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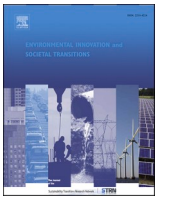

Review Article

Incumbent firms in sustainability transitions – Different conceptions, heterogeneous roles and ideal types

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ABSTRACT

This paper gives an overview of the state of research on the role of incumbent firms in emission-intensive economic sectors (energy supply, transportation, food supply and processing industries) in sustainability transition processes. On the basis of a systematic review of 174 case studies, the paper comes to two conclusions: Firstly, there is a lack of clear definitions and therefore some conceptual confusion regarding the question of what is actually meant by an incumbent. Secondly, the roles of incumbent firms in transition processes are usually heterogeneous, multidimensional, temporally variable and ambiguous in their implications for the transition process. On this basis, the paper makes two conceptual contributions. Firstly, it offers a (new) definition of the term "incumbent firm" that is tailored to transition research and addresses previous conceptual ambiguities. Secondly, it formulates six ideal types of incumbent firms in sustainability transition processes that go beyond dichotomous role attributions and do justice to the ambiguity and temporal dynamics of the activities of incumbents.

1. Introduction

Incumbent firms in emission-intensive sectors such as energy supply, transportation, food provision and processing industries play a central role in overcoming today's ecological challenges. In 2019, 34 % of human greenhouse gas emissions were caused by energy supply, 24 % by industry, 22 % by agriculture, forestry and land use, and 15 % by transportation (Intergovernmental Panel on Climate Change, 2022, p. 8). These sectors are characterized by the dominance of large companies with a long history and significant political and economic power – commonly termed incumbents. Understanding their role in sustainability transition processes and the reasons behind their actions is therefore highly relevant for gaining a realistic picture of the challenges and opportunities of combating climate change. However, even a cursory glance shows that their influence on sustainability transitions is not only quite diverse but often rather ambivalent, and therefore the subject of extensive academic debate (Kungl, 2024; Turnheim and Sovacool, 2019).

Sustainability transition research has been particularly active in exploring the role of incumbent firms. In the past five years alone, 85 case studies have been published in this research area that look at the activities of incumbent firms (see Fig. 1).

These studies have provided far-reaching insights. The heterogeneity of the sustainability-related activities of incumbents has been widely explored, and case studies depict a broad spectrum of possible roles as a result. These include everything from attempts to establish markets for sustainable technologies (Berggren et al., 2015) to cross-sector collaborations (Apajalahti et al., 2018), the strategic containment of sustainable innovations (Smink et al., 2015), political lobbying for or against sustainability-related regulations (Vormedal and Skjærseth, 2020; Richter and Smith Stegen, 2022), copying the business models of new sustainable companies

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(Sovacool et al., 2017), all the way to the dissemination of misinformation about human-driven climate change (Kenner and Heede, 2021). The state of research has been subject to critical evaluation (Turnheim and Sovacool, 2019; Kungl, 2024) and conceptual developments have addressed different aspects such as the dynamics of corporate reorientation (Penna and Geels, 2015; Turnheim and Geels, 2013) and the factors influencing the strategies of incumbents (Mori, 2021; Kump, 2023; Karltorp and Perez Vico, 2025). Some works also drew on organizational research and applied its theoretical concepts to transition research (van Mossel et al., 2018; Magnusson and Werner, 2022).

However, these debates, while fruitful, have also repeatedly led to dead ends and circular debates. Firstly, there seems to be some confusion regarding the question of what incumbents actually are. Different and often implicit definitions of incumbents hamper the discourse and repeatedly lead to artificial debates. Secondly, the discourse on the possible roles of incumbents still gets lost in a dichotomous view of incumbents as either supporters or hinderers of sustainability transitions, which does not do justice to the multidimensionality and ambiguity of their activities (Kungl, 2024).

In a situation like this, in which a lot of research is available but there remains disagreement on key issues, a systematic literature review is a promising method of advancing the academic debate (Petticrew and Roberts, 2006, p. 21). There are already a few literature reviews in the thematic context of incumbents in sustainability transitions. These reviews explore and systematize the observed strategies of incumbent firms (Saleh et al., 2025), identify the factors influencing incumbents' implementation of radical innovations (Karltorp and Perez Vico, 2025) and the factors explaining incumbents' heterogeneous responses in the context of sustainability transition processes (Mori, 2021), or explore the activities of specific types of firms such as government-owned enterprises (Meelen and Sluijs, 2025) or automotive incumbents (Magnusson and Werner, 2022). While these reviews provide valuable contributions to the discourse, the gaps mentioned above remain unaddressed. Studies that deal with different theoretical perspectives on incumbents do not address the issue of unclear definitions (Magnusson and Werner, 2022; van Mossel et al., 2018). Reviews that contribute to the discussion of the roles of incumbents either remain stuck in a dichotomous view of incumbents (Saleh et al., 2025), only consider studies within a limited time frame (Mori, 2021) or only cover specific sectors (Magnusson and Werner, 2022).

In light of this, I carried out a systematic literature review in order to create an overview of research on incumbent firms in sustainability transition processes in the energy, automotive, food and processing industries and answer the following research questions:

1. What are the different theoretical conceptions of incumbent firms in sustainability transition research?
2. What different roles can incumbent firms play in sustainability transition processes?

On this basis, I develop two conceptual contributions – a new definition and an ideal typology of incumbent firms – and identify areas for future research.

My text is structured as follows. In Section 2, I provide background information on research into incumbents in sustainability

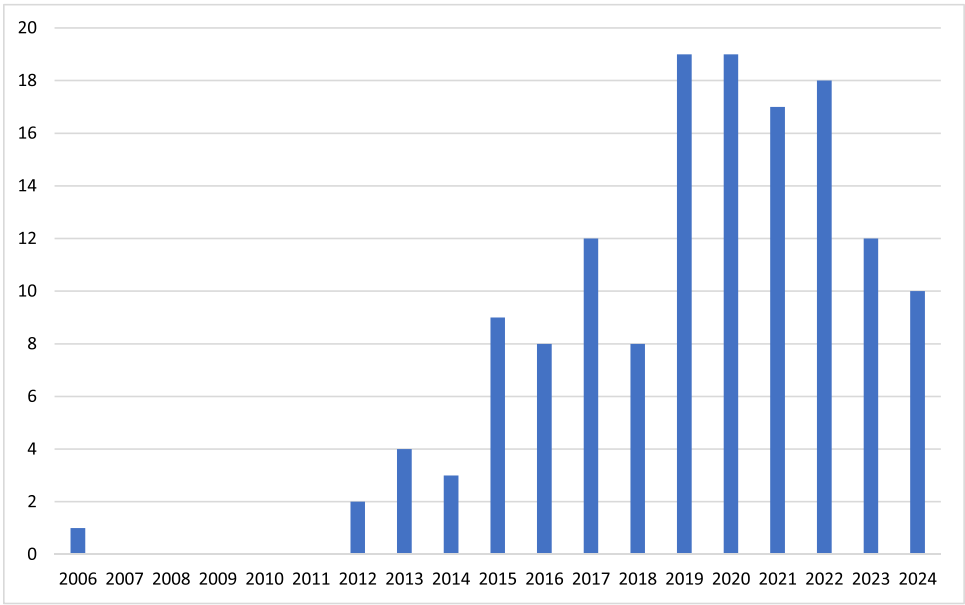

Fig. 1. Number of studies on incumbent firms from sustainability transition research over time (as at June 2024).
Source: Own research, The figure shows 142 of a total of 174 studies from the pool of the present review that can be categorized as sustainability transition research. The total pool is somewhat broader (for the selection criteria, see Section 3.2). I have classified as sustainability transition research all studies that are either based on classic theoretical concepts of transition research (the multi-level perspective, technological innovation systems, strategic niche management or transition management) or contain one of the following terms: sustainability transition, green transition, low-carbon transition, energy transition, electricity transition, mobility transition, agricultural transition.

transitions before presenting the methodology of my literature review in Section 3. In Section 4, I present the results in two steps. I first provide a systematic overview of the various definitions of incumbents that are used in the literature, then describe the sustainability-related activities of the companies examined and the roles they are attributed in the transition process. In Section 5, I present conceptual considerations based on the results of the two research questions. I formulate a new definition of incumbent firms for sustainability transition research and I develop six ideal types of the roles of incumbent firms in sustainability transition processes. After discussing my conceptual considerations, I conclude by pointing out topics for future research and discussing the limitations of my review.

2. Background – incumbents in sustainability transitions

Incumbents have been a core concept of transition research since its early days. There is a certain implicit agreement about who or what is meant by the term, but there has been relatively little conceptual discussion about its concrete meaning. Over time, it has become increasingly clear that it is by no means always obvious who or what is actually meant by an "incumbent" (Turnheim and Sovacool, 2019; Kungl, 2024). In transition research, four implicit perspectives on incumbents prevail: A system-centered concept of incumbents, which speaks in terms of incumbent systems, incumbent regimes or incumbent technologies and thus refers to the (institutional, technological and actor-related) configurations that have developed around a dominant technology (see e.g. Janipour et al., 2020 as an example from this review); a narrow actor-centered incumbent concept, which focuses on dominant companies in a specific context and usually speaks in terms of incumbent firms or incumbent industries (e.g. Steen and Weaver, 2017); a broad actor-centered incumbent concept, which refers to the totality of the central actors in a specific context, be they corporate or individual actors from business, politics or other relevant case-related social fields (e.g. Trencher et al., 2021); and a depersonalized concept of incumbency that emphasizes the cultural dimension of domination, which is also reproduced beyond established actor constellations and can only be explored to a limited extent through actor-centered research (e.g. Ertelt and Kask, 2024). However, it is not only these four perspectives that studies (usually implicitly) take; there are also often different definitions and concepts that coexist within these perspectives without being explicitly stated.

Fundamentally, past transition research has contributed a great deal to highlighting the plurality of incumbency, the variety of incumbent actor types and the potential heterogeneity of incumbents' activities (Turnheim and Sovacool, 2019; Mori, 2021). However, there is a lack of work that contributes to screening and organizing this diversity. Ultimately, this conceptual fuzziness poses challenges for the discourse in transition research. Kungl (2024), for example, argues that the widespread use of unspecific or implicit definitions leads to divergent case selection practices (i.e. depending on which actors are considered incumbents), thereby promoting artificial debates and hindering the generation of theoretical knowledge across different case studies (Kungl, 2024). Saleh et al. (2025), in turn, argue that the identification of suitable articles for systematic reviews on incumbents, and thus the process of gaining an overview on the state of research, is complicated by the inconsistent use of the term.

Against this background, I consider it helpful to provide a systematic overview of existing definitions of incumbents in transition research. In the context of this study, I can only cover one of the perspectives mentioned above, namely the second, which focuses on incumbent firms.

The situation is similar with regard to the question of the possible roles that incumbents can play in sustainability transition processes. This has also shaped transition research since its early days and is subject to a lot of controversy. While the antagonistic role of incumbents was initially emphasized, the view of incumbent firms expanded about ten years ago with the first studies that identified their possible proactive role (Berggren et al., 2015; Hoes et al., 2016). Today, the diversity of incumbents is emphasized in almost every introduction to a new case study.

Over the years, a couple of researchers have developed typologies of the activities of incumbents in the context of sustainability transitions (Green et al., 2021; Lauber and Sarasini, 2015; Mori, 2021; Saleh et al., 2025; van Mossel et al., 2018). Table 1 gives an overview of existing typologies.

These typologies, however, have two limitations. Firstly, they categorize the role of incumbents according to whether they support or prevent sustainability transitions, thus reproducing a dichotomous view of incumbents. This obscures ambiguities and ambivalences, which are also part of the nature of incumbents (Kungl, 2024). Secondly, the activities of established companies are usually characterized by changes over time (Turnheim and Sovacool, 2019); these typologies, however, do not have a temporal dimension. The typologies can thus only represent rather basic activity patterns; more complex cases can only be represented by a combination of types or a change of types over time. I therefore consider it useful to create an overview of the possible roles of incumbents in sustainability transition processes based on a systematic review as a basis for further conceptual work.

3. Methodology – systematic literature review

In my systematic literature review, I am following the method presented by Petticrew and Roberts (2006). The population of studies covered by the literature review comprises studies that deal with the activities of incumbent firms in the context of sustainability transition processes in emission-intensive sectors (energy supply, transportation, food supply and processing industries). According to a common definition, sustainability transitions are "long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption" (Markard et al., 2012, p. 956).

Table 1
Typologies of the activities of incumbent firms.

	Typology of…	Types
Green et al. (2021)	Strategies for firms in sectors facing pressure to decarbonize	1. Transitioner 2. Greenwasher 3. Prepper 4. Resister
Lauber and Sarasini (2015)	Corporate Social Responsibility (adapted from Carroll, 1979).	1. Reaction (Fight all the way) 2. Defense (Do only what is required) 3. Accommodation (Be progressive) 4. Proactivity (Lead the industry)
Mori (2021)	Responses to sustainability transitions (adapted from Lauber and Sarasini, 2015)	1. Adaptation and advancing reorientation 2. Horizontal diversification 3. Staying inert 4. Weaker reorientation
Saleh et al. (2025)	Strategies of incumbent firms in sustainability transitions	Proactive vs. defensive strategies on the levels of (a) Organization and management (b) Technology (c) Industry and market (d) Institutions
van Mossel et al. (2018)	Behavior in relation to niches	1. First to enter niches 2. Follow others into niches 3. Delay the transition 4. Remain inert

Source: Own compilation

3.1. Data collection and selection

The primary data collection was carried out in the Scopus literature database on June 28, 2024. After experimenting with different search strings, I decided on a two-stage data collection procedure. First, I conducted a broad search across various journals. The search string

(TITLE-ABS-KEY (*incumbent* OR *firm* OR *"regime actor"*) AND TITLE-ABS-KEY (*sustainability* OR *sustainable* OR *green* OR *climate*) AND TITLE-ABS-KEY (*transition*))

yielded 1,925 hits. After excluding non-social science disciplines, books and conference papers, 1,053 hits remained. In a second step, a supplementary search was conducted in the nine most popular journals in sustainability transition research (STRN, 2018).[1] The search

(TITLE-ABS-KEY (incumbent))

yielded 586 hits. After excluding duplicates with the previous search, 118 hits remained. While reading the studies, I identified a further 80 studies by checking cross-references that had not been suggested by the previous searches. All in all, this resulted in a starting pool of 1251 studies, which I narrowed down in further steps based on their relevance for answering the research questions.

The selection criteria for including studies in the review were as follows:[2]

- They are empirical case studies (and not purely conceptual works).
- They deal with the activities of incumbent firms (this includes studies with a broader focus that also examine other actors besides incumbent firms).
- The context of the study is a sustainability transition process.
- The studies collected and analyzed original data on incumbent firms (such as interviews with decision-makers or corporate communications documents).
- The companies are incumbents that cause substantial greenhouse gas emissions through their business activities (the sectors included are energy supply, food supply, transportation and processing industries).

After this selection process, the pool of reviewed studies comprised 174 studies (see Table 5 in the appendix for a full list and Table 6 in the appendix for an overview by journal), which I evaluated according to the procedure described below.

[1] These are: the Journal of Cleaner Production; Energy Policy; Technological Forecasting and Social Change; Environmental Innovation and Societal Transitions; Energy Research and Social Science; Sustainability Switzerland; Research Policy; Technology Analysis and Strategic Management; Renewable and Sustainable Energy Reviews.

[2] These collection and selection criteria led to the inclusion of some studies that do not explicitly reference sustainability transition research, most of them from business or innovation research.

3.2. Data extraction and sample overview

In order to get a general overview of the sample, I extracted the following descriptive information for all studies:

(1) Theoretical background
(2) Data basis and methodology
(3) Sector/subsector studied
(4) Geographical context
(5) Companies studied (insofar as named)

Almost half of the studies (78 studies) work with theoretical frameworks from the field of socio-technical transitions such as the Multi-Level Perspective, Technological Innovation Systems or the Triple Embeddedness Framework. Thirty-seven studies use concepts from business administration (e.g. business model innovation, dynamic capabilities), 18 from sociology (e.g. institutional theory, field theory), 11 from innovation studies (e.g. sectoral systems of innovation) and 9 from political science (e.g. advocacy coalitions). Eight studies come from other disciplines, such as economics, geography or psychology. Thirteen studies do not mention an explicit theoretical background.

The transparency of the research methods varies greatly, making it difficult to create a systematic overview. However, the vast majority of the studies are case studies, typically based on interviews or publicly available documents.

The sector that was most intensively researched with regard to the role of incumbents was energy supply (101 studies), in particular electricity supply (67 studies) and oil and gas production (35 studies). Transportation came in second place (38 studies). Automobile production in particular was covered in a relatively large number of studies (24 studies), with some coverage of truck transportation too (9 studies). By contrast, less research has been carried out in the processing industry (28 studies) – the main focus here being on the pulp and paper industry (9 studies) and metal processing (6 studies) – and in food supply (23 studies). Thirty-five studies cover two or more sectors.

In terms of the geographical focus of incumbent research (by company location), there is a clear focus on the Western world (163 studies), particularly Europe (145 studies). Although there are some studies dealing with Asian incumbents, especially in Japan (7 studies) and China (6 studies), the rest of the world is only marginally covered (e.g. South Africa with three studies and Brazil with two studies). Forty-eight studies are multi-country studies. Tables 7 and 8 in the appendix provide an overview of the degree of coverage of the various sectors and regions.

3.3. Thematic analysis

In order to answer the research questions posed at the beginning, extensive material was extracted in two initially open categories: theoretical conceptions of incumbents and observed roles of companies. This material was then subjected to a thematic analysis (Ayress, 2008; Braun and Clarke, 2023) in order to synthesize the findings from the review.

What are the different theoretical conceptions of incumbent firms in sustainability transition research? To answer this question, I first extracted all the information from the individual studies that referred to the conceptualization of incumbents, i.e. sentences that contained formulations such as "incumbents are", "incumbents are defined as…" or "by incumbents, we refer to…". In a second step, all the definitions (or quasi-definitions) extracted in this way were summarized in a document and broken down into their individual conceptual building blocks, i.e. the characteristics attributed to incumbents in the respective definition. I then compared these characteristics and grouped them into categories. I describe the results of this process in Section 4.1.

What different roles can incumbent firms play in sustainability transition processes? Since only a few studies attributed a clear role to the companies under investigation, interpretative work was necessary to extract this content from the studies. To do this, I followed the method of reflexive thematic analysis (Braun and Clarke, 2023). Since in the discourse on incumbents, the term "role" is used in its everyday linguistic sense and is not defined further, I would like to clarify what I mean by it. By the role of an incumbent, I mean the influence that it exerts on a transition process through its activities.

Based on this understanding of roles, I began by extracting all the information from the studies about the companies' activities and (if mentioned) the attributed effects of these activities on the sustainability transition process under investigation. I noted which activities were particularly emphasized in the studies and used by the authors as a basis for evaluating the firms' influence on the transition process. I then grouped similar identified activities into categories (with the broad categories being business activities, socio-political activities and innovation activities). Secondly, I differentiated the studies by breadth of focus (does the study consider only one area of activity in isolation or several areas of activity at the same time?) and the duration of observation (do the studies consider a time horizon above or below five years?), since the state of research indicates that these differences are of significance for the attribution of roles (Kungl, 2024). I describe the results of this analysis in Section 4.2.

3.4. Ideal-type analysis

In light of the results of the thematic analysis, I decided to conduct an ideal-type analysis. An ideal type is an analytical construct that is gained by over-stylizing the characteristics of empirical cases (Weber, 1949). They are thus "generalisations or mental representations of a social phenomenon that will never be identical with reality, but will help to make that reality understandable" (Stapley et al., 2022, 2). The formation of ideal types is based on the grouping of similar cases. While the thematic analysis seeks to

identify sets of themes across the dataset, the ideal-type analysis seeks to identify groupings of cases (Stapley et al., 2022, 3).

In building the ideal types, I followed the approach of Stapley et al. (2022) as well as Kelle and Kluge (2010). First, I selected a subset of texts from the literature review that contained sufficiently detailed and extensive information for type-building. The selection criteria were: a long investigation period, a broad perspective on several areas of activity of the companies under investigation, and detailed empirical information about the activities of the companies under investigation. This applied to 53 texts.

Subsequently, I worked out comparative dimensions, which can be used to compare cases and form groups that are clearly distinguishable from each other on the one hand but homogeneous on the other (Kelle and Kluge, 2010, p. 93). These dimensions and the criteria for differentiation were developed inductively, and are as follows:

- *Scope of the researched company's sustainability-related activities.* Differentiated along the scales low, medium and high. Low refers to isolated incremental end-of-pipe solutions; medium refers to more extensive sustainability-related activities in specific areas; high refers to comprehensive organizational and strategic integration.
- *Scope of the researched company's defensive activities.* Differentiated along the scales low, medium and high. Low refers to a lack of explicit activities to defend established business areas; medium describes context-dependent specific activities to defend individual established business areas; high describes consistent defense of the company's established core activities.
- *Temporal pattern of the company's sustainability-related activities.* Differentiated along the categories ebb and flow, situational, static, incrementally increasing and increasing with varying intensity. Ebb and flow describes upward and downward movements in longer cycles (without necessarily indicating an overall trend); situational describes context-dependent activities that do not necessarily form a pattern; static refers to a low degree of change over time; increasing with varying intensity describes an overall upward trend characterized by turning points and longer periods marked by varying degrees of change; incrementally increasing describes a steady upward trend without major variations in intensity.
- *Consistency of the company's activities (in terms of sustainability) across different areas of activity.* Differentiated along the scales low, medium and high. Low consistency describes a significant deviation in sustainability-related behavior within a single area of activity; medium consistency refers to overall discrepancies in sustainability-related behavior in different areas of activity (e.g. political activities and business activities, or with regard to different political issues); high consistency refers to a low degree of difference in sustainability-related behavior between different activities.
- *External factors influencing the company's activities highlighted in the analysis.* These are the factors influencing the company's sustainability-related actions that originate externally to the company (e.g. through political, market, technical or societal changes, or actions by other actors) and are highlighted in the case studies.
- *Internal factors influencing the company's activities highlighted in the analysis.* These are the factors influencing the company's sustainability-related actions that originate internally within the company (e.g. corporate culture, knowledge and capabilities, assets, management) and are highlighted in the case studies.
- *Overall influence of the company on the sustainability transition process.* Differentiated along the categories hindering, rather passive, ambivalent and supportive. Hindering means an overall negative influence on the progress of the sustainability transition process; rather passive means a low level of participation or influence; ambivalent either means that the impact points in different directions in terms of sustainability or that the impact of the activities is ambiguous and difficult to assess; supportive refers to an overall positive impact on the progress of the sustainability transition process.

Finally, I grouped cases that had similar characteristics along these comparative dimensions and formulated ideal types on this basis. While the ideal type is formulated in general terms and represents an over-generalization of the empirical reality, I have named illustrative cases for each type that come as close as possible to the ideal type (Kelle and Kluge, 2010, p. 83; Stapley et al., 2022, 3f.). I describe the results of this process in Section 5.2.

4. Results

4.1. The divergent conceptualizations of incumbents

When talking about incumbents, most studies take a narrow, actor-centered view of incumbents that focuses on incumbent firms (and excludes incumbent actors from other societal domains, such as politics). However, the specific understanding of the term remains implicit in the majority of the studies. Of the 158 studies that use the term incumbent, only 31, or just under a fifth, explain their specific understanding of it.[3] These 31 definitions are comparatively heterogeneous. Even though some definitions from the literature are taken up more frequently in the studies (e.g. Fligstein and McAdam, 2012; Steen and Weaver, 2017; Smink et al., 2015), most studies choose ad hoc definitions that are derived from various earlier attempts at definitions or from observations of empirical studies. Examples of such definitions are:

> "Incumbents are defined as those actors that are deeply entrenched in the socio-technical regime. They have accumulated (intangible) resources which provide competitive advantages over newcomers, have a strong network position in a regime, and can influence political processes of agenda-setting (Grin et al., 2011; Geels, 2014; Kungl, 2015)" (Galvan et al., 2020, p. 79).

[3] 17 studies fulfill all the selection criteria listed above, but use different terms for the firms they study.

> "[Incumbents are] powerful companies, utilities, or other actors who 'mainly have competencies related to the current technological regime' (Smink et al., 2015, p. 87), and who 'are assumed to strategically enact their interest' (Späth et al., 2016, p. 4)" (Mauw et al., 2022, p. 2).

> "In reference to Steen and Weaver (2017), we conceptualize incumbent companies as being profit-seeking actors that are 'established' and 'positioned' in markets" (Mori, 2021, p. 56).

These examples illustrate the diversity of characteristics attributed to incumbents – e.g. structural features, interests, relational position, expected behavior. A comparative analysis of the definitions using the method described in Section 3.3 shows that, for all their differences, some characteristics are more regularly ascribed to incumbents than others. Table 2 provides an overview. Most often, authors refer to the power and influence of the companies (at the business, political and symbolic levels), their established position in a market (in the sense of a significant market share and the company having existed for a long time) and their entanglement in the technologies, rules and cultural ideas of the existing socio-technical regime. Other frequently mentioned characteristics of incumbents are a conservative attitude towards change (and an associated interest in maintaining the status quo), control over a significant amount of resources (material and political), a large company size in terms of employees and economic indicators, and a high company age. While control over resources is typically associated with power, I have listed the two aspects separately because many definitions explicitly do so.

In summary, not only are there few explicit definitions (and no single prevailing one), but existing definitions often consist of a mixture of previous conceptual considerations and empirical observations from previous studies. Since the characteristics of incumbents differ across sectors, this has led to divergent generalizations about the characteristics of incumbents. Furthermore, there are differences in the extent to which the classification of a company as an incumbent depends on characteristics such as structural features, interests, relational position or expected behavior. There is therefore no common understanding of which characteristics should be used to differentiate between incumbents and other firms.

4.2. *The heterogeneous, ambivalent and temporally variable roles of incumbents*

Only a few studies identify a clear overarching role for the incumbents studied in the respective sustainability transition process. Stalmokaitė and Yliskylä-Peuralahti (2019), for example, argue in their study of Baltic shipping companies that "incumbent shipping

Table 2
Characteristics of incumbents mentioned in various definitions.

	Power and influence	Establishedness	Entrenched in the regime	Conservatism	Control over resources	Size	Age
Almeida and Melo (2016)					x	x	
Altunay and Bergek (2023)	x	x				x	x
Altunay et al. (2021)	x	x					
Ampe et al. (2021)	x			x	x		
Apajalahti et al. (2018)	x				x		
Berggren et al. (2015)		x					
Bohnsack et al. (2020)		x	x				
Bulah et al. (2023)			x	x			
Černoch et al. (2021)			x				
Černý and Ocelík (2020)				x			
Friedrich et al. (2023)	x	x	x		x	x	x
Galvan et al. (2020)	x		x		x		
Hellsmark and Hansen (2020)	x				x		x
Hildermeier and Villareal (2011)	x					x	
Hoes et al. (2016)		x	x				
Karttunen et al. (2021)						x	x
Köhrsen (2018)	x			x			
Kungl (2015)	x				x		
Lockwood et al. (2019)	x	x					
Lowes et al. (2020)	x	x					
Mah et al. (2017)		x	x				
Mauw et al. (2022)	x		x	x			
Miller (2013)		x					
Mori (2021)		x					
Ramanauskaite (2021)	x	x				x	x
Ruggiero et al. (2021)	x		x	x			
Shittu and Weigelt (2022)		x	x				
Smink et al. (2015)			x	x			
Späth et al. (2016)	x		x				
Steen and Weaver (2017)		x		x			
Strøm-Andersen (2020)		x					
Trencher et al. (2021)	x	x	x				

Source: Own compilation. The list includes all characteristics mentioned in five or more definitions.

actors play an active role in creating protected niches […]" (Stalmokaitė and Yliskylä-Peuralahti, 2019, p. 14) and Köhrsen (2018) describes the case of an urban energy transition where "the incumbent and its allies promote the low carbon transformation of the city's energy system" (Köhrsen, 2018, p. 312). Lockwood et al. (2020) "provide a detailed empirical case relating to the wider argument that incumbents will play a major role in slowing and shaping sustainable energy transformations" (Lockwood et al., 2020, p. 8), while Černý and Ocelík (2020) analyze the case of Czech coal policy and argue that "incumbents successfully prevented policy change in the direction of rapid coal phase-out" (Černý and Ocelík, 2020, p. 272).

The vast majority of studies, however, do not end with such clear-cut diagnoses. Most of the studies describe the activities of incumbents, sometimes focusing on single areas of activity (such as business activities or socio-political activities), sometimes taking a

Table 3
Categories of activities and overall roles of incumbents as highlighted in different studies.

Studies focusing on one area of the firms' activities
Business activities
Diversifying into sustainability-related business areas
Altunay et al. (2021); Andersen and Gulbrandsen (2020); Bui et al. (2019); Criqui and Zérah (2015); Chizaryfard and Karakaya (2022); Doblinger and Soppe (2013); Frei et al. (2018); Garcia Hernández et al. (2021); Hansen and Steen (2015); Hörisch (2018); Kattirtzi et al. (2021); Kim et al. (2022); Li et al. (2022); Kishna et al. (2017); Loder et al. (2024); Mäkitie (2020); Mäkitie et al. (2018); Mäkitie et al. (2019); Midttun and Piccini (2017); Miller (2013); Moncreiff et al. (2024); Nilsen (2017); Novotny and Laestadius (2014); Ossenbrink et al. (2019); Peirera et al. (2022); Pickl (2019); Pinkse and van den Buuse (2012); Richter (2013a); Ruggiero et al. (2021); Shittu and Weigelt (2022); Sovacool et al. (2017); van der Loos et al. (2020); Wassermann et al. (2015)
Improving sustainability of processes, practices or products
Barford and Ahmad (2023); Del Río González (2005); Franco (2017); Frishammar and Parida (2019); Gandolfo and Lupi (2021); Guldmann and Huulgaard (2020); Karttunen et al. (2021); Mylan et al. (2015); Raven (2006); Zucchella et al. (2022)
Support for sustainability-related newcomers
Altunay and Bergek (2023); Bulah et al. (2023); Fevolden and Klitkou (2017); Hegeman and Sørheim (2021)
Exerting power over other firms to become more sustainable
Bor et al. (2024); Touboulic et al. (2018)
Low level of sustainability-related business activities
Hansen and Coenen (2016); Richter (2013b)
Heterogeneous business activities across firms
Goggins and Rau (2021); Gonera et al. (2022); Palmié et al. (2021); Ratinen and Lund (2014); Steen and Weaver (2017); Vieira et al. (2022a); Weigelt et al. (2021)
Socio-political activities
Hindering sustainability-related regulation
Černý and Ocelík (2020); Downie (2017); Hess (2013); Hess (2016); Hess (2019); Holtkamp (2023); Lee and Hess (2019); Leipprand and Flachsland (2018); Lockwood et al. (2020); Kuhl et al. (2024); Malmborg (2024); Richter and Smith Stegen (2022); Strambo et al. (2020); Trencher et al. (2019)
Supporting sustainability-related regulation
Behrsin et al. (2021); Galvan et al. (2020); Hoes et al. (2016); Lowes et al. (2020); Ohlendorf et al. (2023); Scharnigg (2024); Vormedal and Skjærseth (2020)
Shifting from hindrance to support of sustainability-related regulations over time
Bach (2019); Bonneuil et al. (2021); Vormedal et al. (2020); Wesseling et al. (2014); Wesseling et al. (2015b)
Communicative legitimization strategies
Halttunen et al. (2022); Maroun et al. (2018); Patala et al. (2017); Tillotson et al. (2023)
Heterogeneous socio-political activities across firms
Bähr and Fliaster (2023); Bosman et al. (2014); Hess and Brown (2018); Kronsell et al. (2019); Stenzel and Frenzel (2008)
Innovation activities
Sustainability-oriented research and pilot projects
Almeida and Melo (2016); Apajalahti et al. (2018); Augenstein (2015); Bohnsack et al. (2020); Borghei and Magnusson (2016b); Borgstedt et al. (2017); Engwall et al. (2021); Heiskanen et al. (2018); Hellsmark and Hansen (2020); Matschoss and Heiskanen (2018); Mauw et al. (2022); Moors (2006); Nurdiawati and Urban (2022); Onufrey and Bergek (2020); Sierzchula et al. (2012); Sovacool et al. (2019); Späth et al. (2016); Stalmokaitė et al. (2022); Stalmokaitė and Yliskylä-Peuralahti (2019); Strøm-Andersen (2019); Strøm-Andersen (2020); Tsvetanova et al. (2021); Zimmerling et al. (2017)
Studies with a broad perspective on the firms' activities
Overall activities
Hindering the transition
Berlo et al. (2017); Černoch et al. (2021); Hanto et al. (2022); Hildermeier and Villareal (2011); Ince et al. (2016); Skeete (2019); Ting and Byrne (2020)
Supporting the transition
Berggren et al. (2015); Greer et al. (2020); Köhrsen (2018); Mah et al. (2017); Morgunova and Shaton (2022); Ramanauskaite (2021); Trencher et al. (2021)
Supporting and hindering the transition at the same time – dual roles
Kenner and Heede (2021); Sillak and Kanger (2020); Smink et al. (2015); Vieira et al. (2022b)
Staying largely inert
Dewald and Achternbosch (2016); Friedrich et al. (2023); Janipour et al. (2020); Wesseling and van der Vooren (2017)
Incremental reorientation towards sustainability
Dzhengiz et al. (2023); Green et al. (2021); Geels (2022); Geels and Gregory (2023); Geels and Gregory (2024); Gregory and Geels (2024); Johnstone et al. (2020); Karltorp and Sandén (2012); Kungl (2015); Kungl and Geels (2018); Penna and Geels (2015); Stalmokaitė and Hassler (2020); Tziva et al. (2020); Urban et al. (2024)
Heterogeneous roles across firms
Ampe et al. (2021); Ertelt and Kask (2024); Käsbohrer et al. (2024); Levy and Kolk (2002); Lis and Szymanowski (2022); Mori (2021); Mylan et al. (2019); Peirera et al. (2020); Werner et al. (2022); Wesseling et al. (2015a)

Source: Own compilation

broad perspective across various areas of activity, and give (sometimes more, sometimes less explicitly) an assessment of the impact of these activities on the transition process. I have grouped the activities described and the influence they are assumed to have on the transition process into categories (for the methodological approach, see Section 3.3). Table 3 provides an overview, focusing on the activities that were particularly emphasized in the respective study. I will present the categories of activities in more detail below and describe the variations within the categories.

There are a large number of studies that focus on the analysis of a single area of activity within incumbent firms, such as their business activities, socio-political activities or innovation activities. I will cover these areas in turn before turning to the broader studies that cover several areas of activity at once.

Numerous studies describe the expansion of *business activities* to include more sustainability-related technologies, often under the term "diversification". This diversification can take place within the companies' own sector – e.g. electricity suppliers diversifying into renewable energies (Ossenbrink et al., 2019) or carmakers diversifying into alternative drive systems (Loder et al., 2024) – or by entering other sectors, e.g. oil and gas producers expanding into wind power plants (Hansen and Steen, 2015). In most cases, the established business remains unaffected by these activities (Bui et al., 2019; Chizaryfard and Karakaya 2022). Moreover, diversification into sustainability-related business areas is not necessarily persistent – companies often withdraw again (Garcia Hernández et al., 2021; Miller, 2013) or the intensity of the activities fluctuates over time (Mäkitie et al., 2019). In some cases, these activities also occur in the context of broader diversification strategies that go beyond sustainability-related business areas (Andersen and Gulbrandsen, 2020; Kattirtzi et al., 2021) and may also result from motives that oppose the sustainability transition, for example the desire to ward off new challengers (Sovacool et al., 2017). While diversification into sustainability-related business areas is typically viewed positively by the authors, the studies also show that it can have very different implications for a transition process depending on the context.

Other business activities frequently observed in the sample are the incremental sustainability-related improvement of business practices, processes or products (Mylan et al., 2015; Raven, 2006), and support for sustainability-oriented newcomers (Bulah et al., 2023; Hegeman and Sørheim, 2021). Some studies also address the use of market power, which can go in different directions. For example, incumbents can erect barriers to market entry for newcomers (Ting and Byrne, 2020), but they can also put pressure on suppliers to increase the sustainability of their products (Bor et al., 2024). Finally, some incumbents show little in the way of sustainability-related business activity or remain largely inert (Hansen and Coenen, 2016; Richter, 2013b).

Especially when studies examine a larger number of incumbents, it becomes clear that the extent of sustainability-related business activities, even within a sector and country, is typically quite heterogeneous (Palmié et al., 2021; Steen and Weaver, 2017; Weigelt et al., 2021).

When it comes to *socio-political activities*, many studies describe the attempts of incumbents to hinder or weaken sustainability-related political regulations – with varying degrees of success – through lobbying or information strategies (Richter and Smith Stegen, 2022; Černý and Ocelík, 2020). Some studies have also observed incumbents supporting sustainability-related regulations (Galvan et al., 2020; Ohlendorf et al., 2023), but often only selectively based on business opportunities (Lowes et al., 2020; Scharnigg, 2024) or in order to disadvantage other market players (Vormedal and Skjærseth, 2020).

Some studies describe socio-political activities that became more supportive of sustainability (Vormedal et al., 2020; Wesseling et al., 2014) or more heterogeneous within a sector (Bosman et al., 2014) over time. In addition, incumbent companies were often observed to use communicative legitimation strategies to counter social criticism (Patala et al., 2017; Tillotson et al., 2023). In general, the potential heterogeneity of the activities of incumbents with regard to sustainability is also evident in their socio-political activities (Stenzel and Frenzel, 2008; Kronsell et al., 2019).

Finally, a number of studies focus on the *innovation activities* of incumbents, i.e. their research and development activities and their participation in pilot projects for the development and testing of new technologies or processes. Such activities often take place in collaboration with other actors such as start-ups (Mauw et al., 2022), users (Zimmerling et al., 2017), local authorities and citizens (Matschoss and Heiskanen, 2018), research institutions (Stalmokaitė et al., 2022) or companies from other sectors (Engwall et al., 2021; Nurdiawati and Urban, 2022). Incumbents can give collaborative research projects a certain drive, but authors typically view their participation critically as weakening the radicality of the niche (Augenstein 2015; Späth et al., 2016; Apajalahti et al., 2018).

Not only is the extent of sustainability-related innovation activities often heterogeneous among incumbents within a sector (Borgstedt et al., 2017), but the degree of radicalism in the approach to a certain innovation and the level of commitment over time can also vary greatly (Sovacool et al., 2019; Stalmokaitė and Yliskylä-Peuralahti, 2019). Finally, sustainability-related innovation activities are often not exclusive; instead, companies work simultaneously on sustainability-related and non-sustainability-related innovations (Onufrey and Bergek, 2020).

Taken together, studies that take a narrow view of the activities of incumbents and are limited to one area of activity indicate a wide variety of possible impacts by incumbents on sustainability transitions. However, due to the lack of context, they usually do not allow a clear attribution of the role of an incumbent in a transition process.

Studies that analyze a broader spectrum of activities (e.g. business activities, socio-political activities and innovation activities at the same time) are more likely to allow the attribution of an overarching role. Some studies describe cases of incumbents impeding sustainability transitions, ranging from fundamental obstruction (Hanto et al., 2022; Ting and Byrne, 2020) to attempts to control the speed and direction of a transition process (Skeete, 2019). Another set of studies describe incumbents that overall support sustainability transitions (Mah et al., 2017; Greer et al., 2020), while others portray incumbents that are largely inert (Janipour et al., 2020; Wesseling and van der Vooren, 2017). Further studies point to the ambivalent role of incumbents and describe dual strategies in which activities in different areas point in different directions (Kenner and Heede, 2021; Sillak and Kanger, 2020). Finally, some studies show an incremental reorientation of incumbents towards sustainability, which unfolds over an extended period of time with different

dynamics, consistency and depth (Kungl and Geels, 2018; Stalmokaitė and Hassler, 2020). Among the broad studies, some also highlight the heterogeneous roles of different incumbents within a sector (Peirera et al., 2020; Mori, 2021).

In summary, the review of the case studies shows that the roles of incumbent firms in sustainability transition processes are typically heterogeneous (including within a given sector), often change over time and, especially when several areas of activity are considered, are often inconsistent from a sustainability perspective. As a result, only a few studies allow a clear role to be attributed to an incumbent firm.

5. Conceptual contributions and discussion

In the following, I develop two conceptual contributions based on the results of the literature review – a new definition of incumbent firms and an ideal typology of their roles in sustainability transition processes – and discuss these against the backdrop of the current discourse on incumbents.

5.1. A new definition of incumbent firms

Considering that not even a fifth of the studies define their subject – incumbent firms – and considering how different the existing definitions sometimes are, more conceptual reflection on the term incumbent is needed in transition research. Existing definitions are not only heterogeneous; they also often mix conceptual considerations with empirical observations of single studies and can thus contribute only to a limited extent to a clearer understanding of what incumbents actually are. This lack of clarity leads to divergent criteria for case selection, influences the interpretation of study results and ultimately stands in the way of a nuanced discourse on the role of incumbents in sustainability transitions (Kungl, 2024).

Against this backdrop, I propose a definition for a narrow concept of incumbents that focuses on companies and is tailored to transition research: *Incumbent firms are the firms that, at a certain point in a sustainability transition process, hold a central position for the reproduction of an existing socio-technical system.*

This definition takes the existing socio-technical system whose transition is being investigated as the basic ontology for incumbent research. It thereby addresses the challenges that arise in the discourse on incumbents due to the utilization of different, often implicit, reference ontologies such as markets and regimes (Kungl, 2024). According to the common understanding, a socio-technical system serves to provide specific services (such as energy supply or food production) for a society and consists of (1) actors/networks of actors (individuals, companies and other organizations, collective actors), (2) rules and institutions (social and technical norms, regulations, standards of good practice; also referred to as socio-technical regimes) and (3) material artifacts and knowledge (factories, infrastructures, technology, material flows) (Geels and Turnheim, 2022, p. 8; Markard et al., 2012, p. 956). As an ontological reference point, a socio-technical system is comprehensive, including market configurations and institutional rules (inscribed in the regime) but also explicitly including material aspects.

The centrality of a company in a socio-technical system, and thus the question of which companies can be considered incumbents, can be determined based on the relevance of a company for fulfilling the social function of a specific socio-technical system (e.g. the provision of food). This is ultimately a relational question that can be answered in a Bourdieusian sense by referring to control over specific resources. This includes ownership of production facilities, infrastructure or market shares, but also non-material resources such as knowledge, recognition or connections to other actors (Husu, 2022). The classification must be carried out on a case-by-case basis. A central position is typically associated with power, but not necessarily (see below).

I included the time dimension in the definition to account for the temporal dynamics of incumbency (Turnheim and Sovacool, 2019). A company like Tesla, for example, is quite rightly framed in early research on electric mobility as a new challenger to the established automotive industry, but has since qualified itself as an incumbent in the mobility system (also in view of the fact that the long-established incumbents are increasingly focusing on electric mobility, too). Which companies are incumbents therefore depends on the period under investigation.

If one follows this definition, the specific characteristics of an incumbent (size, age, power or similar) – which previous definitions only agree on to a limited extent – emerge from the characteristics of the system under investigation (and the associated regime). For example, German incumbents in the electricity supply system in the context of the energy transition were large, old, powerful companies with a conservative attitude towards change (and thus largely fulfill all conventional notions of incumbents; Kungl, 2015). In the food supply system in Germany, on the other hand, the characteristics of incumbents vary considerably depending on their position in the production chain. The incumbents at the production level are a comparatively large number of comparatively small agricultural enterprises, which, although they have a certain ability to exert pressure on politicians and are well organized in the form of associations, have extremely limited power at the market level and essentially have to follow the rules set by the incumbents at the levels of food processing and distribution (Friedrich et al., 2023).

Against the backdrop of the challenges outlined in Section 2 and the characteristics of existing definitions of incumbents identified in Section 4.1, my redefinition serves two purposes: It is tailored to sustainability transition research and formulated in a way that is compatible with concepts from business administration, sociology and innovation research that are commonly used in transition research, such as dynamic capabilities, field theory and sectoral systems of innovation. In this way, I want to facilitate the integration of ideas from different disciplines into transition research. Magnusson and Werner (2022), for example, note in their review of different organization theories that each of them opens up different perspectives on incumbents and can therefore lead to different role attributions. Saleh et al. (2025), in turn, argue that the integration of knowledge from management, organization and business research into transition research is hampered by the lack of overarching interdisciplinary frameworks. Against this background, I want to

contribute to an interdisciplinary understanding of incumbent firms by formulating a definition that is compatible with various strands of transition research and can thus help to overcome disciplinary silos.

Second, my new definition can help to prevent artificial debates about the role of incumbents by contributing to the standardization of the classification of companies as incumbents and by turning specific characteristics of incumbents that have been the subject of definitional disagreement (power, size, conservatism) into questions for the respective empirical case. My definition is therefore able to represent incumbent firms in all their diversity and provide a basis for empirical studies and conceptual developments that help explain this diversity.

5.2. An ideal typology of incumbent firms

My literature review confirms the assumption that the role of incumbents is heterogeneous, often ambivalent and variable over time (Kungl, 2024; Mori, 2021; Turnheim and Sovacool, 2019). Since existing role typologies can reflect heterogeneity but not ambivalence and temporal variability, I have developed an ideal typology of incumbents based on the review that integrates these characteristics. Table 4 provides an overview of the identified ideal types along the applied comparative dimensions (the methodology for identifying the ideal types is described in Section 3.4).

In the following, the identified types are presented in more detail and illustrative cases are provided. To avoid misunderstandings, it must be emphasized once again that an ideal type is a construct that arises from the exaggeration of the characteristics of empirical phenomena. This means that an ideal type cannot be found in empirical reality, but it can be used to classify observed phenomena (Weber, 1949). It also follows that the illustrative cases mentioned rarely represent the respective ideal types 100 %.

Type 1: the crisis-ridden re-orienter

This ideal type is a company with significant market power and political influence which, aware of its dominant position, is initially confident that it can control the transition process via defensive lobbying and incremental innovations. Faced with a combination of economic difficulties, competition from sustainability-oriented companies, legitimacy crises, declining political support and stricter regulation, it ultimately undertakes a far-reaching strategic reorientation with a focus on sustainability-related business areas. The old business is continued as long as it seems economically reasonable and is phased out step by step. This is also reflected in political double strategies: the company supports sustainability-related regulations, but at the same time tries to maintain the profitability of the remaining non-sustainable business areas – for example by negotiating lucrative compensation for the phasing out of old technologies.

Illustrative cases: German energy companies (Kungl and Geels, 2018; Ossenbrink et al., 2019) and car manufacturers (Loder et al., 2024).

Type 2: The risk-hedging diversifier

This type of incumbent diversifies into new business activities in response to (anticipated) negative developments in the core business, but without seeking a fundamental reorientation. The new business activities are selected based on the transferability of existing resources and competencies and may include both sustainability-related and non-sustainable business areas. The extent and commitment of the new business areas depends, among other things, on developments in the core business (i.e. to what extent anticipated negative developments materialize). Since sustainability is not a primary decision criterion for diversification activities, the political and socio-cultural activities of these incumbents are also opportunistic and situation-dependent, and can either support or hinder sustainability.

Illustrative cases: Oil and gas (Pinkse and van den Buuse, 2012; Mäkitie et al., 2019), petro-tech (Andersen and Gulbrandsen, 2020) and pulp and paper companies (Onufrey and Bergek, 2020; Novotny and Laestadius, 2014).

Type 3: the dedicated re-orienter

Influenced by political regulations, a weakening core business and the growing potential of new technologies, this type divests all high-emission business units and undertakes a comprehensive reorientation towards sustainable business areas. This sustainable reorientation can take place within a sector or by entering another sector. Not only are its business activities consistently geared towards the new business areas, but its socio-political and innovation-related activities are also stringently aligned to support sustainability. However, the impact of the reorientation on the sustainability transition in the respective sector depends on how the emission-intensive business is phased out and whether it is continued by other companies.

Illustrative cases: Danish oil and gas company Dong (Dzhengiz et al., 2023) and Italian oil and gas company ERG (Vieira et al., 2022a).

Type 4: the sustainability greenhorn

This type of incumbent has long been outside the public focus due to the lack of visibility of its products (in the sense of their distance from end consumers). Environmental activities have historically been limited to end-of-pipe solutions that reduce pollutant emissions. Climate protection and public and political pressure to fundamentally change production processes are comparatively new challenges for this type of company. The company publicly advocates sustainability, but due to how embedded it is in fierce international competition for homogeneous goods, it is under huge economic pressure and has neither the economic flexibility nor the internal competencies required for a far-reaching sustainable reorientation. Political lobbying therefore aims at establishing (expensive) regulations or funding structures, without which the company would not be able to make sufficient changes to its activities.

Illustrative cases: British steel firms (Geels and Gregory, 2023, 2024), British and Dutch chemicals firms (Janipour et al., 2020; Geels, 2022) and German and Swiss cement firms (Dewald and Achternbosch, 2016).

Table 4
Attributes of ideal types of incumbents along comparative dimensions.

Comparative dimensions Ideal types	Scope of sust.-related activities	Scope of defensive activities	Temporal pattern of sust.-related activities	Consistency of activities (in terms of sust.)	External influencing factors highlighted	Internal influencing factors highlighted	Influence on sust. transition process	Number of related cases
Type 1: The crisis-ridden re-orienter	Medium	Medium	Increasing with varying intensity	Medium	Political and public pressure; market developments	Cultural change; management change	Ambivalent	8
Type 2: The risk-hedging diversifier	Low to medium	Medium	Ebb and flow	Low	Market develop-ments	Transferable competences and resources	Ambivalent	16
Type 3: The dedicated re-orienter	High	Low	Increment-ally increasing	High	Political and public pressure; market developments	Management change	Supportive	2
Type 4: The sustainability greenhorn	Low	Medium to high	Increasing with varying intensity	Low	Political pressure	Lack of competences and resources	Rather passive	6
Type 5: The self-enriching obstructor	Low	High	Static	High	Political entanglement	Economic interest	Hindering	5
Type 6: The gatekeeper	Low to medium	Low to medium	Situational	Low	Customer demand; public pressure	Lack of opportunity costs; power; image gain	Ambivalent	4

Source: Own conceptualization. For a definition of the comparative dimensions and criteria for differentiation, see Section 3.4.

Type 5: the self-enriching obstructor

This type is characterized by strong links between the state and companies, which manifest themselves in a blending of political and economic interests and go hand in hand with extensive opportunities for individuals to enrich themselves. This alignment of interests between politics and business allows for a fairly effective avoidance of sustainability-related regulations and the prevention of new players from entering the market. The company's embeddedness in global material flows and the state's dependence on these further complicate change processes. Sustainability-related activities by the company are limited to communication activities and defensive lobbying. Opportunities for change arise in the context of industry crises (due to mismanagement) or organized local resistance.

Illustrative cases: Energy suppliers and commodity firms in South Africa (Hanto et al., 2022; Ting and Byrne, 2020), Puerto Rico (Kuhl et al., 2024) and Colombia (Strambo et al., 2020).

Type 6: the gatekeeper

This ideal type of incumbent occupies a central interface between the producers of sustainable products and their customers and can thus control the distribution of these products. However, since sustainable products do not compete with their established business, their support depends on strategic considerations: customer demand, possible gains in terms of their public image and opportunities for diversifying their producer base (thereby strengthening their own market power). These incumbents thus have a great deal of power, but they use it neutrally from a sustainability perspective. The inclusion of sustainable products in their portfolio can lead to a gradual expansion of the product range and thus contribute to a wider distribution of these products. However, the existing non-sustainable business is usually continued in parallel, and a fundamental reorientation does not take place.

Illustrative cases: Food distribution companies from the UK, Belgium, the Netherlands and the USA (Mylan et al., 2019; Mylan et al., 2015; Bui et al., 2019; Bulah et al., 2023).

Types 1 to 3 are characterized by (sustainable) diversification or reorientation. However, the changes are not uniformly profound, unfold on different temporal scales and, when several areas of activity are considered simultaneously, appear to vary in consistency. In contrast, Types 4 to 6 are much more static. They do not fundamentally reorient themselves, and their significance for sustainability transition processes varies considerably due to their different interests and power resources. Overall, only two types can be attributed a relatively clear role in the transition process in the sense of either supporting or blocking it. In the other cases, the overarching role is ambivalent or rather passive. This suggests that both the old view of incumbents as blockers of sustainability transitions and the newer trend of focusing on the supportive roles of incumbents somewhat miss the point.

Against this background and compared with existing typologies, I take a novel approach. So far, the core characteristics of the role of incumbents – ambivalence and temporal variability – have been addressed by switching between or combining types. My types, on the other hand, are formulated at a higher level and deal with these two core aspects within each individual ideal type. The different types are thus characterized by varying degrees of ambivalence and different temporal dynamics.

This is in line with an argument by Magnusson and Werner (2022), who claim that the problem with an actor-centered view of firms is that it tends to regard an incumbent firm as a coherent actor. With my ideal typology, I attempt to capture the ambivalences, tensions and inconsistencies of incumbents. Whereas previous typologies can only capture companies in their entirety and with their whole history in very simple and exceptional cases (and are therefore more typologies of activities in specific areas and time periods than typologies of roles), my typology can do so more comprehensively.

I argue that a more complex typology of this kind provides a better starting point for further research into the reasons behind the heterogeneous roles of incumbents. Some authors (Karltorp and Perez Vico, 2025; Mylan et al., 2015) argue that the actions of incumbents in the context of sustainability transitions can only be explained multicausally, i.e. through the interaction of various influencing factors. A narrow focus on roles in specific areas or time periods runs the risk of only providing a partial picture of the constellation of influencing factors behind these actions. My typology offers a holistic perspective on incumbents, which can be used, for example, to examine variations within types and their causes – such as why individual incumbents of the risk-hedging diversifier type continue to reorient themselves towards sustainability over time, while others fall back into their traditional business activities.

This ideal typology, however, should not be regarded as complete. After all, it is a reflection of the sample of case studies on which it is based and thus of the uneven state of research in different sectors and world regions (see Section 3.2). Furthermore, only 41 of the 53 studies on which the typology is based can be related to one of the identified types; 12 studies remain that do not fit the typology. These are either cases that are very specific (Černoch et al., 2021) or cases that do not have enough in common with other cases to allow for grouping (Garcia Hernández et al., 2021; Köhrsen, 2018). There is thus potential for refining and complementing the ideal typology.

6. Conclusion

In the present text, I have summarized the results of 174 studies on the activities of incumbent firms in sustainability transition processes. My literature review provides two key findings, which I have taken as the starting point for conceptual contributions.

Firstly, research on incumbents is characterized by a certain nonchalance regarding the conception of the term, which results in heterogeneous definitions or, in many cases, the lack of any definition at all. I therefore propose a new definition of the term incumbent: Incumbent firms are the firms that, at a certain point in a sustainability transition process, hold a central position for the reproduction of an existing socio-technical system. I argue that such a definition is compatible with the most common frameworks of transition research and thus supports dialogue between different strands of theory. Furthermore, it reflects the diversity of incumbents and helps to overcome disagreements about the characteristics of incumbents by turning them into empirical rather than theoretical questions. Further research on this topic could address the implications of different definitions, theoretical frameworks and academic backgrounds on incumbent research – aspects for which Magnusson and Werner (2022) and van Mossel et al. (2018) have already laid

important groundwork.

Secondly, the role of incumbent firms in sustainability transition processes is usually heterogeneous (within a sector), multidimensional (i.e. it differs in different areas of a firm's activity) and temporally variable. With these considerations in mind, I have developed an ideal typology of incumbent firms based on a grouping of empirical cases, which comprises six types: the crisis-ridden re-orienter, the risk-hedging diversifier, the dedicated re-orienter, the sustainability greenhorn, the self-enriching obstructor and the gatekeeper. Compared with existing typologies of incumbents, I take a broader approach that reflects the ambivalence and temporal variability of the activities of incumbents within the individual types. This ideal typology thus goes beyond previous typologies in that it captures incumbents in their historicity and complexity.

Given that my study offers little support for a dualistic view of incumbents as either supporters or blockers of sustainability transitions, I suggest that future research should focus more on understanding the ambivalences of incumbents' activities and on evaluating the overall impact of incumbents with diverging activities. This means, firstly, that the causes for seemingly contradictory activities by incumbents in different areas of activity could be investigated more systematically. Research on this topic can build on existing work by Karltorp and Perez Vico (2025), Mori (2021) and Mori and Zhang (2024). Secondly, future research could help to create a methodological toolkit for the assessment of the impact of the activities of incumbents on the transition process under investigation. Although the development of objective evaluation criteria is an impossible task, there is some potential for making current evaluation practices more systematic.

However, my literature review also has limitations. For one thing, it focuses on studies in transition research, which, despite the diversity of the research stream, still means it takes a specific perspective on the object of study. Extending the review to other research strands could help to produce a more precise picture of incumbents. In particular, organization and management research has the potential to address specific gaps in transition research, such as the tendency to focus on overall sectoral developments and pay less attention to internal organizational processes. This resonates with arguments put forward by Saleh et al. (2025) and Magnusson and Werner (2022). Furthermore, in transition research, incumbent research continues to be biased towards the Western world and the energy and transport sectors. Other world regions, as well as the food and the processing industries, have been researched less by comparison. This means that my considerations, in particular regarding the role of incumbents, must be viewed against the backdrop of these research gaps (see also Saleh et al., 2025).

CRediT authorship contribution statement

Gregor Kungl: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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.

Appendix

Table 5
Overview of the reviewed studies.

Study	Sector	Region	Country	Investigated companies
Almeida and Melo (2016)	Oil and gas	South America	BR	Petrobras
Altunay and Bergek (2023)	Electricity	Scandinavia	SE	n/a
Altunay et al. (2021)	Electricity	Scandinavia	SE	30 Swedish utilities
Ampe et al. (2021)	Waste water	Western Europe	BE	DeSaH; Farys; Sogent; CAAAP; Aquafin
Andersen and Gulbrandsen (2020)	Petro-technology	Scandinavia	NO	n/a
Apajalahti et al. (2018)	Electricity	Scandinavia	FI	Fortum; Helen
Augenstein (2015)	Automobility	Central Europe	DE	n/a
Bach (2019)	Oil and gas	Global (various)	Global (various)	n/a
Bähr and Fliaster (2023)	Electricity	Central Europe	DE	n/a
Bakker (2010)	Automobility	Global (various)	Global (various)	n/a

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Table 5 (*continued*)

Study	Sector	Region	Country	Investigated companies
Barford and Ahmad (2023)	Chemistry	USA	USA	Dow Chemical
Behrsin et al. (2021)	Coal mining; forestry; animal husbandry	USA	USA	n/a
Berggren et al. (2015)	Heavy vehicles	Europe (various)	SE; GB	Volvo; Scania; BAE
Berlo et al. (2017)	Electricity	Central Europe	DE	E.ON; RWE; EnBW
Bohnsack et al. (2020)	Automobility	Global (various)	DE; IT; USA; CN; JP; NL; FR; SE	BMW; Daimler; Fiat; Ford; Geely; General Motors; Honda; Mitsubishi; Nissan-Renault; Peugeot/Citroen; Tesla; Toyota; Volkswagen; Volvo
Bonneuil et al. (2021)	Oil and gas	Western Europe	FR	Total
Bor et al. (2024)	Food processing; retail; packaging	Scandinavia	FI	n/a
Borghei and Magnusson (2016a)	Heavy vehicles	Europe (various)	DE; SE	Daimler; Volvo/Renault; MAN; Scania
Borghei and Magnusson (2016b)	Heavy vehicles	Europe (various)	SE; CZ; ES; PL; BE; NL	Volvo; Ekova; Irizar; Solaris; VanHool; VDL
Borgstedt et al. (2017)	Automobility	Global (various)	Global (various)	100 biggest suppliers
Bosman et al. (2014)	Electricity	Western Europe	NL	Eneco; E.ON Benelux; GDF-Suez; VEMW; Nuon/Vattenfall; RWE/Essent
Brauers et al. (2020)	Electricity	Europe (various)	GB; DE	n/a
Budde et al. (2015)	Automobility	Global (various)	DE; JP	Daimler; Toyota
Bui et al. (2019)	Retail	Western Europe	BE	Carrefour
Bulah et al. (2023)	Food processing; retail; services	Global (various)	USA; NL; GB	n/a
Černoch et al. (2021)	Electricity	Central Europe	CZ	EPH
Černý and Ocelík (2020)	Coal mining	Eastern Europe	CZ	ČEZ Group; Sev.en; Sokolov Coal
Chen and Yu (2024)	Electricity	Asia	CN	State Grid
Chizaryfard and Karakaya (2022)	Metals	Scandinavia	SE	Boliden
Criqui and Zérah (2015)	Electricity	Asia	IN	BRPL; BYPL; TPDDL
Del Río González (2005)	Pulp and paper	Southern Europe	ES	n/a
Dewald and Achternbosch (2016)	Cement	Central Europe	DE; CH	n/a
Doblinger and Soppe (2013)	Electricity	USA	USA	n/a
Downie (2017)	Oil and gas; coal mining; electricity	USA	USA	n/a
Dzhengiz et al. (2023)	Oil and gas; electricity	Scandinavia	DK	Dong/Orsted
Engwall et al. (2021)	Electricity; steel; heavy vehicles	Scandinavia	SE	Scania; Siemens; SSAB; LKAB; Vattenfall
Ertelt and Kask (2024)	Road freight transport	Scandinavia	SE	n/a
Fevolden and Klitkou (2017)	Oil and gas	Scandinavia	NO	Cambi; Norske Skog; Xynergo; Weyland; Borregaard
Franco (2017)	Textile production	Europe (various)	CH; DE; AT	n/a
Frei et al. (2018)	Electricity	Global (various)	Global (various)	25 largest global utilities
Friedrich et al. (2023)	Animal husbandry	Central Europe	DE	n/a
Frishammar and Parida (2019)	Automobility; heavy vehicles; engineering; aviation	Europe (various)	SE; FI; FR; GB	Scania; Volvo; Saab; Metso; Smith & Nephew; Volvo Construction Equipment; Asko; Nexans
Galvan et al. (2020)	Electricity	Western Europe	NL	n/a
Gandolfo and Lupi (2021)	Pulp and paper	Southern Europe	IT	Lucart
Garcia Hernández et al. (2021)	Agricultural production	Central America	MX	n/a
Geels (2022)	Chemistry	Western Europe	GB	SABIC; INEOS; ExxonMobil; CF Fertilisers; Tata Chemicals; Tioxide Europe; Millenium Inorganic Chemicals; BOC Linde

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Table 5 (*continued*)

Study	Sector	Region	Country	Investigated companies
Geels and Gregory (2023)	Metals	Western Europe	GB	Tata Steel UK; Liberty Steel; EMR; Celsa Steel; British Steel
Geels and Gregory (2024)	Steel; petro-chemistry; oil refining	Western Europe	GB	Tata Steel UK; Liberty Steel; EMR; Celsa Steel; British Steel; Petroineos; Prax Lindsay; Phillips 66; Essar; Valero; ExxonMobil; SABIC; INEOS; ExxonMobil; CF Fertilisers; Tata Chemicals; Tioxide Europe; Millenium Inorganic Chemicals; BOC Linde
Goggins and Rau (2021)	Food services	Western Europe	IE	n/a
Gonera et al. (2022)	Food production; processing; distribution; retail	Scandinavia	NO	n/a
Green et al. (2021)	Oil and gas	Global (various)	USA; NO; GB; FR; IT; ES	ConocoPhillips; Exxon; Chevron; Equinor; Shell; BP; Total; Eni; Repsol
Greer et al. (2020)	Food services	Western Europe	NL	Sodexo
Gregory and Geels (2024)	Oil refining	Western Europe	GB	Petroineos; Prax Lindsay; Phillips 66; Essar; Valero; ExxonMobil
Guldmann and Huulgaard (2020)	Textile production; engineering	Scandinavia	DK	n/a
Halttunen et al. (2022)	Oil and gas	Global (various)	Global (various)	n/a
Hansen and Coenen (2016)	Pulp and paper	Europe (various)	SE; FI	n/a
Hansen and Steen (2015)	Oil and gas; electricity	Scandinavia	NO	n/a
Hanto et al. (2022)	Electricity; coal mining	South Africa	ZA	SASOL; Eskom
Hegeman and Sørheim (2021)	Electricity; oil and gas; fish farming; metal processing	Scandinavia	NO	n/a
Heiskanen et al. (2018)	Electricity; heat	Scandinavia	FI	Helen; Tampere Electricity Utility
Hellsmark and Hansen (2020)	Electricity; oil refining; heat; forestry	Scandinavia	SE	Göteborg Energi; Volvo; Preem; E.ON; Domsjö Fabriker/ Aditya Birla; Setra u.a.
Hess (2013)	Electricity	USA	USA	n/a
Hess (2016)	Electricity	USA	USA	n/a
Hess (2019)	Electricity	USA	USA	n/a
Hess and Brown (2018)	Water	USA	USA	n/a
Hildermeier and Villareal (2011)	Automobility; electricity	Europe (various)	DE; FR	n/a
Hoes et al. (2016)	Dairy	Western Europe	NL	n/a
Holtkamp (2023)	Agricultural production	Southern Europe	IT	n/a
Hörisch (2018)	Animal husbandry	Central Europe	DE	n/a
Ince et al. (2016)	Electricity	Caribbean	Caribbean (various)	n/a
Janipour et al. (2020)	Chemistry	Western Europe	NL	Royal Dutch Shell; AkzoNobel; Chemelot
Johnstone et al. (2020)	Electricity	Europe (various)	DE; GB	n/a
Karltorp and Sandén (2012)	Pulp and paper	Scandinavia	SE	n/a
Karttunen et al. (2021)	Cement	Global (various)	Global (various)	n/a
Käsbohrer et al. (2024)	Electricity; automobility	Central Europe	DE	n/a
Kattirtzi et al. (2021)	Electricity	Western Europe	GB	Centrica; EDF; E.ON; RWE; Scottish Power; SSE
Kenner and Heede (2021)	Oil and gas	Global (various)	GB; USA	BP; Chevron; ExxonMobil; Royal Dutch Shell
Kim et al. (2022)	Automobility	Global (various)	DE; JP	Volkswagen; Toyota
Kishna et al. (2017)	Agricultural production	Western Europe	NL	n/a
Köhrsen (2018)	Electricity	Central Europe	DE	Stadtwerke Emden
Kronsell et al. (2019)	Various	Scandinavia	SE	n/a
Kuhl et al. (2024)	Electricity	Caribbean	PR	n/a
Kungl (2015)	Electricity	Central Europe	DE	E.ON; RWE; EnBW; Vattenfall

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Table 5 (*continued*)

Study	Sector	Region	Country	Investigated companies
Kungl and Geels (2018)	Electricity	Central Europe	DE	E.ON; RWE; EnBW; Vattenfall
Kvellheim (2017)	Buildings	Scandinavia	NO	n/a
Lang and Mohnen (2019)	Automobility	Central Europe	DE	n/a
Lee and Hess (2019)	Electricity	USA	USA	n/a
Leipprand and Flachsland (2018)	Electricity; coal mining	Central Europe	DE	EnBW; Vattenfall; RWE; Steag; Mirbag; Leag
Levy and Kolk (2002)	Oil and gas	Global (various)	USA; GB	Exxon; BP; Shell; Texaco
Li et al. (2022)	Oil and gas	Global (various)	USA; GB	Chevron; ExxonMobil; BP; Shell
Lindfors and Jakobsen (2022)	Fish farming	Scandinavia	NO	n/a
Lis and Szymanowski (2022)	Automobility; electricity; oil refining	Central Europe	PL	Citroen; Innogy; Tauron; PGE; Energa; Enea; PKN Orlen
Lockwood et al. (2019)	Electricity	Western Europe	GB	n/a
Lockwood et al. (2020)	Electricity	Western Europe	GB	n/a
Loder et al. (2024)	Automobility	Central Europe	DE	BMW; Daimler; VW
Lowes et al. (2020)	Heat	Western Europe	GB	n/a
Mah et al. (2017)	Electricity	Asia	CN	SGCC; CSG
Mäkitie (2020)	Oil and gas	Scandinavia	NO	n/a
Mäkitie et al. (2018)	Oil and gas	Scandinavia	NO	n/a
Mäkitie et al. (2019)	Oil and gas	Scandinavia	NO	n/a
Malmborg (2024)	Shipping	Europe (various)	EU (various)	n/a
Maroun et al. (2018)	Agricultural production; fish farming; retail	South Africa	ZA	n/a
Matschoss and Heiskanen (2018)	Electricity; heat	Scandinavia	FI	Helen
Mauw et al. (2022)	Water; electricity	USA	USA	DWP
Mazur et al. (2015)	Automobility	Central Europe	DE	VW; Daimler; BMW
Midttun and Piccini (2017)	Electricity	Europe (various)	DE; IT; FR; ES; GB; AT; FI	E.ON; RWE; Enel; ENGIE; EDF; Iberdrola; SSE; Verbund; Fortum
Miller (2013)	Oil and gas	Western Europe	GB	BP; Shell
Moncreiff et al. (2024)	Oil and gas	Western Europe	NL	NAM
Moors (2006)	Metals	Europe (various)	NL; NO	Aluminium Delfzijl; Hydro Aluminium
Morgunova and Shaton (2022)	Oil and gas	Global (various)	Global (various)	n/a
Mori (2021)	Electricity	Asia	CN	Huaneng; Guodian; Huadian; Datang; SPIC; Huarun
Mylan et al. (2015)	Retail	Western Europe	GB	Asda; Morrisons; Tesco; Waitrose
Mylan et al. (2019)	Dairy	Western Europe	GB	n/a
Nilsen (2017)	Oil and gas	Scandinavia	NO	Statoil
Novotny and Laestadius (2014)	Pulp and paper	Scandinavia	SE	Domsjö Fabriker; Södra Cell; Holmen Paper
Nurdiawati and Urban (2022)	Electricity; oil refining; heavy vehicles	Scandinavia	SE	Preem; Neste; St1; Stockholm Exergi; Volvo Trucks; Scania; Vattenfall
Ohlendorf et al. (2023)	Electricity; heat; processing industries; transport	Central Europe	DE	n/a
Onufrey and Bergek (2020)	Pulp and paper	Scandinavia	SE	n/a
Ossenbrink et al. (2019)	Electricity	Central Europe	DE	E.ON; RWE; EnBW; Vattenfall
Palmié et al. (2021)	Electricity	Global (various)	USA; GB; IN	n/a
Patala et al. (2017)	Electricity	Global (various)	Global (various)	n/a
Penna and Geels (2015)	Automobility	USA	USA	n/a

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Table 5 (*continued*)

Study	Sector	Region	Country	Investigated companies
Peirera et al. (2020)	Electricity	Europe (various)	EU (various)	n/a
Peirera et al. (2022)	Electricity	Europe (various)	GB; CZ; DE; PT; FR; IT; FI; DK; SE; AT	Centrica; CEZ; E.ON; EDP; EDF; EnBW; Enel; Engie; Fortum; Iberdrola; Innogy; National Grid; Naturgy Energy; Orsted; RWE; SSE; Uniper; Vattenfall; Veolia Environment; Verbund
Pickl (2019)	Oil and gas	Global (various)	NO; IT; FR; GB; USA; BR	Equinor; Eni; Total; Shell; BP; Chevron; Petobras; Exxon Mobil
Pinkse and van den Buuse (2012)	Oil and gas	Europe (various)	GB; FR	BP; Royal Dutch Shell; Total
Ramanauskaite (2021)	Electricity; heat; water	Central Europe	LT	n/a
Ratinen and Lund (2014)	Electricity	Europe (various)	DE; ES; FI; DK	E.ON; RWE; Vattenfall; Iberdrola; Gas Natural Fenosa; Endesa; Fortum; PVO; TVO; Dong Energy; Vattenfall; Østkraft
Raven (2006)	Electricity	Western Europe	NL	UNA; EPZ; EZH; EPON
Richter (2013a)	Electricity	Central Europe	DE	E.ON; RWE; Vattenfall; EnBW; EWE; Stadtwerke München; Stadtwerke Düsseldorf; Mainova; Stadtwerke Karlsruhe; HEAG; Stadtwerke Aachen; Elektrizitätswerke Mittelbaden; Stadtwerke Tübingen
Richter (2013b)	Electricity	Central Europe	DE	E.ON; RWE; Vattenfall; EnBW; EWE; Stadtwerke München; Stadtwerke Düsseldorf; Mainova; Stadtwerke Karlsruhe; HEAG; Stadtwerke Aachen; Elektrizitätswerke Mittelbaden; Stadtwerke Tübingen
Richter and Smith Stegen (2022)	Automobility	Central Europe	DE	n/a
Ruggiero et al. (2021)	Electricity	Scandinavia	FI	n/a
Scharnigg (2024)	Electricity	Southern Europe	PT	EDP
Shittu and Weigelt (2022)	Electricity	USA	USA	n/a
Sierzchula et al. (2012)	Automobility	Global (various)	JP; USA; DE; KR; FR; IT; CN	Toyota; General Motors; Volkswagen; Ford; Hyundai; PSA; Nissan; Fiat; Suzuki; Honda; Renault; Daimler; Chana Automobile; BMW; Mazda
Sillak and Kanger (2020)	Shale oil	Central Europe	EE	n/a
Skeete (2019)	Light duty vehicles	Western Europe	GB	Audi; AVL Powertrain UK; Ford; Jaguar Land Rover; Tesla u. a.
Smink et al. (2015)	Lighting; fuel production	Western Europe	NL	n/a
Sovacool et al. (2017)	Automobility	Global (various)	DE; USA	Volkswagen; General Motors; Tesla
Sovacool et al. (2019)	Automobility	Europe (various)	DE; IT	BMW; Fiat
Späth et al. (2016)	Automobility; electricity	Central Europe	DE	Daimler; Bosch; EnBW
Stalmokaitė et al. (2022)	Shipping	Scandinavia	SE	Wallenius Marine
Stalmokaitė and Hassler (2020)	Shipping	Europe (various)	EE; LV; LT	n/a
Stalmokaitė and Yliskylä-Peuralahti (2019)	Shipping	Europe (various)	EE; LV; LT	n/a
Steen and Weaver (2017)	Oil and gas; electricity	Scandinavia	NO	n/a
Steffen et al. (2022)	Electricity	Europe (various)	DE; SE; CZ; AT; PT; EE	Enervie; Mainova; Skellefteakraft; CEZ; EnBW; Rheinenergie; Energie AG Oberösterreich; EDA; Stadtwerke München; Eesti Energia
Stenzel and Frenzel (2008)	Electricity	Europe (various)	DE; ES; GB	n/a
Strambo et al. (2020)	Coal mining	South America	CO	n/a
Strøm-Andersen (2019)	Food processing	Scandinavia	NO	n/a
Strøm-Andersen (2020)	Food processing; dairy	Scandinavia	NO	n/a
Tillotson et al. (2023)	Oil and gas	Global (various)	USA; GB	ExxonMobil; Chevron; BP
Ting and Byrne (2020)	Electricity	South Africa	ZA	Eskom
Touboulic et al. (2018)	Food processing	Western Europe	GB	n/a
Trencher et al. (2019)	Electricity; coal mining	Asia	JP	n/a
Trencher et al. (2021)	Automobility	Global (various)	CN; JP; US	Air Liquide; Honda; Hyundai-Kia; Shell New Energies; Toyota; Iwatani; Kawasaki Heavy Industries; Toyota

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Table 5 (*continued*)

Study	Sector	Region	Country	Investigated companies
Tsvetanova et al. (2021)	Chemistry; pulp and paper	Central Europe	DE	n/a
Turnheim and Geels (2019)	Public transport	Western Europe	FR	n/a
Tziva et al. (2020)	Food processing	Western Europe	NL	n/a
Urban et al. (2024)	Aviation; heavy shipping	Scandinavia	SE	n/a
van der Loos et al. (2020)	Oil and gas; maritime industries	Western Europe	NL	n/a
Vieira et al. (2022a)	Oil and gas	Europe (various)	FR; GB; IT; ES; HU; AT; PL; GR	Total; BP; Royal Dutch Shell; Eni; Repsol; MOL; OMV; PKN Orlen; ERG; Hellenic Petroleum
Vieira et al. (2022b)	Oil and gas	Europe (various)	NL; FR; AT; GB; PL; HU; PT; IT; SE; ES; GR	Royal Dutch Shell; Total; OMV; BP; PKN Orlen; MOL Group; Galp Energia; Eni; Lundin Energy; Grupa LOTOS; Repsol; Hellenic Petroleum
Vormedal et al. (2020)	Oil and gas	Global (various)	USA; GB; NO; FR; IT	ExxonMobil; Chevron; ConocoPhillips; BP; Shell; Equinor; Total; ENI
Vormedal and Skjærseth (2020)	Fish farming	Scandinavia	NO	Marine Harvest; Lerøy Seafood Group; Salmar; Cermaq/ Mitsubishi; Grieg Seafood; Nordlaks Holding; Norway Royal Salmon
Wassermann et al. (2015)	Electricity	Central Europe	DE	n/a
Weigelt et al. (2021)	Electricity	USA	USA	n/a
Werner et al. (2022)	Heavy vehicles	Scandinavia	SE	Scania; Volvo Trucks
Wesseling et al. (2014)	Automobility	USA	USA	n/a
Wesseling et al. (2015a)	Automobility	Global (various)	JP; DE; USA; KR; FR; IT	Toyota; VW; General Motors; Hyundai; Honda; PSA; Nissan; Ford; Suzuki; Renault; Fiat; BMW; Daimler; Mazda; Mitsubishi
Wesseling et al. (2015b)	Automobility	USA	USA	General Motors; Chrysler; Ford; Toyota; Honda; Nissan
Wesseling and van der Vooren (2017)	Cement	Western Europe	NL	n/a
Zimmerling et al. (2017)	Electricity; automobility	Europe (various)	DE; AT; GB	n/a
Zucchella et al. (2022)	Packaging	Southern Europe	IT	n/a

Source: Own compilation.

Table 6
Number of studies by journal.

Journal name	Number of articles
Environmental Innovation and Societal Transitions	40
Energy Research & Social Science	26
Energy Policy	21
Journal of Cleaner Production	14
Business Strategy and the Environment	10
Research Policy	7
Technology Analysis & Strategic Management	7
Sustainability	6
Technological Forecasting & Social Change	3
Business and Politics	2
Global Environmental Change	2
International Journal of Automotive Technology and Management	2
Journal of Environmental Policy & Planning	2
Technovation	2
Agriculture and Human Values	1
Business & Society	1
California Management Review	1
Circular Economy and Sustainability	1
Climate Policy	1
Energy for Sustainable Development	1
Energy Strategy Reviews	1
Environment and Planning E: Nature and Space	1
Environmental Policy and Governance	1
Environmental Politics	1
European Review of Industrial Economics	1
Global Environmental Politics	1
Global Transitions	1
IEEE Transactions on Engineering Management	1
Industrial Marketing Management	1

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Table 6 (*continued*)

Journal name	Number of articles
Industry and Innovation	1
International Entrepreneurship and Management Journal	1
Marine Policy	1
Organization Science	1
Organization Studies	1
PLoS ONE	1
Politics and Governance	1
Qualitative Research in Accounting & Management	1
Renewable Energy	1
Review of International Political Economy	1
Review of Policy Research	1
Sociologica Ruralis	1
Supply Chain Management	1
Technology in Society	1
Transportation Research Part D	1

Source: Own calculation.

Table 7
Number of studies by economic sector.

Sector	Subsector	Number of studies
Energy supply	Electricity	67
	Oil & gas	35
	Coal mining	7
	Heat	6
	Water	3
Transportation	Automobility	24
	Trucks/utility vehicles	9
	Shipping	5
	Aviation	2
	Public transportation	1
Food supply	Food processing	7
	Retail	5
	Agricultural production	4
	Fish farming	4
	Dairy production	3
	Animal husbandry	3
	Food services	3
Processing industry	Pulp & paper/forestry	9
	Metals	6
	Chemicals	5
	Cement	3
	Other processing industry	7
Of which multi-sector studies		35

Source: Own calculation.

Table 8
Number of studies by country (company location).

Region	Country	Number of studies
Central Europe	Germany	40
	Austria	7
	Baltic states	5
	Czechia	5
	Poland	4
	Hungary	2
	Switzerland	2
Northern Europe	Sweden	23
	Norway	19
	Finland	10
	Denmark	4
Western Europe	United Kingdom	32
	Netherlands	17
	France	15
	Belgium	3
Southern Europe	Italy	14
	Spain	8
	Portugal	4
	Greece	2

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Table 8 (*continued*)

Region	Country	Number of studies
Americas	USA	28
	Caribbean	2
	Brazil	2
	Mexico	1
	Colombia	1
Asia	Japan	7
	China	6
	India	2
	South Korea	2
Africa	South Africa	3
Not clearly classifiable/global		8
Of which multi-country studies		48

Source: Own calculation.

Data availability

Data will be made available on request.

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