and municipalities [72]. These developments show that attempts to accelerate wind energy can draw attention to processes of peripheralization that displace the politics of acceleration and justice by moving wind energy offshore and in the process attempting to depoliticize wind energy. Both cases show that acceleration and justice relations do not occur within a vacuum but are linked to broader processes of periphery creation. These processes also extend beyond wind energy and are connected to underlying causes of justice such as structural dimensions and historical inequalities and attempts to displace and depoliticize contested low-carbon energy developments.

### 5.2. Shifting and co-shaping acceleration and justice relations within wind energy over time

Our empirical investigation points to different temporalities in wind energy composed of accelerations, slowdowns, stagnations, etc. as well as changing discourses and practices surrounding the need to address (or not) the acceptability of wind energy with different (spatial) justice implications. These have influenced each other and therefore create

diverse acceleration and justice relations that co-shape each other over time. In both cases, we see that long histories of protest against wind energy have only recently translated into new governance approaches. Both cases show that resistance to wind energy has primarily emerged because of initial experiences with expansions in the regions. Both are related to the advent of international developers using mainly top-down approaches to wind energy development. Political reactions concerning the local distribution of benefits and burdens only occurred over time and after protests against wind energy could no longer be ignored, which slowed and stopped developments.

Whereas in Brandenburg social acceptance issues have mainly been addressed through local value creation considerations since 2018 (such as the introduction of a levy), in North Holland, both participation and benefit distribution are considered in the RES approach. In North Holland, the creation of the RES regions shifted the decision-making power away from the province towards municipalities, who vote on the approval of wind energy search areas within their boundaries and develop a locally tailored framework for enforcing participation in local projects. An emphasis on participatory processes is thus more pronounced in the Netherlands. Although novel governance approaches have emerged, protests against wind energy prevail in both regions. Resistance groups have professionalized in recent decades, moving from distributed actions to setting up diverse networks and organizational structures [43]. Such developments have led to some opponents acquiring concrete expertise in the planning, financing, etc. of wind energy which they have started to use to stop and slow down projects in Brandenburg as well as North Holland (Interviewee 12; [41]). In North Holland, they have also empowered others to negotiate terms around how wind energy should be developed and for whom.

Such changing relations between acceleration and justice are often neglected in the existing literature but are key to creating more nuanced understandings. Low-carbon energy technologies (including wind energy) have been introduced with little justice considerations, shaping patterns of acceleration and justice relations over time. Considering the professionalization of resistance to wind energy, it can be argued that both the introduction of the 6-Point Plan in Brandenburg and the RES regions in the Netherlands have come too late for some areas with high levels of resistance to wind energy where it has become difficult to shift narratives and protests against wind energy. Eichenauer [5] has pointed to the need to find modes of engaging with and recognizing conflicts, which does justice to the demands of a pluralistic democracy and might also entail a recognition of past injustices since the start of wind energy developments in the regions [73].

### 5.3. Whose responsibility is acceleration? Notions of justice in governing wind energy

Much focus has been put on local residents and the general public in discussing issues of acceleration and justice in wind energy. Our findings draw attention to institutional conflicts and tensions across governance levels when it comes to governing wind energy, in particular at points of slowdowns and accelerations [74]. National governments (partly due to European Union legislations) have been busy legislating and regulating policies with the aim to accelerate transitions, whereas the implementation of these renewable policies has been mainly a local government responsibility, drawing attention to several tensions that can occur between governance levels. As argued by Koelman et al. (ibid.) local issues are often not considered in wind energy policies.

In Brandenburg, the introduction of the Easter Package, including wind energy area targets, emerged when there had been a moratorium on wind energy due to a lack of legal regional plans, slowing down

developments and even stalling expansion during the time. The introduction of the Easter Package was meant to address these issues but has currently led to a situation where some municipalities wonder how they will meet the wind energy area targets and what might happen if they do not. As some obstacles have not been addressed, such as a shortage of skilled labor in permitting authorities, drawing up new wind energy plans might take years. In North Holland, the governance of wind energy has shifted and changed over time. For example, in the years prior to the introduction of RES regions, the urban areas of Amsterdam and Harlem were limited in developing wind energy due to restrictive provincial provisions, which prioritized rural anti-wind agendas. While the introduction of the RES regions addressed this issue, municipalities with smaller capacities for energy planning now struggle to implement the iterative and participatory processes involved in RES projects, made no easier by delays in national legislation. The role of municipalities should not be underestimated as it has been signified by past reservations and increasing mobilization against wind energy at the municipal level in both regions [75] (for example, the signing of the Bernau declaration in Brandenburg), often slowing the process. While the national government has been recently busy creating legislation for accelerating transitions, less time has been spent on increasing the resources and capacities within lower governance levels responsible for implementation, creating tensions and uncertainties at the lower levels.

Our findings show that acceleration is not a uniform policy agenda and responsibilities between government levels are often blurred. The different levels have their own temporalities and interests and “multi-tier strategies” [74] (p. 394) that concern aspects of wind energy developments and influence their agency, capability, and power in governing these processes. As highlighted by Brisbois [76], governance for decentralization can be most appropriate if it is broadly participatory and assigned to the lowest level but also ensures adequate capacities, financing, and powers that are lacking in both regions. The lack of capacities, finance, and power draws attention to several justice issues that are also implicated in the governance of wind energy across its different levels.

## 6. Conclusions

With this paper, we set out to understand how accelerations in wind energy developments relate to justice issues. We introduced a focus on temporal and spatial aspects of wind energy to allow for a more nuanced understanding of acceleration and justice relations through a literature review. We then empirically investigated their interrelations within wind energy by introducing and comparing regional wind energy developments in Brandenburg, Germany, and North Holland, the Netherlands. Our findings show how policies have been put in place in both regions with the aim to accelerate expansion of wind energy, after phases of slowdowns and delays. Efforts to accelerate wind energy have not been straightforward due to continuing actions against wind energy as well as institutional conflicts between governance levels. First, slowdowns and rapid expansions of wind energy are linked to processes of periphery creation that point to how wind energy developments can perpetuate social injustices linked to variations in geographical characteristics and their histories that can be based on underlying structural inequalities and displacements of contested developments. Second, many of the political concerns surrounding the ‘acceptance’ of wind energy seem to have come too late for some areas with high levels of resistance where it has become difficult to shift narratives and actions

against wind energy. Much more work needs to go into how to proactively engage with conflicts [5]. This might also entail recognizing the harm done since the start of wind energy developments in the regions and possible responses to past injustices. Finally, the misalignment of temporalities, interests, capacities, resources, and responsibilities between governance levels needs to be considered when wanting to accelerate wind energy expansions, considering that they have been key issues for slowdowns in the past. Justice issues can also be linked to shifting governance levels and their resources to govern contested low-carbon energy developments.

Drawing attention to the geographies of low-carbon energy transitions, Bridge et al. [23] have argued that future research needs to aim to understand transitions as spatially constituted, rather than considering them as processes that have an impact on people and places. As seen in this paper, the same counts for temporal aspects of transitions. Analyzing the spatial and temporal aspects of low-carbon energy transitions and histories linked to energy infrastructures allows for studying justice issues as inherent in transition processes rather than mere outcomes and part of processes of individual projects. Making use of the spatial and temporal heuristic has helped us to foreground questions about a) considering preexisting social conditions and structures, underpinning, and/or maintaining injustice that are rarely taken into account when exploring acceleration and justice relations, b) unpacking patterns of uneven developments creating differing acceleration and justice relations that change and co-shape each other over time, and c) drawing attention to acceleration being not a uniform policy agenda and their own temporalities and interests, pointing to different and changing justice issues. By turning attention to spatial and temporal aspects of acceleration and justice relations within low-carbon energy transitions, we hope to have further enriched the work on acceleration and justice discussions while taking the first steps away from more dualistic understanding towards more nuanced approaches to understanding these relations.

## CRedit authorship contribution statement

**Sabine Hielscher:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Julia M. Wittmayer:** Writing – review & editing, Methodology, Conceptualization. **Sophie Progscha:** Writing – review & editing, Writing – original draft, Investigation. **Audrey Wientjes:** Writing – review & editing, Investigation. **Helen Sharp:** Investigation.

## Declaration of competing interest

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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## Appendix A. Overview of interviewees

#	Position	Date & duration
Case study Brandenburg		
1	Mayor within municipality in Brandenburg	04-08-23; 60 min
2	Mayor within municipality in Brandenburg	21-09-23; 120 min
3	Two wind energy project developers	24-07-23; 90 min
4	Academic researcher	23-03-23; 60 min
5	Academic researcher	09-01-23; 90 min
6	State politician (previously working on energy)	05-09-23; 75 min
7	Regional government representative	19-09-23; 60 min
Case study North-Holland		
8	Community energy cooperative coordinator	08-05-23; 90 min
9	Regional government representative	31-05-23; 60 min
10	Regional government representative	31-05-23; 60 min
11	Regional government representative	06-06-23; 90 min
12	Director of an environmental organization	16-06-23; 60 min
13	Two project managers from an environmental organization	22-08-23; 60 min
14	Researcher from an environmental organization	03-10-23; 60 min
15	Academic researcher	17-10-23; 60 min

## Data availability

The authors do not have permission to share data.

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