



Incumbents' enabling role in niche-innovation: Power dynamics in a wastewater project

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ABSTRACT

More pluralised understandings of incumbencies are often overlooked in transitions research, which may lead to underestimating the enabling roles of incumbents in niche projects. This study explores these roles by applying a power framework to five struggles revolving around a path-breaking decentralised wastewater treatment project in the city of Ghent (Belgium). Remarkably, incumbents from multiple regimes use power to enable the niche project. The study identifies and discusses four patterns in the enabling role of incumbents in niche projects. These patterns are clarified by focussing on incumbents from multiple regimes, belonging to local authorities, neighbouring and more distant regimes, as well as on the power of structural trends related to the urgency of sustainability challenges. As such, the study contributes to the understanding of multiple incumbencies and the conditions under which these may reinforce niche projects. For practitioners, the study underscores the role of power dynamics in the water/wastewater sector.

1. Introduction

Persistent environmental problems result from long-term, complex, unsustainable consumption and production patterns and require fundamental change in socio-technical systems that provide, for example, energy, food, transportation and water (Köhler et al., 2019). So far, progress has been rather limited in achieving long-term sustainability objectives (EEA, 2019; UN Environment, 2019) because of vested interests and path-dependencies of existing infrastructure and current political-economic institutions. Here sustainability transitions research has shown how established actors or incumbents and their practices resist, delay or prevent transitions (Geels, 2014; Hess, 2014; Klitkou et al., 2015; Smink et al., 2015; Wells and Nieuwenhuis, 2012). Within a given regime, incumbents 'often have vested interests in maintaining the status quo rather than enabling transitions and will often act to strategically protect their privileged position' (Johnstone et al., 2017, p. 148) and they 'tend to be powerful, materially resourceful, politically influential, societally authoritative, strategically conservative and risk-averse' (Sovacool et al., 2020, p. 3). Yet incumbents are also increasingly being recognised as important in accelerating transitions because of their dynamic capabilities (Stalmokaitė and Hassler, 2020), radical technology strategies (Berggren et al., 2015) and ability and interest to mobilise resources (Hansen and Coenen, 2017). Given

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the urgency of addressing the different global challenges, including the development of strategies that ‘build back better’ after Covid-19, the involvement of incumbent actors could accelerate transitions towards more sustainable societies. In this context, [Turnheim and Sovacool \(2020\)](#) call attention to the diversity of incumbent actors and strategies, the transient nature of strategic positioning and the varied resources incumbents may mobilise. They propose to investigate ‘how more pluralised understandings of incumencies can lead to novel insights’ (p. 183).

A number of scholars of sustainability transitions have similarly sought to overcome the typical interpretation of a monolithic and single regime that consists of resistant incumbents who have to be overthrown by radical niches. At least four different approaches can be distinguished to understand incumbents’ roles. Some research has directed attention to the role of multiple regimes and systems. For instance, it has been shown that multi-regime dynamics can be induced by radical innovations that cross traditional regime boundaries ([Konrad et al., 2008](#); [Raven and Verbong, 2007](#)) and that transformative change may also emerge from multi-system interactions ([Papachristos et al., 2013](#); [Rosenbloom, 2020](#)). Some scholars provide insights into the positive role that incumbent firms may play in radical innovation: they may overcome their limited interest in, and limited ability to mobilise resources for, new technologies ([Hansen and Coenen, 2017](#)) and, accordingly, may pursue radical and incremental innovation strategies ([Berggren et al., 2015](#); [Penna and Geels, 2015](#); [Stalmokaitė and Hassler, 2020](#); [Steen and Weaver, 2017](#)). Along these lines, other scholars examine regime-to-niche activities in addition to niche-to-regime activities. Such a symmetrical perspective may uncover new mechanisms on the roles of incumbents in niches ([Mylan et al., 2019](#); [Turnheim and Geels, 2019](#)). Still other scholars, finally, emphasise the role of incumbents’ power in niche-innovation. Niche organisations may form coalitions with political parties, mobilise social movements and gain support from industrial, incumbent firms with countervailing power to overcome the regime organisations’ power ([Hess, 2016](#)). Dominant institutions and incumbent rules shape niche actors’ room for manoeuvre ([Kern et al., 2015](#)) but local niche-initiatives may also take advantage of governance dynamics to reconfigure these institutions and rules ([Barnes et al., 2018](#)). Although the four approaches point to a nuanced and dynamic understanding of regimes and incumbents, more research is needed to elucidate precisely how incumbents use power to enable or restrict niche projects.

This study delves deeper into these discussions by using an existing framework on power dynamics in transitions ([Avelino, 2017](#); [Grin, 2010](#)). A focus on power is appropriate because questions of how new socio-technical configurations replace dominant configurations involve political conflicts ([Meadowcroft, 2011](#); [Shove and Walker, 2007](#)). Power analyses also concentrate on the politics underlying spaces of innovation, envisioned futures and actor roles in transitions ([Avelino et al., 2016](#)). Moreover, niche research acknowledges that the policy and financial support in constructing and mainstreaming protective space takes place within ‘powerful incumbent regimes’ ([Smith and Raven, 2012](#)). By analysing power dynamics, we thus aim to generate new insights about incumbents’ power in niche projects.

Against this backdrop, we selected a niche project in which multiple incumbent actors are involved for a case study: a wastewater treatment project called DuCoop in the city of Ghent (Belgium). The wastewater regime is generally characterised by lock-in mechanisms induced by centralised large-scale infrastructure and cost-efficiency ([Ampe et al., 2019](#); [Fuenfschilling and Binz, 2018](#); [Kiparsky et al., 2016](#)) but DuCoop succeeded in realising a path-breaking decentralised system. It treats the wastewater of 400 households and recovers process water, energy and nutrients. In theory and given time, combinations of pioneering projects like DuCoop may disrupt the water/wastewater regime and give shape to fundamental transitions. When a project such as DuCoop addresses pressing challenges such as water, energy and resource recovery ([Kisser et al., 2020](#); [Larsen et al., 2013](#)), it is typically confronted with deeply embedded infrastructures, actors and rules in the wastewater sector ([Hoffmann et al., 2020](#); [Pakizer and Lieberherr, 2018](#)). Interestingly, for our study of the role of incumbents, we observed that multiple actors such as real estate companies, a financial institution and the municipality, which do not dominate nor belong to the wastewater regime, played a crucial role in the realisation of this innovative project.

Accordingly, the research question put forward in this paper is how incumbents use power to enable or restrict DuCoop’s radical innovation. The paper contributes to research on niche-innovation by generating novel insights about the enabling role incumbents may play in niche projects. It also empirically grounds niche-innovation with a case outside of the well-investigated energy domain ([Raven et al., 2016](#)) and thematic focus of current transitions research (i.e. energy, mobility and agro-food systems; [Kanger, 2020](#)). For practitioners in the water/wastewater system, it highlights the role of power dynamics.

The paper unfolds as follows: section 2 introduces the role and power of incumbents in transitions and niche-innovation. Section 3 details the analytical framework and research techniques. Section 4 presents the case and section 5 the empirical analysis. In section 6, we discuss the analysis and section 7 concludes the paper.

2. The power of incumbents in niche-innovation

Here the conventional understanding of the multi-level perspective, transitions and niches are first reiterated. Next, we concentrate on four – often interwoven – research streams that are associated with how incumbents may use power in niche-innovation, namely multiple regimes, incumbent firms, regime-to-niche activities and incumbents’ power in niche-regime struggles. These topics are explored in the next sections by using an established framework on power dynamics.

The multi-level perspective conceptualises transitions by distinguishing between three socio-technical levels of structuration: landscape, regime and niche. The landscape comprises the slowly changing context and shocks. The regime is the locus of dominant practices and the associated technology, actors and rules that stabilise existing systems, whereas a niche is a space that protects an alternative socio-technical configuration from the regime ([Geels, 2011](#); [van den Bergh et al., 2011](#)). The interplay between the processes functioning at the three levels may lead to a fundamental transition: a long-term, multi-dimensional process of change through which an established socio-technical regime shifts to more sustainable modes of consumption and production ([Markard et al., 2012](#)).

According to research on sustainability transitions, new pathways to regime change usually emerge out of sequences of projects and niches. Early work conceived learning, networking and visioning as the drivers of successful niche development. Later on, the role of the regime came into focus as an essential factor for niche development (Schot and Geels, 2008). Some contributions then scrutinised the ‘translations’ (Smith, 2007), technological, network and institutional ‘anchoring’ (Elzen et al., 2012) and ‘adaptive linkage processes’ (Ingram, 2015) between niches and regimes. In addition, Smith and Raven (2012) asked ‘what is protective space’ and identified three properties of niche protection: shielding (holding off selection pressures), nurturing (learning, networking and visioning) and empowerment. The latter concentrates on how innovations escape protective spaces; by making the niche competitive with the regime or by changing the regime in ways favourable to the niche.

Recently, however, transition scholars have provided more nuanced interpretations of transitions, diverging from the conventional understanding of radical niches that overthrow resistant incumbents who belong to a single and monolithic regime. We distinguish four different approaches to understanding incumbents’ roles. First, some scholars have directed attention to multiple regimes and systems. For instance, it was found that interactions such as competition, symbiosis, integration and spill over between the electricity and the gas regime were important in the diffusion of combined heat and power (Raven and Verbong, 2007). Likewise, functional (e.g. shared value chains) and structural (e.g. shared infrastructure and institutions) couplings exist between multiple utility regimes and transformations may thus cross and affect established regime-boundaries (Konrad et al., 2008). The reinforcing interactions between two or more socio-technical systems may further lead to niche emergence outside of these systems and, subsequently, a system emergence transition pathway (Papachristos et al., 2013). As sustainability challenges stretch beyond individual systems, a multi-system perspective was also proposed to capture the diverse, layered and evolving interactions between systems (Rosenbloom, 2020). These contributions thus highlight the importance of looking beyond single regimes and systems because multiple regimes may influence niche-innovation and vice versa.

Second, other scholars have provided insights into the potentially positive role of incumbent firms in radical innovation. By analysing the intense competition between incumbent firms as a result of new technological options, it was shown that the capabilities of firms to absorb and integrate radical technologies are frequently underestimated (Bergek et al., 2013). In similar fashion, the technology strategies of established firms in the heavy vehicle sector are more radical than previously assumed and may consist of multiple technological paths at niche and regime levels (Berggren et al., 2015). An in-depth qualitative analysis of incumbent shipping firms in the Baltic sea region further shows that, depending on socio-political and customer pressures as well as firms’ ambitions and capabilities, incumbents experiment with radical and incremental innovation in their gradual reorientation towards decarbonisation (Stalmokaitė and Hassler, 2020). Reacting to climate change and societal pressures, American automakers are also slowly developing competencies in multiple low-carbon technologies, although lock-ins and the possibility to invest in the wrong technology delay the industry’s full reorientation (Penna and Geels, 2015). Similarly, external pressures and uncertainty about future developments lead Norwegian hydropower and oil and gas incumbents to proactively diversify their activities into various niche renewable sectors that offer new value creation opportunities (Steen and Weaver, 2017). In addition to these firms pursuing radical innovation, it was also found that incumbent firms’ limited ability to mobilise resources for and limited interest in new technologies may be overcome by establishing new divisions within the firm, promoting internal use, providing certainty for new markets and investing in new managerial competencies (Hansen and Coenen, 2017). Finally, by reviewing five organisation theories, four typical modes of behaviour of incumbent firms during transitions are proposed: incumbent firms are the first to ‘enter’ niches; wait for other actors and then follow into niches; remain inert; and employ strategies to slow down transitions (van Mossel et al., 2018). These findings demonstrate that incumbent firms may play a positive role in transitions, in addition to their well-investigated roles in delaying and resisting transitions.

Third, still other scholars propose a so-called symmetrical approach to analyse niches in order to pay attention to the role of incumbents in niche-innovation (Geels, 2018; Mylan et al., 2019; Turnheim and Geels, 2019). Such a proposal may be due to how they observed a niche-to-regime perspective on change in research on niches (e.g. Diaz et al., 2013; Ingram, 2015; Raven et al., 2016; Smith and Raven, 2012; Verhees et al., 2013), which downplays regime-to-niche activities and leads to overlooking the roles played by incumbents in niches. Accordingly, the ‘diachronic and systemic focus’ of the multi-level perspective has been applied to observe how established actors are enrolled in niche networks and practices to increase their impact. Findings indicate, for example, that these new interactions influence gradual reconfigurations in local agro-food policies (Bui et al., 2016). Other research shows how incumbents such as coffee shop chains and supermarkets were essential for mainstreaming non-dairy products. Due to their limited sunk investments in dairy production, these actors are less locked-in to the dairy-milk regime and can engage downwardly with plant-based milk innovations (Mylan et al., 2019). In the auto-mobility regime, the positive role of incumbents characterises the developments of the French modern tramways niche, which was facilitated by actors from ‘neighbouring regimes’ such as railways and urban planning (Turnheim and Geels, 2019). These examples illustrate the relevance of symmetrical analyses that focus on niche-to-regime and regime-to-niche activities, especially to uncover the roles that incumbents may play in niche-innovation.

Fourth, still other scholars pay attention to incumbents’ power in niche-innovation by analysing niche-regime struggles, in which the focus is often on the restricting instead of the enabling use of power by incumbents. Concerning these struggles, empowerment research recognises narratives as a ‘political strategy to argue for empowering institutional reforms’ (p. 1031), particularly by developing positive expectations, arguing for reforms or competitiveness and challenging the regime (Smith and Raven, 2012). Using this framework to investigate solar photovoltaic technology from 1920 to 2010, Verhees et al. (2013) have shown that the struggles of niche-advocates sometimes entangle with broader change processes in policy and socio-economic contexts. They suggest future research to pay attention to shorter periods ‘where regimes and niches become intertwined’ (p. 287). Furthermore, Kern et al. (2015) propose to examine more closely how the ‘institutional (regime) context’ shapes niches because their empowerment framework mainly analyses niche actor-networks and narratives used to promote global niches.

In addition to empowerment researchers, other authors have also directed attention to incumbents' power in niche-regime struggles. A creative interplay between innovation and its context is observed in the struggles to reconfigure institutions in horticulture: novel practices bring networks of new and established actors together, who interpret and challenge routines to transform the prevailing interests, institutions and actors in which the novel practices are embedded (Hoffman and Loeber, 2016). Likewise, local institutions are reconfigured more successfully when sustainability initiatives take advantage of changes in the urban context (e.g. governance dynamics) and when their actor-network mediates between the novelty and established arrangements (Barnes et al., 2018). In niche-regime conflicts over solar energy, Hess (2016) found that niche organisations partially overcome the regime organisations' power by forming coalitions with political parties and social movements as well as by countervailing power of companies who have invested in the niche. Nonetheless, the multi-dimensional discursive approach not only shows struggle taking place between the narratives of niche-advocates and opponents but also indicates that incumbents may adopt different positions to niches over time (Rosenbloom et al., 2016). What is more, most of these findings point to niche-regime struggles and regime resistance but do not elucidate precisely how incumbents may use power to enable niche-innovation.

When taken together, the above contributions of four different research streams give us an idea of incumbents' roles in niche projects: incumbents, particularly firms, belonging to multiple regimes may use power to enable niche-innovation. However, more research is required to elucidate exactly how incumbents use power to enable or restrict niche projects. As such, section 3 elaborates on an existing framework on power dynamics and our research techniques to explore these themes.

3. Methodology

3.1. Analytical framework

This section elaborates on an existing framework to explore the power of incumbents in niche projects. A focus on power is appropriate as political analyses of transitions frequently concentrate on the dynamics between dominant and new socio-technical configurations (Avelino et al., 2016; Meadowcroft, 2011). Research on niches also confirms the role of power as niches aim at changing regimes: innovative projects require hard work to resist the normalising power of the regime (Bos and Grin, 2008). Further, empowerment processes take place 'within the context of a historically privileged regime, which holds the authority to arbitrate and the power to provide protective support' (Smith and Raven, 2012, p. 1032).

Several approaches are being developed to scrutinise the politics of transitions. These concentrate on: the interplay of discourses, institutional contexts and interests in influencing policy initiatives (Kern, 2011); Lukes' instrumental, structural and discursive power dimensions to examine decentralised energy transitions (Brisbois, 2019); Gramscian concepts such as hegemony to analyse regime resistance (Geels, 2014); the interaction between ideas, interests, institutions and infrastructure in shaping pathways to sustainability (Rosenbloom, 2018); and, to explain gridlock, agency's 'power with' and 'power to' in addition to environmental politics' focus on 'power over' (Partzsch, 2017). However, as we want to use the framework as a tool to explore how incumbents use power to enable or restrict radical innovation, we draw from an established power framework from Grin (2010, 2012) and Avelino (2011, 2017) that builds on three manifestations of power which are generally distinguished in the literature on power (Arts and van Tatenhove, 2004). The framework is, to our knowledge, one of the only power frameworks related to sustainability transitions' research that has been thoroughly discussed, adapted and applied (Hoffman, 2013; Köhler et al., 2019; Kok et al., 2021; Lieferink, 2006; Omukuti, 2020; Paredis, 2013; Ramírez-Monsalve and van Tatenhove, 2020). Furthermore, both Grin and Avelino elaborate on the struggles between established and new socio-technical configurations in transitions, which will help us to generate insights into the power of incumbents in niche projects.

Grin (2010) connects the three levels of the multi-level perspective to three layers of power of a framework developed by Arts and van Tatenhove (2004), who define power as 'the organisational and discursive capacity of agencies, either in competition with one another or jointly, to achieve outcomes in social practices, a capacity which is however co-determined by the structural power of those social institutions in which these agencies are embedded' (p. 347).

Drawing from Grin (2010, 2012) and Arts and van Tatenhove (2004), relational power is the capacity of agents to achieve outcomes in day-to-day interactions. Actors may be creative and do things differently by naming and framing certain problems as well as by mobilising resources such as knowledge, tactics, persuasion, money and personnel to formulate and realise their most desirable outcomes. Nonetheless, avoiding a voluntarist approach, Arts & van Tatenhove note that human action is highly routinised and that the capacity of agents is co-determined by dominant practices and the associated rules of the game, resources and discourses. Correspondingly, dispositional power is the power that derives from the position that actors occupy in a specific situation (e.g. in an organisation or a system). This process of positioning is mediated by actor configurations, the rules of the game (e.g. norms and routines as well as legislation and guidelines), resources, discourses and, following Hoffman (2013), artefacts such as technology and infrastructure. As such, because of their position, some actors are better able than others to make use of the resources available, they can more easily use rules to achieve an outcome and they have more legitimacy when drawing on a particular discourse. Mediating dispositional power, established artefacts, actors, rules, resources and discourses thus position practices in a specific manner: existing practices will be privileged, whereas novel practices may be confronted with resistance and stability. Yet pressures induced by novel practices and slowly changing trends may affect this process of positioning which, for example, leads new actors to challenge certain rules to enable innovative practices (Grin, 2012). Accordingly, structural power is derived from shocks and slowly changing trends such as increasing environmental concerns and macroeconomic processes. Although these trends are beyond the direct influence of the actors involved, they may be interpreted and mobilised by such actors. Hence, the dynamics between these three layers of power will then influence change or stability in socio-technical systems.

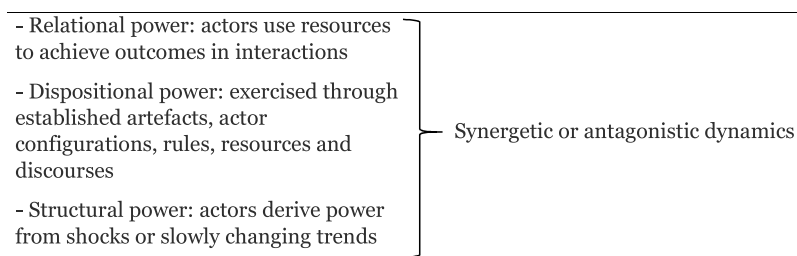


Fig. 1. Power type exercised by actors and dynamics.

Avelino (2011, 2017) criticised this framework. Grin's contribution suggests a vertical power typology by connecting the three layers of power to the levels of the multi-level perspective, privileging the regime's dispositional power (structure) over the niche's relational power (agency) and thus stability over change. Avelino, on the other hand, proposes a more horizontal typology. The agency for change and particularly the power exercised by human actors is placed at the forefront. Niches and regimes are then 'spaces' in which actors may exercise different types of power to enable and restrict any other type of power exercise. However, Avelino notes that a regime is the exercise of power by a group of actors to reproduce established institutions. If the dynamics between different types of power enable each other, they are synergetic, and if they prevent one another, they are antagonistic.

In our analysis, we apply Grin's three types of power but we use Avelino's contribution to underscore that these three types of power are primarily exercised by human actors, can be combined and may enable (synergetic) and restrict (antagonistic) other types of power. We focus on how actors exercise relational, dispositional and structural power and on whether this leads to synergetic or antagonistic dynamics (see Fig. 1). Hence, this framework may help to explore how incumbents use power to enable or restrict radical innovation.

3.2. Research process and techniques

In the process of selecting a case, choosing a conceptual and analytical approach, collecting empirical material, coding and analysing, we followed an abductive approach: 'an (often surprising) single case is interpreted from a hypothetic overarching pattern, which, if it were true, explains the case in question. [...] During the process, the empirical area of application is successively developed, and the theory (the proposed over-arching pattern) is also adjusted and refined' (Alvesson and Sköldbberg, 2009, p. 4). As such, we first heard about DuCoop's radical innovation in a presentation of a Dutch new sanitation expert called Grietje Zeeman in 2017 (e.g. Zeeman et al., 2008; Zeeman and Lettinga, 1999). Prior knowledge about the wastewater sector and the politics of transitions as well as preliminary field observations helped to obtain a rough idea of dominant and alternative socio-technical configurations, and our interpretations were regularly adjusted by alternating between the different types of empirical material, literature and framework.

Between 2017 and 2019, we conducted thirteen (out of fifteen) interviews and we also joined events and a field trip. The interviewees were selected by purposive and snowball sampling (Weiss, 1995; Yin, 2016) and included different incumbents and local niche actors. The in-depth interviews took 70–130 min and began with personal histories and roles in DuCoop, after which we gradually focussed on the enabling and restricting factors in DuCoop's development. In doing so, we were guided by the perspective of the interviewees. The observed events were documented in field notes and dealt with DuCoop, decentral sanitation and resource recovery from wastewater. At this time, we also selected relevant (internal) documents and videos (see Appendix A for a list of the empirical material).

By the second half of 2019 and before the coding process, we had identified approximately twelve struggles in which we observed incumbents from multiple regimes using power to enable or restrict DuCoop's innovation. Subsequently, the empirical material was codified into 1700 text fragments in the MAXQDA software, assembled into three broad categories: DuCoop's trajectory, political struggles and the elements of the analytical framework. Throughout this process, we observed that a number of the struggles were interlinked and, by March 2020, we narrowed the analysis to five struggles in which one or more incumbents, to a certain extent, helped to enable DuCoop's innovation. The empirical material and conceptual approach guided this selection process: we focussed on the struggles that frequently reoccurred in the material; decisive struggles for the success of DuCoop; and struggles that took place after the formal establishment of DuCoop in 2014 (see 4.2), as a range of incumbents were involved during this period. In our analysis in section 5, we thus present five struggles revolving around DuCoop and centring around one or more incumbents whose power played a crucial role in enabling DuCoop's radical innovation.

In the first half of 2020, two more interviews were conducted in which saturation in responses started to appear. We then stopped gathering empirical material and asked the interviewees to give feedback on the manuscript.

4. Introduction to the case

This section introduces the case by describing Belgium's locked-in wastewater regime and DuCoop's pioneering project. It shows how DuCoop differs from the regime and presents the setting of, and the actors involved in, the five struggles analysed in section 5.

4.1. The Belgian wastewater regime

The dominant Belgian wastewater treatment technology is characterised by an extensive sewerage network that transports diluted wastewater and urban runoff to large-scale treatment plants. After treatment, the water is discharged to surface water, which is frequently used as influent for drinking-water production by drinking water utilities. The regional sewers and treatment plants are managed by the Flemish wastewater treatment company (Aquafin), whereas the Flemish Environment Agency oversees its economic and environmental performance. Municipalities are responsible for local sewers and the transport of wastewater on their territory. In Ghent, this responsibility is outsourced to the public-private drinking water utility (Farys).

The formal rules state that the disposal of domestic wastewater to the treatment system is obligatory. This mandatory-connection rule is related to the regime's financial means: the water bill of municipalities' drinking water utilities consists of local and regional treatment taxes, which are transferred to the municipality and Aquafin, respectively. The regional tax comprises 75 % of Aquafin's budget, whereas 25 % is subsidised by the region (Flanders).

Belgium's wastewater regime is further characterised by end-of-pipe management, which comes with a flush-and-forget culture. The regime is focussed on clean waterways, which is a target that is being achieved by tightening the criteria for treated wastewater and by expanding the connection rate of households to the wastewater infrastructure (as only 86 % of the households is connected to sewers in Flanders, whereas this rate is, for instance, 99 % in the Netherlands). Moreover, Aquafin's annual reports and R&D department recently started to cover the circular economy and resource recovery from wastewater.

4.2. Niche project: DuCoop

DuCoop is a cooperative company that combines path-breaking innovations in wastewater treatment, heat and water recovery, urban agriculture and shared car parks to realise the first 'circular neighbourhood' in Flanders (see Appendix B for six pictures), which is done within a broader, ambitious urban development project at Ghent's outskirts. In contrast to the wastewater regime, DuCoop works with decentralised, small-scale treatment technology. It constructs pipes for black (excreta and organic food waste) and grey (showers, sinks and washing machines) water to separately treat the wastewater from 400 residential units and a school. The black water stream is highly concentrated: the vacuum toilets, installed by Roediger, only use approximately one litre of rainwater per flush and the residents' organic food waste is shredded to small particles before adding it to this stream. A fertiliser (struvite) and biogas (providing 1–2 % of the heating demand) are recovered from this stream. Heat is recovered from the grey wastewater stream (providing one-third of the demand). An adjacent chemical plant (Christeyns) also recovers heat from their processes for DuCoop's residents (providing two-thirds of the demand), while using DuCoop's grey water as process water.

In 2011, the Municipal Development Agency (Sogent), that owned the land where DuCoop is located today, launched a call to develop a part of the neighbourhood of the urban development project. By scoring high on the call and particularly on the sustainability and financial components, a partnership between an investment fund (Clean Energy Innovative Projects) and three real estate companies (Revive, Van Roey and CAAAP), amongst others, won. In 2014, this led to the establishment of DuCoop. Revive and Clean Energy Innovative Projects are both associated with one of Belgium's most wealthy business families (Colruyt). In the subsequent years, a few other financiers joined DuCoop: investors related to the social economy (Trividend) and energy (EnerGent), two impact investors that are linked to Colruyt (Human Capital and OYA Seed) and the municipality's drinking water utility. In this complex construction, Clean Energy Innovative Projects' director serves as the manager of DuCoop. During DuCoop's development, the Flemish Environment Agency, the municipality and its solid waste company were involved as public actors, whereas the involved private actors are the adjacent chemical plant, engineering companies and a financial institution (Triodos).

In addition, DuCoop does not comply with the regime's mandatory-connection rule for domestic wastewater as it constructs local sewers and treatment technology. Consequently, the local and regional treatment taxes levied by the municipality's drinking water utility on the residents' water bill are directly transferred to DuCoop. The rest of the required financial means for the technological innovation came from Flanders, the EU, a financial institution and impact investors, whereas the real estate companies mainly financed the investments in the residential units. The European subsidies were also used to extend DuCoop's team with two engineers.

In comparison with the regime, DuCoop adds an extra layer to the focus on clean waterways and resource recovery. Specifically, it concentrates on end-user awareness by involving the residents in the cooperative company and it significantly outscored the sustainability criteria of the municipality in the Municipal Development Agency's call. Here DuCoop ties in with Ghent's ambition to become climate neutral by 2050, which is, amongst other things, reflected in Ghent being the first Belgian city to sign the Covenant of Mayors in 2009 and the new covenant in 2015. Furthermore, DuCoop draws inspiration from a prominent decentralised treatment system in Sneek (the Netherlands) that was constructed around 2005 and that is making waves in the international wastewater sector.

5. Empirical analysis of five struggles

The previous section described the context of the analysis and showed that the niche project (DuCoop) fundamentally deviates from the wastewater regime. We now use the power framework to explore how incumbents use power to enable or restrict DuCoop's innovation. We do so by analysing five struggles revolving around DuCoop and centring around one or more incumbents whose power played a crucial role in DuCoop's innovation by providing resources (5.1), providing a loan (5.2), installing specific technology (5.3) and circumventing established rules (5.4 and 5.5). In section 6, we discuss the analysis and the implications for practitioners.

5.1. 'Traditional real estate companies' and risks

The first struggle focusses on the dynamics between the boards of 'traditional real estate companies' (Interview 9), belonging to the building regime, and a coalition between two innovators of those companies and DuCoop's team. The struggle is an example of how the power of innovators can lead to radical reorientation in incumbents' roles, providing resources such as money, personnel and know-how to the project. From the start, the boards defined three 'risks' by using their position as funders of the project vis-à-vis the innovators (i.e. dispositional power). First, as the boards adhere to the motto 'euros per square meter', the sustainability considerations of the coalition were perceived as a risk and, accordingly, revoked by cost-efficiency. Moreover, the boards wanted to establish a competitive selling price, which does not reflect the high sustainability performance of the residential units. Second, questions were raised about the risky and delayed return on investment. The sector is used to supplying finance building by building. However, this project required them, for example, to supply finance for the neighbourhood's centralised car park and (a part of) the technologies ten years before selling the last units. Third, the boards voiced concerns about the technology, particularly about the noise produced by the vacuum toilets, explosion risk of the biogas-digester, chemicals used in the treatment process, release of odours and, as we will see in section 5.5, technological deficiencies. In Sneek, moreover, the residents were exposed to unpleasant odours, which is an argument the boards frequently used in these discussions (i.e. relational power). Hence, in defining three risks, the boards negatively influenced the coalition and their novel ideas. Such influence can be interpreted as antagonistic dynamics between the boards' dispositional and the innovators' relational power.

The coalition countered the first two risks (cost-efficiency and pre-financing) by convincing the boards (i.e. relational power) that most of the investment risks in the technology should be concentrated in DuCoop's cooperative company and, consequently, the real estate companies mostly had to invest in the residential units. The latter allowed the companies to offer competitive prices to their customers and to 'stick to the script: buy, develop, build and sell' (Interview 13). The coalition further persuaded the boards by directing attention to the marketing and learning-about-sustainability opportunities of the whole project as well as the municipality's sustainability criteria for developing the area, mobilising and combining relational and structural power to create synergetic dynamics. As such, DuCoop's proposal to separate the investments into sustainable technologies and residential units was realised. Regarding the odours, a filter and an air outlet were installed. The other issues of the third risk (noise, explosion and chemicals) gradually lost relevance by repeated explanations about how the technology works in the meetings between the coalition and the boards, signifying the use of relational power.

In sum, the real estate companies' boards first induced antagonistic dynamics using dispositional power, although the coalition's ongoing use of relational power (reinforced with structural power related to sustainability) led them to follow the coalition's arguments. Over time, the boards radically switched roles by providing resources such as money, personnel and know-how to the project.

5.2. The lending guidelines of financial institutions

The second struggle revolves around the guidelines to obtain a loan and involved four financial institutions from the financial regime and a team consisting of DuCoop's manager, innovators from real estate companies and financial consultants. This struggle is an example of how innovators can realise incremental change with incumbents, which is nevertheless crucial for realising the project. Although the loan only comprises 30 % of the project's financial capital, it was necessary for the project's development. The search took more than a year during which the team meticulously prepared every meeting to convince the institutions to do things differently for once. Meeting after meeting, however, the institutions drew on the conventional guidelines. Primarily their risk analysts were not used to combinations of technologies such as wastewater treatment and heat networks. As the analysts were unable to examine the probability of default, three big financial institutions refused to provide a loan to such an unusual project. In this context, an interviewee observes: 'In the pursuit for a loan, the institutions turned DuCoop down one by one, because the project differs from other projects' (Interview 9). The institutions thus drew on established guidelines and knowledge (i.e. dispositional power) to counter the relational power of the team's proposals. From DuCoop's perspective, the antagonistic dynamics induced by the institutions shifted to more synergetic dynamics because the team ultimately persuaded one institution (Triodos) that specialises in sustainable projects.

Nevertheless, this institution was cautious about the criteria of the loan as it not only perceived the project as risky but also realised that it was the last institution available for a loan. As such, DuCoop's first loan proposal was rejected by the credit committee. Eventually, the second proposal was accepted as a result of the team's struggles and the institution's recognition of the project's connection to the bank's vision and DuCoop's contribution to sustainability (i.e. structural power). After this agreement which mainly focussed on the substantive aspects of the project (e.g. combinations of technologies), the institution raised questions about the collateral because a part of the privately-owned technology is built on land owned by the municipality, real estate companies or the adjacent chemical plant. Such antagonistic dynamics induced by the dispositional power of the institution resulted in DuCoop's loan being characterised by strict default conditions and a high-risk premium.

Overall, three financial institutions refused to deviate from established guidelines. However, the ongoing struggles of the innovators led a fourth institution, specialised in sustainability, to facilitate the project by cautiously providing a loan. In doing so, it only incrementally changed its role and primarily used its monopoly position to preserve strict loan requirements.

5.3. Manufacturers of vacuum toilets

The manufacturers of vacuum toilets, belonging to the manufacturing regime, and the Municipal Development Agency (part of the urban planning regime) are involved in the third struggle, mainly because DuCoop also treats the wastewater of an adjacent school

where providing children-sized toilets is mandatory. The struggle is an example of incremental changes in incumbents' roles in niche projects, influenced by incumbents' use of power to maintain established practices. Drawing on established rules and using its position in the development of the neighbourhood, the Municipal Development Agency asked DuCoop to install children-sized vacuum toilets. In turn, DuCoop requested the three European manufacturers of vacuum toilets to provide children-sized versions. However, the manufacturers stated that such toilets do not exist and that they were unable to produce them because the production process is not cost-efficient and there is no market demand, suggesting the mobilisation of dispositional power using established rules, resources and technology. Despite the questions of the Agency, DuCoop's relational nor dispositional power was strong enough to convince the manufacturers to produce children-sized vacuum toilets and mitigate the antagonistic dynamics.

More synergetically, however, one manufacturer used relational power by proposing to install a collector in between the school toilets and vacuum system. This idea is a cost-efficient solution the firm has previously used, clearly using established rules and knowledge (i.e. dispositional power) in an enabling way. As such, regular children-sized toilets and a collector were installed. This installation implies more than one litre of water per flush and diluting the black water stream, which results in a slight loss in efficiency of the digester used for biogas production.

Together, the rule of children-sized toilets was mobilised by the Municipal Development Agency and restricted DuCoop's plan. In turn, DuCoop did not succeed in convincing the manufacturers because such toilets do not exist and the production process is not cost-efficient. However, one manufacturer incrementally changed its role by providing the collector as an alternative, cost-efficient solution.

5.4. *The Flemish Environment Agency and the mandatory-connection rule*

The topic of the fourth struggle is the mandatory-connection rule for domestic wastewater and mainly takes place between the Flemish Environment Agency, belonging to but not dominating the wastewater regime, and DuCoop. The struggle is an example of the ongoing efforts of innovators, which influences incumbents in radically reorienting their role and use of power in niche projects. From the start, DuCoop used relational power to gather stakeholders (e.g. companies, departments and agencies such as the Flemish Environment Agency) in a discussion group, improving its relationship with these actors and, over time, also enhancing its reputation and position within this group (i.e. dispositional power). In collaboration with the municipality, the Agency then asked how DuCoop would comply with the mandatory-connection rule and the local and regional treatment taxes, drawing on established rules, resources and infrastructure in mobilising dispositional power. In response, DuCoop invited the municipality's drinking water utility to their board to maintain the relations with the Agency, improving its relationship with the Agency and the municipality to discuss possible solutions (i.e. relational power). The dynamics were mostly antagonistic: many discussions went into the question about how to circumvent the mandatory-connection rule and 'how to shift the revenue of the local and regional wastewater treatment tax from Farys [the drinking water utility] to DuCoop' (Interview 5).

The struggles of the innovators were then accommodated by the Agency that used its position in, and knowledge of, the wastewater system (i.e. dispositional power), inducing more synergetic dynamics. Specifically, it drew on DuCoop's broader sustainability agenda (i.e. structural power) to point out the existence of a loophole. The latter exists as the mandatory-connection rule does not hold for certified industrial wastewater. Such certification can be obtained by collecting and then adding organic food waste to domestic wastewater. To achieve this, DuCoop had to negotiate a subcontracting agreement with the municipal solid waste company to obtain permission to collect organic food waste, indicating dynamics between DuCoop's relational power and the company's established rules and resources. Although this is no standard procedure for the company, it signed the agreement as it acknowledged the importance of DuCoop's project regarding innovation in waste management. In line with the Agency, the company used its dispositional power and drew on structural power to support the synergetic dynamics. These power dynamics resulted in the following arrangement: the drinking water utility still levies taxes but the revenue is directly transferred to DuCoop's cooperative company, organic food waste is added to the black water through shared shredders (permitted by the solid waste company) and the wastewater is licensed as industrial by the Agency.

On the whole, the Flemish Environment Agency used its position to raise questions about the conformity of the project with established rules. In response to these mostly antagonistic dynamics, DuCoop continuously attempted to induce synergetic dynamics, eventually met with the Agency radically changing its role to enable the project.

5.5. *The municipality's concerns over pipes built on public land, technological deficiencies and backup systems*

The fifth struggle concerns the dynamics between the municipality, belonging to the urban planning regime, and DuCoop and focusses on pipes built on public land, bankruptcy, technological deficiencies and backup systems. The struggle is an example of how radical reorientations take place in incumbents' roles in niche projects, resulting from other incumbents' power. The controversy started because a part of the pipes of the privately-owned treatment technology and heat network has been built on land owned by the municipality. The Department of Public Roads, Bridges and Waterways (in collaboration with Facility Management and Legal Services) typically uses standardised contracts to collaborate with utilities to avoid liability and secure the municipality's property. In this way, 2015's agreement in principle between the municipality's council and DuCoop, which usually precedes concession agreements, stipulates that DuCoop is obliged to relocate pipes if a public authority requests so. By drawing on the established rules and resources, the Departments thus mainly mobilised dispositional power, which induced antagonistic dynamics. Consequently, DuCoop hired a law firm to temper these proposals and included the municipality's drinking water utility in their board as a trustworthy, public-private partner of the municipality, clearly using relational power and then increasing its position vis-à-vis the Departments (i.e. dispositional

power).

Simultaneously, the Departments were worried about the possibility of bankruptcy and technological deficiencies (e.g. clogged pipes, odours or complete failure). As utility services and public land are involved, they assumed that the municipality would be held responsible by the residents for supplying heat and the disposal of wastewater in case of deficiencies or DuCoop's bankruptcy. An interviewee observes 'The failure of the technological system is the worst-case scenario; if the neighbourhood does not have access to sewers, the pressure on the municipality would be enormous [...] and it would be obliged to provide a solution' (Interview 12). Hence, the Departments used their position in the project to protect the municipality's resources and rules against bankruptcy and deficiencies, indicating the use of dispositional power.

These antagonistic dynamics were further strengthened as the above issues evolved into concerns over 'backup systems' for the utility services such as emergency sewers and a power plant. On top of that, the real estate companies worried about selling residential units with technological deficiencies and the Municipal Development Agency about the provision of utilities. Both actors used their position in the project to mobilise dispositional power, strengthening the antagonistic dynamics. But 'when the project was about to be jeopardised by these struggles' (Interview 15), the Department of Environment and Climate intervened in favour of DuCoop and used its position to underscore the sustainable and innovative contribution of DuCoop to the city. Such action can be interpreted as combining the three types of power to bring about synergetic dynamics.

As a result of these struggles, the 2016 concession agreement between the municipality and DuCoop prescribes mutual consultation and exploration of alternative solutions in relocating pipes. The solution also included reaching agreements in principle with energy and water/wastewater utilities to take over in case of failure; opening a savings account as a safeguard for maintenance; and authorisation of the municipality if the infrastructure is transferred to a third party. In addition to these legal agreements, an emergency sewer connects DuCoop's treatment system to the established sewer system and DuCoop holds a natural gas plant under perpetual lease from the adjacent chemical plant as an emergency power station.

Overall, the Department of Public Roads, Bridges and Waterways (in collaboration with other incumbents) mobilised dispositional power in an antagonistic manner. Concerning legal requirements, DuCoop tried to temper these dynamics but soon faced even more challenges such as concerns over bankruptcy. Notably, the Department of Environment and Climate dealt with these challenges by using its position in the project and drawing on broader sustainability trends, eventually leading to radical changes in the municipality's role to enable the project.

6. Discussion

The previous section analysed five struggles between one or more incumbents and DuCoop. It explored the research question about how incumbents use power to enable and restrict DuCoop's radical innovation. By using the specificities of the five struggles, this question is now answered by identifying four patterns. Here we use an ideal-type approach that accentuates certain elements emerging from the analysis, particularly by focussing on the enabling instead of the restricting role of incumbents in niche projects. Next, we move towards a more refined and nuanced understanding of the patterns by focussing on incumbents belonging to multiple regimes as well as on the power of structural trends. Before concluding the paper, we also provide lessons for practitioners.

6.1. Four patterns in the enabling role of incumbents in niche projects

6.1.1. Radical reorientation through innovators' power

This pattern is called radical reorientation through the power of innovators. It is characterised by the ongoing efforts of innovators that eventually lead incumbents to radically reorient their role to enable niche projects. In the case study of DuCoop, this is visible in how the real estate companies' boards (5.1) first restricted the coalition of innovators by defining three risks. However, ongoing struggles with the innovators led to radical reorientations (e.g. providing resources to the project). Similarly, the Flemish Environment Agency (5.4) raised critical questions about the project but the ongoing work of the innovators eventually led to an enabling role of the Agency.

6.1.2. Radical reorientation through incumbents' power

We label this pattern as radical reorientation through the power of incumbents. As a result of the incumbents' mobilisation of power, radical reorientations take place in the role of other incumbents to enable niche projects. This pattern is reflected in the struggle revolving around the municipality (5.5), in which we noted that incumbents (the Department of Public Roads, Bridges and Waterways, amongst others) obstructed the project by drawing on established rules and resources. Nonetheless, these blockages were removed by the power of other incumbents (the Department of Environment and Climate), profoundly changing the municipality's role in the project.

6.1.3. Incremental change through innovators' power

This pattern is called incremental change through innovators' power. The ongoing work of the innovators influences the incumbents to change their role to enable niche projects incrementally. The pattern is reflected in the struggle involving the financial institutions (5.2): three institutions refused to provide a loan, whereas the innovators succeeded in convincing one institution specialised in sustainable banking after a long process. However, although the institution enables the project, the loan is stringent and in line with the established guidelines.

6.1.4. Incremental change through incumbents' power

Incremental change through incumbents' power is the name of this pattern. Incremental changes take place in the role of incumbents to enable niche projects, resulting from incumbents' use of power to maintain established practices. The struggle involving the manufacturers of vacuum toilets (5.3) follows this pattern. Specifically, as producing children-sized vacuum toilets is not cost-efficient, these toilets do not exist and the manufacturers refused to develop such toilets (i.e. established rules). However, one manufacturer provided a watered-down, cost-efficient alternative (the collector) to the niche project, incrementally changing its role to enable the project.

6.2. The enabling role of incumbents from multiple regimes in niche projects

Conveying a more detailed understanding of the patterns and drawing from the four research streams described in section 2, we further explore the enabling role incumbents may play in niche projects by focussing on three observations. We concentrate on incumbents from multiple regimes, belonging to (1) local authorities and (2) neighbouring or more distant regimes, as well as on (3) the power of structural trends related to the urgency of sustainability challenges.

The first observation is that two local/regional public authorities are covered by the radical reorientation-patterns, namely the Flemish Environment Agency and the municipality. Both hesitated to support the project but then radically adjusted their role in the project. From our observations, we may cautiously conclude that local authorities may radically reorient their roles in enabling niche projects by altering local rules and supporting new socio-technical configurations, which is also suggested by other studies on the leading role of local authorities in transitions (Barnes et al., 2018; Grin, 2020).

However, this first observation does not hold for the real estate companies as these are private companies who radically reoriented their roles, bringing us to a second observation about incumbents' proximity (of, for instance, missions, scales and networks) to niche projects. The real estate companies became partners in the project and the municipality was also closely involved by, for example, owning the land. This observation suggests that these actors belong to 'neighbouring regimes' (i.e. the building and urban planning regime)¹ that offered 'a way to mobilise counter-veiling power against locked-in incumbents' in the 'focal' wastewater regime (Turnheim and Geels, 2019, p. 1425). Moreover, such physical, institutional and social proximity has been observed before in cities (Grin et al., 2017), indicating a connection between multiple innovations, regimes and systems in urban transition processes (Hodson et al., 2017). Such observations help in understanding the radical reorientations in the roles of the real estate companies and the municipality to enable niche projects.

This second observation is further supported by the lack of proximity to the project of the financial institutions and the manufacturers of vacuum toilets (e.g. not closely involved from the beginning and a more independent role), leading to incremental changes instead of radical reorientations in their roles. Furthermore, cost-efficiency, financing and production norms were important factors influencing the incremental change-patterns. These rules can then be interpreted as lock-in mechanisms of the broader and more distant manufacturing and financial regimes. The latter, in particular, is subject to path-dependency, which may suggest a fit-and-conform 'niche-financial regime interaction' in our case (Geddes and Schmidt, 2020). These mechanisms may indicate 'multiple and interacting points of lock-in' (p. 339) across the wastewater, financial and manufacturing systems (Rosenbloom, 2020). Hence, the second observation leads us to suggest that incumbents belonging to neighbouring regimes (i.e. proximity) may radically reorient their roles, whereas incumbents belonging to more distant regimes only incrementally change their roles to enable niche projects.

A third observation that clarifies the enabling role of incumbents is about the power of structural trends and particularly the urgency of sustainability challenges, observed in the radical reorientation-patterns. Specifically, the real estate companies were convinced by the innovators' argument about the sustainability-opportunities of the whole project; the Flemish Environment Agency underscored the broader sustainability agenda of the project; and the Department of Environment and Climate mobilised the sustainable and innovative contribution of the project to the city. Additionally, concerning the struggle involving the financial institutions (characterised by incremental change), we hypothesise that the lock-in mechanisms of the financial regime were partially overcome by the innovators' capacity to connect the broader sustainability agenda of the project to the vision of the institution that provided the loan. Taken together, the third observation confirms that political, social and environmental pressures influence incumbents' role in radical innovation, which is confirmed by studies of incumbent firms (Penna and Geels, 2015; Stalmokaitė and Hassler, 2020; Steen and Weaver, 2017), suggesting that the urgency of sustainability challenges and the related new policies and strategies (e.g. EU and UN) influences the enabling role of incumbents. Using our case, we also add that structural trends are interpreted and then used as a source of power by incumbent and innovative actors, which may indicate how so-called landscape elements are 'endogenized through political struggles' (Rosenbloom et al., 2016, p. 1286) and are socially constructed (Hermwille, 2016; Loorbach et al., 2016).

Summing up, the four patterns underscore the distinct ways in which incumbents may enable niche projects. In turn, closer inspection of these patterns helped to understand the circumstances required for doing so. In other words, the study both identified the 'varieties of incumbencies' (p. 183) in niche projects and the 'conditions under which these may contribute to (positively or negatively) transformative pathways' (p. 183), which supports the recommendations of Turnheim and Sovacool (2020) empirically. Additionally, the patterns and our clarification demonstrate that niche-innovation should be analysed symmetrically (Mylan et al., 2019; Turnheim and Geels, 2019) and they also confirm that the power frameworks of Avelino and Grin are fruitful tools for doing so.

¹ Neighbouring regimes deviate from the focal regime but have a degree of proximity such as relevant knowledge and skills; missions and guiding rules; geographical areas and scales; or access to networks (Turnheim and Geels, 2019).

6.3. Lessons for practitioners in the water/wastewater sector

For practitioners in the water sector, the analysis underscores the role of power dynamics in innovation processes, which are often overlooked in a sector dominated by techno-economic knowledge. Specifically, it shows that DuCoop's project ran into resistance from incumbents such as real estate companies, financial institutions and the municipality. Consequently, this required continuous creativity to do things differently from both the project and incumbents. By scrutinising the struggles between these actors, we presented a different way of knowing water (Krueger et al., 2016) that may be used by practitioners in learning processes on transitions towards sustainability in the water/wastewater sector (Hoffmann et al., 2020).

7. Conclusions

In this study, pluralised understandings of incumbencies, especially the roles played and power used by incumbents in niche projects, were investigated. It shows how incumbents use power to enable and restrict DuCoop's radical innovation. By applying an existing framework on power in transitions, it identified four patterns in the enabling role of incumbents in niche projects. The four patterns were clarified by focussing on incumbents from multiple regimes, belonging to local authorities, neighbouring and more distant regimes, as well as on the power of structural trends such as the urgency of sustainability challenges. This study contributes to the understanding of multiple incumbencies and the circumstances under which these may contribute to niche projects. For practitioners in the water/wastewater sector, the study presents a different way of knowing water by highlighting the overlooked role of power dynamics.

Future research could build on these findings by focussing on the enabling role of incumbents in global niches instead of a niche project. As we draw lessons from a single-case study, the conditions under which incumbents enable niche projects also require further research, particularly necessary is a typology or classification of incumbents and their proximity to certain innovations. Additionally, the findings can be refined and extended in other cases: in more 'unfriendly contexts' for niches (Verhees et al., 2013, p. 275) in which they face a steep 'uphill battle' (Schot and Geels, 2008, p. 549); in 'inter-niche competition' (Lin and Sovacool, 2020); in the absence or presence of a 'system-builder' (Kern et al., 2015); or in other (un)favourable contexts for experimentation (Torrens et al., 2019). Finally, future research could focus on the substantive instead of the processual aspect of power, particularly on the sustainability of niches' power relations (Avelino, 2011) and 'which niche(s) and transformative pathway(s) should be nurtured and on what grounds?' (Lazarevic and Valve, 2020, p. 47).

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendices A and B.

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References

- Alvesson, M., Sköldbberg, K., 2009. *Reflexive Methodology: New Vistas for Qualitative Research*. SAGE.
- Ampe, K., Paredis, E., Asveld, L., Osseweijer, P., Block, T., 2019. A transition in the Dutch wastewater system? The struggle between discourses and with lock-ins. *J. Environ. Policy Plan.* 22, 155–169.
- Arts, B., van Tatenhove, J., 2004. Policy and power: a conceptual framework between the 'old' and 'new' policy idioms. *Policy Sci.* 37, 339–356.
- Avelino, F., 2011. *Power in Transition: Empowering Discourses on Sustainability Transitions*. PhD dissertation. Erasmus University Rotterdam.
- Avelino, F., 2017. Power in sustainability transitions: analysing power and (dis)empowerment in transformative change towards sustainability. *Environ. Policy Gov.* 27, 505–520.
- Avelino, F., Grin, J., Pel, B., Jhagroe, S., 2016. The politics of sustainability transitions. *J. Environ. Policy Plan.* 18, 557–567.
- Barnes, J., Durrant, R., Kern, F., MacKerron, G., 2018. The institutionalisation of sustainable practices in cities: how initiatives shape local selection environments. *Environ. Innov. Soc. Transit.* 29, 68–80.
- Bergek, A., Berggren, C., Magnusson, T., Hobday, M., 2013. Technological discontinuities and the challenge for incumbent firms: Destruction, disruption or creative accumulation? *Res. Policy* 42, 1210–1224.
- Berggren, C., Magnusson, T., Sushandoyo, D., 2015. Transition pathways revisited: established firms as multi-level actors in the heavy vehicle industry. *Res. Policy* 44, 1017–1028.
- Bos, B., Grin, J., 2008. "Doing" reflexive modernization in pig husbandry: the hard work of changing the course of a river. *Sci. Technol. Human Values* 33, 480–507.
- Brisbois, M.C., 2019. Powershifts: a framework for assessing the growing impact of decentralized ownership of energy transitions on political decision-making. *Energy Res. Soc. Sci.* 50, 151–161.

- Bui, S., Cardona, A., Lamine, C., Cerf, M., 2016. Sustainability transitions: insights on processes of niche-regime interaction and regime reconfiguration in agri-food systems. *J. Rural Stud.* 48, 92–103.
- Diaz, M., Darnhofer, I., Darrot, C., Beuret, J.-E., 2013. Green tides in Brittany: What can we learn about niche–regime interactions? *Environ. Innov. Soc. Transit.* 8, 62–75.
- EEA, 2019. The European Environment—State and Outlook 2020: Knowledge for Transition to a Sustainable Europe. European Environment Agency.
- Elzen, B., van Mierlo, B., Leeuwis, C., 2012. Anchoring of innovations: assessing Dutch efforts to harvest energy from glasshouses. *Environ. Innov. Soc. Transit.* 5, 1–18.
- Fuentschilling, L., Binz, C., 2018. Global socio-technical regimes. *Res. Policy* 47, 735–749.
- Geddes, A., Schmidt, T., 2020. Integrating finance into the multi-level perspective: technology niche-finance regime interactions and financial policy interventions. *Res. Policy* 49, 1–13.
- Geels, F., 2011. The multi-level perspective on sustainability transitions: responses to seven criticisms. *Environ. Innov. Soc. Transit.* 1, 24–40.
- Geels, F., 2014. Regime resistance against low-carbon transitions: introducing politics and power into the multi-level perspective. *Theory Cult. Soc.* 31, 21–40.
- Geels, F., 2018. Disruption and low-carbon system transformation: progress and new challenges in socio-technical transitions research and the multi-level perspective. *Energy Res. Soc. Sci.* 37, 224–231.
- Grin, J., 2010. The governance of transitions: an agency perspective. In: Grin, J., Rotmans, J., Schot, J. (Eds.), *Transitions to Sustainable Development*. Routledge.
- Grin, J., 2012. The politics of transition governance in Dutch agriculture. Conceptual understanding and implications for transition management. *Int. J. Sustain. Dev.* 15, 72–89.
- Grin, J., 2020. Doing ‘system innovations from within the heart of the regime. *J. Environ. Policy Plan.* 1–13.
- Grin, J., Frantzeskaki, N., Castán Broto, V., Coenen, L., 2017. Sustainability transitions and the city linking to transition studies and looking forward. In: Frantzeskaki, N., Castán Broto, V., Coenen, L. (Eds.), *Urban Sustainability Transitions*. Routledge, New York, pp. 359–367.
- Hansen, T., Coenen, L., 2017. Unpacking resource mobilisation by incumbents for biorefineries: the role of micro-level factors for technological innovation system weaknesses. *Technol. Anal. Strateg. Manag.* 29, 500–513.
- Hermwille, L., 2016. The role of narratives in socio-technical transitions—fukushima and the energy regimes of Japan, Germany, and the United Kingdom. *Energy Res. Soc. Sci.* 11, 237–246.
- Hess, D., 2014. Sustainability transitions: a political coalition perspective. *Res. Policy* 43, 278–283.
- Hess, D., 2016. The politics of niche-regime conflicts: distributed solar energy in the United States. *Environ. Innov. Soc. Transit.* 19, 42–50.
- Hodson, M., Geels, F., McMeekin, A., 2017. Reconfiguring urban sustainability transitions, analysing multiplicity. *Sustainability* 9, 1–20.
- Hoffman, J., 2013. Theorizing power in transition studies: the role of creativity and novel practices in structural change. *Policy Sci.* 46, 257–275.
- Hoffman, J., Loeber, A., 2016. Exploring the micro-politics in transitions from a practice perspective: the case of greenhouse innovation in the Netherlands. *J. Environ. Policy Plan.* 18, 692–711.
- Hoffmann, S., Feldmann, U., Bach, P., Binz, C., Farrelly, M., Frantzeskaki, N., Hiessl, H., Inauen, J., Larsen, T., Lienert, J., Londong, J., Lüthi, C., Maurer, M., Mitchell, C., Morgenroth, E., Nelson, K., Scholten, L., Truffer, B., Udert, K., 2020. A research agenda for the future of urban water management: exploring the potential of nongrid, small-grid, and hybrid solutions. *Environ. Sci. Technol.* 54, 5312–5322.
- Ingram, J., 2015. Framing niche-regime linkage as adaptation: an analysis of learning and innovation networks for sustainable agriculture across Europe. *J. Rural Stud.* 40, 59–75.
- Johnstone, P., Stirling, A., Sovacool, B., 2017. Policy mixes for incumbency: exploring the destructive recreation of renewable energy, shale gas ‘fracking,’ and nuclear power in the United Kingdom. *Energy Res. Soc. Sci.* 33, 147–162.
- Kanger, L., 2020. Neglected systems and theorizing: a comment on the transitions research agenda. *Environ. Innov. Soc. Transit.* 34, 352–354.
- Kern, F., 2011. Ideas, institutions, and interests: explaining policy divergence in fostering ‘system innovations’ towards sustainability. *Environ. Plann. C Gov. Policy* 29, 1116–1134.
- Kern, F., Verhees, B., Raven, R., Smith, A., 2015. Empowering sustainable niches: comparing UK and Dutch offshore wind developments. *Technol. Forecast. Soc. Change* 100, 344–355.
- Kiparsky, M., Thompson, B., Binz, C., Sedlak, D., Tummers, L., Truffer, B., 2016. Barriers to innovation in urban wastewater utilities: attitudes of managers in California. *Environ. Manage.* 57, 1204–1216.
- Kisser, J., Wirth, M., De Gussem, B., Van Eekert, M., Zeeman, G., Schoenborn, A., Vinnerås, B., Finger, D., Kolbl Repinc, S., Bulc, T.G., Bani, A., Pavlova, D., Staicu, L., Atasoy, M., Cetecioglu, Z., Kokko, M., Haznedaroglu, B., Hansen, J., Istenic, D., et al., 2020. A review of nature-based solutions for resource recovery in cities. *Blue-Green Systems* 2, 138–172.
- Klitkou, A., Bolwig, S., Hansen, T., Wessberg, N., 2015. The role of lock-in mechanisms in transition processes: the case of energy for road transport. *Environ. Innov. Soc. Transit.* 16, 22–37.
- Köhler, J., Geels, F., Kern, F., Markard, J., Onsongo, E., Wiecek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, S., et al., 2019. An agenda for sustainability transitions research: state of the art and future directions. *Environ. Innov. Soc. Transit.* 31, 1–32.
- Kok, K., Loeber, A., Grin, J., 2021. Politics of complexity: conceptualizing agency, power and powering in the transitional dynamics of complex adaptive systems. *Res. Policy* 50, 104183.
- Konrad, K., Truffer, B., Voß, J.-P., 2008. Multi-regime dynamics in the analysis of sectoral transformation potentials: evidence from German utility sectors. *J. Clean. Prod.* 16, 1190–1202.
- Krueger, T., Maynard, C., Carr, G., Bruns, A., Mueller, E., Lane, S., 2016. A transdisciplinary account of water research. *Wiley Interdiscip. Rev. Water* 3, 369–389.
- Larsen, T., Udert, K., Lienert, J. (Eds.), 2013. *Source Separation and Decentralization for Wastewater Management*. IWA.
- Lazarevic, D., Valve, H., 2020. Niche politics: biogas, technological flexibility and the economisation of resource recovery. *Environ. Innov. Soc. Transit.* 35, 45–59.
- Liefferink, D., 2006. The dynamics of policy arrangements: turning round the tetrahedron. In: Arts, B., Leroy, P. (Eds.), *Institutional Dynamics in Environmental Governance*. Springer, Netherlands, pp. 45–68.
- Lin, X., Sovacool, B., 2020. Inter-niche competition on ice? Socio-technical drivers, benefits and barriers of the electric vehicle transition in Iceland. *Environ. Innov. Soc. Transit.* 35, 1–20.
- Loorbach, D., Avelino, F., Haxeltine, A., Wittmayer, J., O’Riordan, T., Weaver, P., Kemp, R., 2016. The economic crisis as a game changer? Exploring the role of social construction in sustainability transitions. *Ecol. Soc.* 21.
- Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: an emerging field of research and its prospects. *Res. Policy* 41, 955–967.
- Meadowcroft, J., 2011. Engaging with the politics of sustainability transitions. *Environ. Innov. Soc. Transit.* 1, 70–75.
- Mylan, J., Morris, C., Beech, E., Geels, F., 2019. Rage against the regime: niche-regime interactions in the societal embedding of plant-based milk. *Environ. Innov. Soc. Transit.* 31, 233–247.
- Omukuti, J., 2020. Country ownership of adaptation: Stakeholder influence or government control? *Geoforum* 113, 26–38.
- Pakizer, K., Lieberherr, E., 2018. Alternative governance arrangements for modular water infrastructure: an exploratory review. *Compet. Regul. Netw. Ind.* 19, 53–68.
- Papachristos, G., Sofianos, A., Adamides, E., 2013. System interactions in socio-technical transitions: extending the multi-level perspective. *Environ. Innov. Soc. Transit.* 7, 53–69.
- Paredis, E., 2013. *A Winding Road: Transition Management, Policy Change and the Search for Sustainable Development*. PhD dissertation. Ghent university.
- Partzsch, L., 2017. Power with’ and ‘power to’ in environmental politics and the transition to sustainability. *Env. Polit.* 26, 193–211.
- Penna, C., Geels, F., 2015. Climate change and the slow reorientation of the American car industry (1979–2012): an application and extension of the Dialectic Issue LifeCycle (DILC) model. *Res. Policy* 44, 1029–1048.
- Ramírez-Monsalve, P., van Tatenhove, J., 2020. Mechanisms of power in maritime spatial planning processes in Denmark. *Ocean Coast. Manag.* 198, 105367.

- Raven, R., Verbong, G., 2007. Multi-regime interactions in the Dutch energy sector: the case of combined heat and power technologies in the Netherlands 1970–2000. *Technol. Anal. Strateg. Manag.* 19, 491–507.
- Raven, R., Kern, F., Verhees, B., Smith, A., 2016. Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases. *Environ. Innov. Soc. Transit.* 18, 164–180.
- Rosenbloom, D., 2018. Framing low-carbon pathways: a discursive analysis of contending storylines surrounding the phase-out of coal-fired power in Ontario. *Environ. Innov. Soc. Transit.* 27, 129–145.
- Rosenbloom, D., 2020. Engaging with multi-system interactions in sustainability transitions: a comment on the transitions research agenda. *Environ. Innov. Soc. Transit.* 34, 336–340.
- Rosenbloom, D., Berton, H., Meadowcroft, J., 2016. Framing the sun: a discursive approach to understanding multi-dimensional interactions within socio-technical transitions through the case of solar electricity in Ontario, Canada. *Res. Policy* 45, 1275–1290.
- Schot, J., Geels, F., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technol. Anal. Strateg. Manag.* 20, 537–554.
- Shove, E., Walker, G., 2007. Caution! Transitions ahead: politics, practice, and sustainable transition management. *Environ. Plan. A* 39, 763–770.
- Smink, M., Hekkert, M., Negro, S., 2015. Keeping sustainable innovation on a leash? Exploring incumbents' institutional strategies. *Bus. Strategy Environ.* 24, 86–101.
- Smith, A., 2007. Translating sustainabilities between green niches and socio-technical regimes. *Technol. Anal. Strateg. Manag.* 19, 427–450.
- Smith, A., Raven, R., 2012. What is protective space? Reconsidering niches in transitions to sustainability. *Res. Policy* 41, 1025–1036.
- Sovacool, B.K., Turnheim, B., Martiskainen, M., Brown, D., Kivimaa, P., 2020. Guides or gatekeepers? Incumbent-oriented transition intermediaries in a low-carbon era. *Energy Res. Soc. Sci.* 66, 101490.
- Stalmokaitė, L., Hassler, B., 2020. Dynamic capabilities and strategic reorientation towards decarbonisation in Baltic Sea shipping. *Environ. Innov. Soc. Transit.* 37, 187–202.
- Steen, M., Weaver, T., 2017. Incumbents' diversification and cross-sectorial energy industry dynamics. *Res. Policy* 46, 1071–1086.
- Torrens, J., Schot, J., Raven, R., Johnstone, P., 2019. Seedbeds, harbours, and battlegrounds: on the origins of favourable environments for urban experimentation with sustainability. *Environ. Innov. Soc. Transit.* 31, 211–232.
- Turnheim, B., Geels, F., 2019. Incumbent actors, guided search paths, and landmark projects in infra-system transitions: Re-thinking strategic niche management with a case study of French tramway diffusion (1971–2016). *Res. Policy* 48, 1412–1428.
- Turnheim, B., Sovacool, B., 2020. Forever stuck in old ways? Pluralising incumbencies in sustainability transitions. *Environ. Innov. Soc. Transit.* 35, 180–184.
- UN Environment, 2019. Global Environment Outlook—GEO 6: Healthy Planet, Healthy People.
- van den Bergh, J., Truffer, B., Kallis, G., 2011. Environmental innovation and societal transitions: introduction and overview. *Environ. Innov. Soc. Transit.* 1, 1–23.
- van Mossel, A., van Rijnsoever, F., Hekkert, M., 2018. Navigators through the storm: a review of organization theories and the behavior of incumbent firms during transitions. *Environ. Innov. Soc. Transit.* 26, 44–63.
- Verhees, B., Raven, R., Veraart, F., Smith, A., Kern, F., 2013. The development of solar PV in the Netherlands: a case of survival in unfriendly contexts. *Renewable Sustainable Energy Rev.* 19, 275–289.
- Weiss, R., 1995. *Learning From Strangers*. Free Press.
- Wells, P., Nieuwenhuis, P., 2012. Transition failure: understanding continuity in the automotive industry. *Technol. Forecast. Soc. Change* 79, 1681–1692.
- Yin, R., 2016. *Qualitative Research From Start to Finish*. Guilford Press.
- Zeeman, G., Lettinga, G., 1999. The role of anaerobic digestion of domestic sewage in closing the water and nutrient cycle at community level. *Water Sci. Technol.* 39, 187–194.
- Zeeman, G., Kujawa, K., de Mes, T., Hernandez, L., de Graaff, M., Abu-Ghunmi, L., Mels, A., Meulman, B., Temmink, H., Buisman, C., van Lier, J., Lettinga, G., 2008. Anaerobic treatment as a core technology for energy, nutrients and water recovery from source-separated domestic waste(water). *Water Sci. Technol.* 57, 1207–1212.