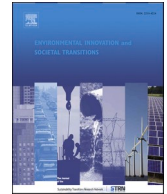




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Review Article

The transformative capacity of public sector organisations in sustainability transitions

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ABSTRACT

Public sector organisations (PSOs) such as municipalities, regulatory bodies, and public utilities are key actors in sustainability transitions. However, the conceptualisation of their transformative capacity is underdeveloped, as several strands of literature pay attention to the topic but remain disjointed. The article takes stock of the literature, reviewing the strengths and weaknesses of the main approaches. Building from there, the article proposes a higher-order holistic conceptual framework based on three constitutive elements: roles, resources, and abilities. We conceptualise the transformative capacity of a public sector organisation as the interaction between its roles, resources, and abilities in the enactment of its transformative agency. This framework offers a granular analytical approach for future empirical studies, acknowledging the diversity of PSOs and sustainability transitions pathways. It also offers practical clues for more targeted efforts to build transformative capacity in PSOs, which is crucial for accelerating transitions.

1. Introduction

Green sustainability transitions^h are complex processes that require purposive and directional action to transform current socio-

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^h This article uses the term 'sustainability transition' to refer specifically to green dimension of sustainability transitions.

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technical systems. These transitions are inherently linked to the capacity of various organisations to undertake transformative action as purposeful change agencies actively seeking to overcome the numerous barriers and lock-ins in the process of path-breaking transformation.

This article focuses specifically on the transformative capacity of public sector organisations (PSOs), with overall functions to serve the public interest and deliver public value (Moore 1995; Bozeman 2007). PSOs are a central building block of the state, implementing governmental policies in many different forms, scales, and levels of intervention. Hence, PSOs are a linchpin between the collective ambitions of green sustainability targets, and the reality of implementing them. To deliver, PSOs have to work towards overcoming the heavy inertia that characterises the current unsustainable modes of production and consumption. However, the likelihood of performing this pivotal function depends on each PSO's transformative capacity. Despite the literature's acknowledgment of the relevance of transformative capacity, the concept needs further conceptualisation.

Three strands in the recent literature have directed attention to this matter, while emphasising different important aspects.

The literature on public governance and public administration has increasingly paid attention to the problem-solving capacity of the modern state (Lodge and Wegrich 2014), focusing on policy capacity in a multi-level context (Wu et al., 2018). Particular attention has been paid to the complexity of grand challenges as wicked problems that need collective problem-solving (Termeer et al., 2016; Head 2018). However, this literature looks more into questions about policy consistency and the overall capacity of the state, rather than on the specific transformative capacity of PSOs in sustainability transitions.

The **innovation policy literature** has paid attention to public innovation in mission-oriented agencies, a subset of PSOs. It has also started to consider the dynamic capabilities of the state's entrepreneurial initiatives (Brenzitz, Ornston et al. 2018; Kattel and Mazucato 2018; Kattel, Drechsler et al. 2022), and the context of transformative policy mixes (Rogge and Reichardt 2016; Weber and Rohrer 2012; Rogge, Pfluger et al. 2020). However, this literature has so far examined national mission agencies, without considering the capacity of other crucial PSOs for green innovation and systemic transformations, such as local public governments or publicly controlled utilities.

The **sustainability transition literature** has been increasingly focusing on change agency in the process of sustainability transitions (Köhler, Geels et al. 2019; Kivimaa, Boon et al. 2019; Geels 2020), particularly in urban contexts (Wolfram 2016; Castan Broto, Trencher et al. 2019; Hölscher and Frantzeskaki 2020; Peris-Blanes, Segura-Calero et al. 2022). This literature studies how transformative capacity is exercised in a distributed manner, which is key to the overall governance of sustainability transitions. With some exceptions, the literature tends to focus on the system level (mostly looking at governance or policy capacity overall) rather than specifically examining PSOs as key implementing actors exercising transformative action.

Taken together, these three strands represent a growing body of literature with highly relevant contributions. However, this emerging field remains fragmented and disjointed when it comes to defining the transformative capacity of PSOs in sustainability transitions. Hence, there is a need to take stock of these recent advances, searching for their strengths and weaknesses, and building further from them in order to advance a higher-order conceptual framework that moves forward this relevant research area (Haddad, Nakić et al. 2022; Duit 2023).

Consequently, this article has two main objectives. Firstly, we do an in-depth review of the main approaches in the three strands of literature. We analyse how scholars have dealt conceptually with the notion of *capacity*, distil their key insights, and highlight the strengths and shortcomings of each conceptual approach. Secondly, we move the research agenda forward by proposing a holistic conceptual framework for PSO transformative capacity in sustainability transitions. By bringing disjointed aspects together, elaborating on core aspects, and theorising further on the nature of interactions in sustainability transitions, we propose a higher-order conceptual framework that allows for a more granular understanding of transformative capacity in future empirical studies.

With these objectives in mind, this article addresses the following research questions: What are the various conceptual approaches and key aspects in studies about the capacity of PSOs in sustainability transitions? What are the key features of a higher-order conceptual framework about the transformative capacity of PSOs in sustainability transitions that can advance empirical studies on this crucial research agenda?

The article proceeds as follows. The next section explains the methodological approach for this literature review. **Section 3** reviews, in-depth each of the three strands of literature mentioned above, identifying conceptual trends in core themes, as well as their respective strengths and weaknesses. **Section 4** takes stock of the findings of the literature review and focuses on the key insights that emerge across the three strands. From these key insights, **Section 5** conceptualises three constitutive elements of PSOs transformative capacity, namely, roles, resources, and abilities, into a higher-order framework. **Section 6** suggests three relevant theoretical considerations: the interlinkages between roles, resources, and abilities; the co-evolution between PSOs' transformative capacity and the processes/pathways of sustainability transitions; and the building of PSOs' transformative capacity. **Section 7** concludes by answering the research questions, considering the novel contributions of the higher-order conceptual framework proposed here, suggesting future lines for an empirical research agenda, and considering the practical implications for more targeted efforts to build the transformative capacity of PSOs given the urgent need to accelerate sustainability transitions.

2. Methodology and data

In this article, we conduct a scope review (Arksey and O'Malley 2005; Pham et al. 2014), which other authors call theoretical review (Paré, Trudel et al. 2015), narrative review (Petticrew and Roberts 2008), or meta narrative review (Gough, Thomas et al. 2012); a type of review that reviews the most important concepts and conceptual approaches.

This type of review "goes beyond merely assembling and describing past work. The primary contribution and value of this type of review lies in its ability to develop novel conceptualisations or extend current ones by identifying and highlighting knowledge gaps

between what we know and what we need to know” and “to provide a context for identifying, describing, and transforming into a higher order of theoretical structure and various concepts, constructs or relationships” (Paré, Trudel et al. 2015:188).

To ensure the methodological quality, we paid particular attention to the rigour, internal consistency, and relevance of the process and outcomes of this review (Paré, Trudel et al. 2015). We provide a detailed account of these key matters and criteria in Appendix 1. Appendix 2 provides the full list of the publications reviewed. Our review process was undertaken in four steps, as illustrated in Fig. 1.

In Step 1, we identified 1604 publications in two bibliographic databases. Based on our expertise and on manually selecting 9 core publications in the field (see Appendix 2), we defined the search terms and the script to be run in the bibliographical database search. Appendix 1 explains Step 1 in detail: the search terms, the decisions in the search, the databases used, the time span, and the search script.

In Step 2, we arrived at our final selection of publications. First, we carefully screened the titles and abstracts of the 1604 publications and made a selection according to explicit inclusion and exclusion criteria that relate to our research goals (see the criteria in Appendix 1). The 226 pre-selected publications underwent a final selection process where we scrutinised their full texts (following the same criteria), which resulted in 112 publications. Ultimately 121 publications were selected for review: 112 selected from databases and 9 core publications selected manually.

In Step 3, we reviewed the publications one by one in a contextual manner, that is, we conducted a review of the concepts in the papers in relation to the stream of literature that the publication belongs to. The research team worked interactively, in several rounds of meetings and discussions. This was done the following way. Each researcher was assigned several publications for review; sub-groups of researchers were organised around the literature streams. In the first sub-step, the research team identified the main themes emerging from each literature strand. The research team discussed in several iterative meetings which themes were most relevant according to the goals of this research. In the second sub-step, we conducted a deep dive, reviewing in detail the concepts and their interactions in all selected publications. This process allowed us to work individually, in sub-groups, and collectively as a whole team.

Step 4 is the conceptual development, the final stage of this research endeavour. We identified the key insights emerging across the literature (Section 4). From those insights, we develop a higher-order conceptual framework, conceptualising three constitutive elements of transformative capacity, namely, roles, resources, and abilities (Section 5). Lastly we engaged in iterative theorising efforts around some specific considerations (Weick 1989) (Section 6). Step 4 was done in an iterative manner both within the research team and with external researchers in various international seminars, providing several rounds of in-depth feedback and suggestions (Alvesson and Sandberg, 2011).

3. Literature review

Different literature strands have dealt with several themes and approaches to capacity. We carry out our literature review in two steps. Firstly, we review each strand in depth, studying the way they have approached these concepts, and assessing their strengths and shortcomings. Secondly, in Section 4, we engage in a cross-sectional review of the key insights that emerge from them.

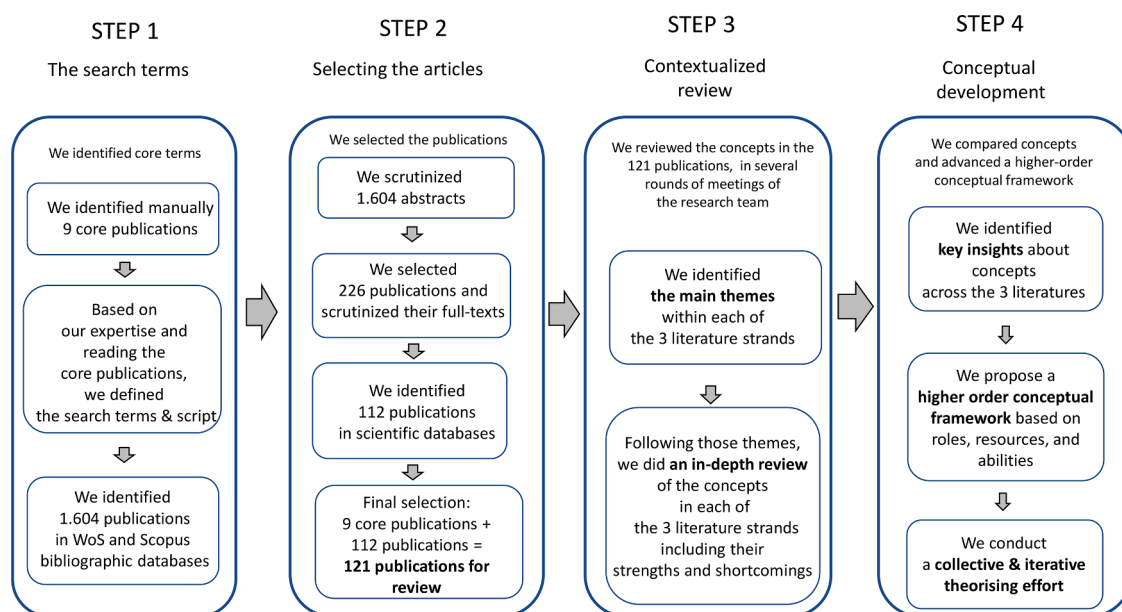


Fig. 1. The steps in the literature review process.

3.1. Public governance and public administration studies

The broad literature on public administration and governance deals with capacity in several interrelated themes, namely, the legacy of New Public Management and the debates around the role of the public sector and its capacity; the multi-level embeddedness of exercising capacity, including urban studies; the different dimensions of capacity as organisational abilities; and the transformative nature of public sector capacity. Our analysis scrutinizes these themes one-by-one in order to provide a structured approach.

Starting with the first theme, the New Public Management (NPM) approach emerged in the 1990s and was related to the idea of 'reinventing government' (Osborne and Gaebler 1992). This agenda aimed at transforming public administration by getting back to core tasks, by decoupling the roles of task-performing and task-steering, by increasing competition between the public and private sectors, by focusing on customers, and by increasing control over public administration performance. Capacity was mentioned sparsely, and only in terms of the public administration capacity to innovate, a strategy that in their perspective invariably involved outsourcing (Osborne and Plastrik 1997). Hence, the agenda of the NPM was about retrenching and transforming bureaucracy itself (Dunleavy and Hood 1994); it was not about public administration engaging in the transformation of socio-technical systems towards sustainability or other public goals. Therefore, the thrust of the NPM agenda sparked a debate about the roles, tasks, and overall purposes of the public sector that still resonates today (Moore 1995; Bozeman 2007; Seabrooke and Sending 2022). Whereas this latter Weberian tradition acknowledges the importance of agility, stability, and innovation in the public sector (Kattel, Drechsler et al. 2022), the extensive outsourcing of the past has been widely perceived as weakening the stance of public sector organisations (PSOs) by limiting severely their knowledge and other resources, a hurdle for them to engage in a transformative agenda towards solving complex collective problems (Mazzucato and Collington 2023).

The second theme in this literature stream is the multi-level embeddedness of exercising capacity. A pivotal publication in this theme defines 'policy capacity' as the ability of governments to marshal the necessary resources and to exercise them effectively to achieve desired policy objectives (Wu, Ramesh et al. 2018). Capacity is defined into three levels - systemic, organisational, and individual. The literature typically takes the starting point from the systemic-level, which refers to the overall capacity of policymaking and introduces considerations about organisational and individual levels. Policy capacity has been used in policy studies analyzing for example environmental policy, and in urban studies. In policy studies, capacity is considered in terms of the public administration ability to integrate environmental considerations into all policy sectors and levels (Ross and Dovers 2008), which requires the development of strategic, procedural, and evaluative abilities in the organisation of public administration. Likewise, urban studies look at capacity from a multi-level perspective, emphasizing that urban environmental performance is related to local governments' capacity in terms of their different types of resources (their decentralized local mandates, their access to international networks of local governments, their staff, and finances, etc.) (Takao 2012; Takao 2017; Kim and Yoon 2018).

The third theme in this literature strand is about the different dimensions of capacity as organisational abilities. Following this approach some studies emphasize the relevance of analytical capacity of public administration in terms of its ability to analyse and make sense of complex data and information, which is key for environmental policy outcomes and evidence-based policymaking (Sugiyama and Muto 2022; Oliphant and Howlett 2010). Other studies emphasize the relevance of learning capacity as the organisational ability of public administration to learn from its own and from others' experiences, constantly incorporating the new knowledge in policy making (Fiorino 2001). The ability of public administration to manage dilemmas, balance trade-offs, accommodate value conflicts, and deal with uncertainty among stakeholders in regulatory enforcement of green policies is another ability mentioned in the literature (Stenzel and Frenzel 2008; Kay and Ackrill 2012; Staricco and Buraschi 2022; van Popering-Verkerk, Molenveld et al. 2022). Managerial or operational capacity is another ability mentioned recurrently, referring to the internal human resources, as well as financial means, which are key in the delivery of every-day practices (Homsy and Warner 2015; Wu, Ramesh et al. 2018). Last but not least, another dimension mentioned in this literature is the political capacity (also named civic capacity) of the public administration, which has to do with the political legitimacy and societal trust as a key resource in any socio-political system, and the public administration's ability to use this resource for engaging with society, mobilizing societal participation (Wu, Ramesh et al. 2018).

The fourth theme in this literature strand is the transformative nature of public administration capacity. Whereas the Weberian tradition emphasizes that the role of the public sector is to reduce uncertainties, a new Weberian approach acknowledges the complexity of social problems and new forms of public action (Kettl 2021), which depend on the capacity of public administration in terms of its context-dependent resources and roles (Peters 2015), and on the dynamic capabilities of bureaucracies as organisations (Kattel, 2022) (see Section 3.2). Following from that, a series of more recent studies focus on transformative and innovation capacity. Some authors point at reflexivity, inclusivity, adaptability, and creativity as key elements for transformative policy capacity. They define transformative policy capacity as the ability of policy actors to initiate and steer fundamental changes in the structures and dynamics of socio-ecological systems (Förster, Downsborough et al. 2021). This transformative capacity means that governments have more directional and strategic approaches, and that they are engaging in more collaboration with the business sector (Kuzemko 2022) and civil society organisations. Following from that remark, some authors in the new urban governance approach emphasize that transformative agency of PSOs has to do with the co-production of urban sustainable solutions, engaging and empowering the local communities and stakeholders (Novalia, Rogers et al. 2020). While other studies acknowledge that certain critical situations - like natural disasters related to climate change - might trigger the mobilization of transformative capacity towards path-breaking policy change (Nohrstedt 2022).

Taken together, the literature on public administration and governance acknowledges PSOs' challenges to deliver solutions to complex problems. This literature has tended to identify specific dimensions such as managerial, fiscal, and civic capacity (Homsy and Warner 2015); analytical, operational and political (Wu et al. 2018); or analytical, delivery, coordination and regulatory capacity

(Lodge and Wegrich 2014). Often, this literature sees capacity largely as the set of internal and external resources to public organisations, which are mobilized by the PSO. This takes place in a multi-level governance context, where these PSOs are embedded, and their resources situated.

A possible limitation of these studies is their predominant focus on policy enforcement and outcomes within existing management and administrative paradigms. Policy consistency is most probably associated with the centrality of early discussions in the field about 'environmental policy mainstreaming' or 'environmental policy integration' (Jordan and Lenschow 2010) and about policy enforcement (Börzel and Buzogány 2019). With some exceptions, this strand of literature tends to understudy the importance of PSOs' embeddedness in wider governance processes (beyond policy enforcement), as well as the organisational capacities related to transformative change. However, as we have seen in the review above, the literature is gradually addressing those shortcomings. Urban studies are bringing clearly to the fore the embeddedness of local governments' administrations in the transitioning towards green urban systems; and the literature is increasingly acknowledging the active steering of the state towards transformation, and the relevance of the transformative capacity of PSOs.

3.2. Innovation studies

The field of innovation studies has also started to pay attention to the capacity of PSOs in the governance of green innovation and green transitions, mostly from the perspective of mission-oriented and/or transformative innovation policy (Haddad, Nakić et al. 2022), and/or from a broader perspective of the various roles of the sector action towards the transformation of socio-technical systems (Mazzucato 2015) (Borrás and Edler 2020). We have identified two specific themes in this literature strand. The first theme is the transformative capacity of PSOs seen as dealing with innovation processes, encompassing technological innovation as well as social innovation and public sector innovation; the second theme focuses on the importance of public administration self-organising its directional and purposeful action.

Weber and Rohracher's seminal article about transformative innovation redefines innovation policy beyond mere adaptation within existing paradigms and into a true transformative thrust, laying the ground for a new understanding of public sector capacity in transformation processes, particularly in green transitions (Weber and Rohracher 2012). They identify systemic failures such as failures in directionality, demand articulation, policy coordination, and reflexivity, each elucidating different aspects of policy capacity and its implications for transformation. Particularly important are the requirements of policy coordination and reflexivity, which "are likely to raise the need to increase administrative capacity. This implies that the frequent claims for down-sizing the capacities of public administration, but also of the private sector, for managing the necessary policy coordination processes, in particular in the context of transformative change, need to be questioned" (Weber and Rohracher 2012, 1044). Weber and Rohracher emphasise the importance of public administration coordination and reflexivity capacity as processes and abilities that are needed to manage the complex and multi-level nature of these transformations. Hence, they consider the capacity of PSOs in terms of their abilities to enact transformation.

Along the same lines, Bos and Brown argue that the organisational capacity for transition policy programs depends on various factors, such as the organisational structure, culture, leadership, and resources. They also argue that organisational capacity can be enhanced by adopting a transition management approach, which involves envisioning, experimenting, learning, and scaling up innovative solutions (Bos and Brown 2014). Similarly, Isaksson and Hagbert examine the institutional capacity to integrate 'radical' perspectives on sustainability, which refer to the public sector adopting alternative and transformative visions and practices that challenge the dominant and unsustainable paradigms. They argue that the institutional capacity to integrate such 'radical' perspectives depends on existing norms, values, and rules, which can be enhanced by fostering a culture of innovation, collaboration, and experimentation in the public sector (Isaksson and Hagbert 2020).

The publications focusing on the second theme, on public administration's self-organising and directional work in transformative innovation, tend to adopt a more strategic perspective. Most prominent in this approach is Kattel and Mazzucato's use of the concept of *dynamic capabilities* in relation to public administration for implementing mission-oriented innovation policies addressing grand societal challenges (Kattel and Mazzucato 2018). They distinguish between the Schumpeterian tradition of dynamic capabilities in strategic management studies and the Weberian tradition of building public sector capacity through capable, autonomous bureaucracies. They propose merging these traditions, suggesting that developing dynamic capabilities as adaptive organising forms are essential for transformative action.

Taken together, the innovation studies literature strand tends to highlight the active role of the state in driving and shaping the transformative innovations seeking to address the systemic failures associated with grand challenges and green transitions (Anadon, Chan et al. 2016; Weber and Rohracher 2012; Gieske, van Buuren et al. 2016). This perspective aligns well with the understanding of the dynamic nature of capacity in contemporary PSOs, and of state action for systemic change (Borrás and Edler 2020). Additionally, these studies refer to the concept of the dynamic capabilities of the PSOs, which focuses attention on the designed and acquired abilities of PSOs for engaging in transformative action (Mazzucato and Kattel 2018; Breznitz et al. 2018). This literature outlines important approaches to how public sector entities can adapt and evolve to address emerging challenges and opportunities. However, this literature has tended to focus mostly on national innovation policy for executive agencies and other similar public organisations directly related to innovation policy, missing the wider picture of the multiplicity of PSOs currently engaged in green innovation for sustainability transitions, such as public utilities and local governments, and also underestimating the importance of the heterogeneous resources available to the PSOs.

3.3. Sustainability transition studies

When dealing with the topic of the capacity of PSOs, the literature on sustainability transitions links several themes: the diversity of change actors, their interactions in power relations, and their different capabilities; the multi-level nature of transition processes; the contextualised capacities of actors across those levels; and the transformative capacity of entire urban systems.

The diversity of actors is a recurrent theme in sustainability transition studies. These actors include not only the niche innovators and the regime incumbents according to the MLP framework (Geels and Kemp 2012), but also the intermediaries, supporters, and opponents of transition. They have different roles, interests, values, and visions, and they operate at different scales, sectors, and stages of transition. Moreover, these actors are not static or homogeneous, but rather dynamic and heterogeneous, as they can shift their roles, identities, and alliances over time and across contexts (Hagbert and Malmqvist 2019). PSOs are generally perceived as one among those multiple actors, yet with some special relevance given the institutional nature of policy making (mainly at the regime level).

Very relevant for this literature is that the relative capacity of the multiple actors in a transition process is characterised by power interactions, opposite views, and resistance to change (Avelino and Wittmayer 2016). Power refers to the ability of actors to influence the behaviour or outcomes of other actors or systems, and it can be exercised through various means, such as coercion, persuasion, or participation. Power relations are not fixed or neutral, but rather contested and normative, as they reflect the distribution of resources, interests, and values among actors. Power relations might enable or constrain the capacity of actors to engage in a transition, and they can also be challenged or transformed by policymaking and implementation (Kuzemko et al. 2016). Moreover, power relations are vertical and horizontal, as they involve not only the interactions between different levels but also the interactions among actors within the same level, who may have opposite and/or different views and cognitive barriers/opportunities (Olazabal and Pascual 2015; Arts and Leroy 2006; Beck et al. 2021; Blythe et al. 2022; Boer 2013; Chaudhury, 2020; Hawkins et al. 2018).

This literature focuses on various dimensions of capacity. For example, *co-productive capacity* refers to the science-governance relations which might foster the mutual understanding, respect, and trust among different change actors in the system (van Kerckhoff and Lebel 2015), ultimately enhancing environmental governance capacity (van der Molen 2018). Other authors emphasise imagination and futuring; for example, Moore and Milkoreit (2020) discuss the role of imagination and creativity in building the capacity of actors and systems to envision and enact sustainable futures. In a similar vein, Pedde et al. (2019) suggest that scenarios can help build the collective capacity for societal learning, participation, and action towards sustainable transitions.

A specific sub-group of this literature looks into the *green dynamic capabilities* of organisations, particularly in governmental organisations (Arshad, Yu et al. 2023) and in publicly controlled utilities engaged in energy or water system transitions (Hartman, Gliedt et al. 2017; Lieberherr and Truffer 2015). Green dynamic capabilities are the specific abilities that enable PSOs to create and implement green innovations. Green dynamic capabilities are related to the culture, structure, resources, and learning processes inside these organisations, varying considerably across organisations. Studies about the innovation challenges of sustainability transitions suggest that utilities need to combine a capabilities and regime perspective, which means that they need to develop and mobilise their internal and external resources as well as their dynamic capabilities in order to change the dominant regime (van Welie, Truffer et al. 2019).

Some studies put emphasis on the national level, examining for example the overall national green innovation capacity (and its limits) (LaBelle 2017; Richter and Mundaca 2015; Meng and Wang 2022), or the capacity of developing countries for implementing green transitions (Konrad, van Deursen et al. 2021). At sub-national level, studies investigate the capacities and constraints in regional climate action and energy transitions (Royles and McEwen 2015; Pigott 2018; van Dijk, Wiczorek et al. 2022). These studies highlight the relevance of multi-level governance, devolution, and intergovernmental relations as enabling or limiting the capacity of sub-state governments to enact their change agency (Marquardt 2017).

Urban transformative capacity is a notion that has recently gained currency in the field of new urban governance studies, and it refers to the ability of urban systems to initiate, facilitate, and steer sustainability transitions in a deliberate and strategic manner (Wolfram et al., 2019). Transformative capacity is not a fixed attribute, but rather a systemic process that depends on the diversity and connectivity of urban actors, the availability and accessibility of resources and knowledge, the alignment and coherence of visions and goals, the legitimacy and accountability of governance processes, and the learning and innovation potential of urban experiments and initiatives (Hölscher, 2020; Spyridaki et al., 2020; Wolfram, 2018; Borgström 2019; Castan Broto et al. 2019; Peris-Blanes et al., 2022). Other studies about the capacity for sustainability transitions at the municipal level have revealed some gaps and challenges that need to be addressed. For instance, many studies note the lack of capacity of local governments to implement and enforce effective climate policies and regulations, especially when there are competing interests, institutional fragmentation, and resource constraints (Bryan, 2016; He and Hultman, 2021; Larson et al., 2017; Ryan, 2015; Ye et al., 2008).

Taken together, the sustainability transitions literature has a long tradition of looking into the transformation of socio-technical systems mainly at a systemic level, but also of focusing on change agency. It has studied power relations and tensions, acknowledging that some social groups and organisations might oppose change. Likewise, the recent approach to urban transformative capacity emphasises the relevance of urban systems. Thus, this literature is particularly strong in its process-oriented and systemic-context approach to transformative change. With some exceptions, it tends to focus on the system level and relatively less on the organisational level. Likewise, while this literature rightly points to the importance of the interaction between the public, private, and societal sectors, it nonetheless tends to underplay the relevance of the public sector in its ultimate function and goal of serving the public interest.

4. The findings: key insights across the literature

The literature review above brings forward two key insights, one about the different approaches to capacity and the second about the ‘transformativeness’ in transformative capacity.

4.1. Key insights about capacity

We observe that some of the reviewed publications use the term *capacity*, whereas others use *capability*; some refer to capacity in general terms (like *institutional capacity*) whereas others refer to specific dimensions of capacity (like *analytical capacity*). In this subsection, we examine how these terms have been conceptualised, identifying their overall background and, most importantly, how they relate to each other.

Capacity is the most extensively used term in the literature and we can identify at least two approaches: Capacity as a resource-based potential and capacity as action-oriented ability.

Capacity as resource-based potential

In the first approach, authors refer to capacity in terms of potential or manoeuvring space, as opportunities to be materialised (Olazabal and Pascual 2015), often in relation to resources (George and Reed 2016). Capacity is seen as the overall potential of an organisation as its license to operate given its resources, which are typically defined by its institutional positioning/situation in a specific context (Pelling, High et al. 2008). Hence, in that sense, the capacity of a public sector organisation refers to its overall potential according to its situated resources—such as political mandate, available financial resources, legitimacy, or human resources—allowing for autonomous action (Royles and McEwen 2015). As an example of the latter, capacity has been defined as the potential of an organisation resulting from the combination of available resources given by its context, such as human resources or financial resources (Homsy and Warner 2015; George and Reed 2016).

Capacity as action-oriented ability

In the second approach, authors refer to capacity in more action-oriented terms, such as when considering that the capacity of a public sector organisation in sustainability transitions is essentially related to their own ability to enact action (Förster, Downsborough et al. 2021). Hence, capacity is less about the potential according to an organisation’s situated position and the availability of resources, and more about the organisation’s own abilities to experiment, learn, and adapt when taking action (Borgström 2019). This approach focuses on the organisation’s ability to connect, to combine exploitation and exploration (their ambidexterity), to improve routines or services, or to learn (Gieske, van Buuren et al. 2016; Fiorino 2001). It also includes abilities related to experimenting (Borgström 2019), stewarding, unlocking, and orchestrating (Pedde, Kok et al. 2019). This approach contains an important reflexive element, as capacity also refers to the organisation’s ability for self-assessing and further developing its abilities (Meijer 2018), and its ability to actualise goals and strategies (Dent 2017). This approach implicitly suggests a dynamic perspective, as the capacity of an organisation may accrue or diminish over time, depending on the extent to which deliberate and continuous efforts inside the organisation are made to sustain and develop the organisation’s own abilities.

Capacity and capability

For its part, the notion of *capability* appears less frequently in the literature reviewed, but it has been gaining pace recently. Most scholars using the term *capability* have drawn from the strategic management literature in business studies to define the concept (Stenzel and Frenzel 2008; Lieberherr and Truffer 2015; Hartman, Gliedt et al. 2017; van Welie, Truffer et al. 2019; Mousavi and Bossink 2020; Zapata-Cantu and González 2021). The influential notion of *dynamic capabilities* was developed in the mid-1990s in the field of strategic management to study private firm’s differential ability to create and capture value in markets with rapid technological change (Teece, Pisano et al. 1997). In the context of sustainability transitions, Lieberherr and Truffer (2015), for example, have studied the dynamic capabilities of public utilities and defined those capabilities “as organisational and strategic routines that enable organisations to create, evolve, and recombine resources (ranging from physical assets to competences such as specific abilities) to generate new “value-creating” strategies and even change the market” (ibid, 103). It is worth noting that the literature on capabilities focuses on the abilities of the organisations, as routines and practices to engage in action adapting to a rapidly changing (market) context. For this reason, this literature sees capacity as organisations’ action developing their own abilities’ (Stenzel and Frenzel 2008); denoting an action-oriented approach to capacity, rather than the resource-based oriented approach mentioned earlier).

Combining approaches

Our review shows that few recent publications have started to use both concepts (capacity and capability) following the two approaches above (resource-based potential, and action-oriented ability). They tend to conceptualise capability as an organisation’s ability to perform certain diversified tasks. Hence, the capacity of a public sector organisation is seen “as a set of resources and capabilities central to perform policy functions” (Förster, Downsborough et al. 2021, 215). Thus, resources are different from capabilities, as capabilities refer to abilities in the form of practices, routines, and processes inside the organisation. “Investigating capacities means to unveil how actors are able or not to make use of their resources to achieve a certain outcome. An agent’s capacity is not necessarily equivalent to its resources. This is an important aspect because resources as such are not enough to foster or prevent policy implementation. Actors need to be able to utilise their resources such as trained staff, finance, or information” (Marquardt 2017, 232).

Following from this, we can see that capacity is about the interaction between resources (as situated assets internal and external to the organisation) and abilities (as the routines, practices, and procedures in the organisation). Fig. 2 shows this.

4.2. Key insights about transformativeness in transformative capacity

The previous key insights refer to capacity in general terms. We look now to how the literature sees *transformative change*.

The first aspect to examine is the degree of change in transformative change. We start with the observation that there is a widespread understanding in the literature that sustainability transitions require deep change from current unsustainable modes of production and consumption (Isaksson and Hagbert 2020). Halfway solutions will not redress the current climate and biodiversity crisis. Aware of the path-breaking, deep change that is needed, the literature reflects a general understanding that this might not happen as an immediate or sudden upheaval of existing institutions and systemic features, but as a process characterised by the determination (and acceleration) towards path-breaking change led by the changing roles of change agents (Avelino and Wittmayer 2016; Hagbert and Malmqvist 2019).

The second aspect is whether the literature refers to transformative change as a process or as an outcome. We observe that both are present. Part of the literature focuses on it as a process, in terms of various pathways towards path-breaking change (Hölscher 2020; Borgström 2019); whereas another part of the literature focuses mostly on transformative change as a (policy) outcome (Homsy and Warner 2015; Kim and Yoon 2018). It is relevant to point that, in both cases, the transformative capacity of organisations is widely seen as a factor in the process of path-breaking change, and as a factor (or variable) for explaining change as an outcome. From the organisational perspective, transformative capacity is the capacity of change agents (including PSOs) in their exercise of path-breaking change agency through directionality, vision, tactics, and imagination, with (eventually) transformative (policy) outcomes (Förster, Downsborough et al. 2021).

We observe as well that the literature does not treat the transformative capacity of an organisation as a single feature. Instead, it treats it as a set of various elements that the organisation puts together strategically to enact and work towards the transformative goal (Hagbert and Malmqvist 2019; Gieske, van Buuren et al. 2016; Anadon, Chan et al. 2016; Weber and Rohracher 2012). In other words, transformative capacity is a combination of various elements, relating to the various roles that the organisation defines and assumes when working purposefully to enact change agency, in the specific context in which the organisation is embedded. This notion of *the purposeful work of change agents* brings us to the topic of roles. We deal with it in the next section, when we conceptualise the constitutive elements of PSOs' transformative capacity.

5. Conceptualising roles, resources, and abilities as constitutive elements of PSOs transformative capacity

The insights above offer us the opportunity to engage in a conceptualisation of some constitutive elements, bringing forward a higher-order framework that focus explicitly on PSOs pursuing system-wide transformations. To do this, we adopt an organisational perspective, understanding that PSOs are embedded in complex, multi-level contexts that vary across countries, geographies, time, and traditions. We take the perspective that each public sector organisation is a distinct and unique organisation with its own approach and idiosyncrasy.

The findings and key insights allow us to identify three core constitutive elements. The first element is the various roles that PSOs play in their exercise of purposeful tasks when exercising agency towards transformation. The second element is the various situational resources that can be mobilised by PSOs to enact their transformative roles. The third element is the set of abilities, which are the routines, practices, and procedures inside the organisation when exercising transformative agency.

5.1. Roles

The literature reviewed tends to underline that roles are performed in interaction with other actors, and that actors might change their roles through time. It mentions as well, without digging deeper, that roles might be ascribed or constructed, and that organisations might (or might not) assume them (Avelino and Wittmayer 2016). Part of the literature sees PSOs mainly as system-maintaining actors (Richter and Mundaca 2015; Bowen and Panagiotopoulos 2020), whereas others observe that PSOs are actively implementing the transformative change defined by political and collective climate/green targets (Anadon, Chan et al. 2016; Fischer and Newig 2016). The literature points at different transformative roles, but does not provide a wide and encompassing view

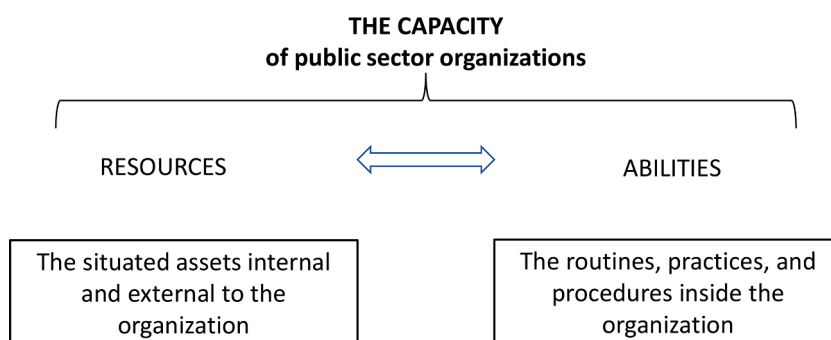


Fig. 2. The capacity of PSOs as the interaction between situated resources and abilities of the organisation.

on them, nor a definition of what those roles are. Below we summarize the roles identified by the literature and provide a definition of role as institutional work.

PSOs might act as *promoters and champions* of visions of change (De Laurentis and Pearson 2021), leveraging the collective imagination of possible futures (Moore and Milkoreit 2020).

They might as well assume the role as *designers of green transformation*, or facilitators, for example, when local administrations actively plan the transformation of the urban context defining ambitious green local plans and restructuring municipal forms of intervention (Frantzeskaki and Tilie 2014), as well as working to overcome existing legal barriers (for example in the permits for installing solar panels) (Quitza, Hoffmann et al. 2012).

Within the conflictual dimensions of transitions, PSOs might take the role as *mediators in conflicts*. The literature also notes that the dialogue or controversy between change-oriented actors and incumbents (or positively and negatively affected parties) matters for how PSOs define their roles (George and Reed 2016; Meijer 2018; Hessevik 2021), as specific public agencies might work towards accommodating various alternative perspectives, addressing value- and distributional conflicts (Kay and Ackrill 2012).

PSOs might also act as active *partner-builders*, brokering to build alliances, collaboration and specific partnerships with heterogeneous actors (George and Reed 2016; Grotenbreg and van Buuren 2018). The lack of performing such a role as partner-builder might lead to green transition failures (Huang 2021).

Enablers of wide societal participation is an important role as well, as PSOs create frameworks and channels for the participation of social actors, seeking to engage them as co-producers of solutions (Wolfram 2018; Novalia, Rogers et al. 2020).

Overall, we see the literature acknowledging the importance of different roles. However, the individual publications tend to focus only on one, or on few of them, typically disregarding that the same public organisations might perform several roles at once.

Likewise, there is a general trend in the literature to disregard the possible dilemmas or paradoxes of performing transformative roles in complex contexts, or the variations of possible roles according to the type of sustainability transition and its governance modes (Borrás and Edler 2020).

When dealing with transformative capacity, we define roles as the variety of specific, purposeful tasks that an organisation performs while enacting institutional work towards transformation in sustainability transitions. We note the current debate about the role of the state in sustainability transitions and transformative processes, and we embrace the variety of roles that the state and its PSOs might assume (Mazzucato 2015; Borrás and Edler 2020). We also acknowledge that those diverse roles have different purposeful character, and therefore might follow the guidance provided by the literature on institutional work. Institutional work is “the purposive action of individuals and organisations aimed at creating, maintaining and disrupting institutions” (Lawrence and Suddaby 2006, 215), an approach that is particularly relevant for studying how organisations assume specific roles when engaging in sustainability transitions (Beunen and Patterson 2019; Kivimaa, Boon et al. 2019). Hence, we consider that PSOs might assume various roles that aim at disrupting, creating, and/or maintaining/stabilising institutions, which taken together work towards path-breaking change. PSOs might do that according to the goals given to them in explicit political targets, and/or according to their own organisational ethos and initiative.

5.2. Resources

The reviewed literature repeatedly mentions resources in relation to transformative capacity. Often, there is no definition of resources, and they are mentioned more than they are analysed. Below we summarize the resources most often mentioned and provide a definition of resources.

Human resources, such as staff, manpower, personnel, etc.; and *financial resources* (budget, funding, etc.), are widely seen as important resources (Spyridaki, Kleanthis et al. 2020).

Data and information are also important resources for PSOs’ capacity for sustainability transitions (Bowen and Panagiotopoulos 2020; Salvador and Sancho 2021).

Physical resources, such as natural resources, infrastructure, geographical location and geological features are also important, defining the locational, physical and materiality context for PSOs action (De Laurentis and Pearson 2021; Marquardt 2017).

Political mandates are another crucial type of resource. Mandates can be *explicit*, like the legal-constitutional aspects of PSOs’ own remit, or concrete political mandates assigned to the PSO - like concrete climate targets at national or local levels¹ (Royles and McEwen 2015; Beck, Jasanoff et al. 2021). But mandates can also be *implicit*, for example, from international policy strategies, which are clear reference points for PSOs’ action. Whether explicit and/or implicit, political mandates are highly relevant resources because they are the PSOs’ ‘license to operate’ towards transformative change.

Network resources, are the PSO’s number and type of contacts, access to influential decision-makers, and/or relations with private actors. Networks are recurrently seen as relevant resources (Grotenbreg and van Buuren 2018; Hölscher 2020).

Cultural resources in terms of public administration/bureaucratic culture, and general sustainability-culture and awareness in the society, are also mentioned in the literature (Larson, Lauber et al. 2017; Avelino and Wittmayer 2016).

Legitimacy resources based on the PSO’s reputation, social acceptance, social authority, trustworthiness, and general civic traditions, are also relevant (Homsy and Warner 2015) (Pelling, High et al. 2008; Boer 2013); but tend to be mentioned less frequently.

Based on the above, we define resources as the set of material or immaterial situated assets that are available (and/or perceived to

¹ A specific example of an explicit mandate is the delegation of political competencies for sustainability transitions from national to lower levels of government (local or regional authorities).

be available) to a public sector organisation, either internally or externally to the organisation. The situated nature of resources is important because PSOs are not free to define the level or the availability of their resources, given the political and located nature of resource allocation. This contrasts with non-state, private organisations that have more leeway in those terms (e.g. firms, civil society organisations, NGOs, etc.). Often, PSOs operate under considerable resource scarcity due to efficiency-focused political goals, that have reduced public sector resources in significant ways over the past decades. Likewise, the resources of PSOs vary according to their situated position in the socio-political context: it matters whether they are a large and central regulatory agency or a small executive agency, a wealthy municipality or a socio-economically deprived municipality. This however does not mean that resources are fixed; they might change through time, as the organisation might make efforts to get access to new resources and reinterpret existing ones.

5.3. Abilities

The third element of the transformative capacity of PSOs in sustainable transitions found in the literature is the set of PSO abilities. Our review shows that the literature focuses on various abilities at the organisational level, clustering around four distinct sets: analytical, operational, coordination, and learning/reflection abilities.

Analytical abilities refer generally to exploring, studying, sense-making, and interpreting. It is “the ability of organisations to produce valuable research and analysis on topics of their choosing” (Oliphant and Howlett 2010, 439), gathering information and assessing it (Kattel 2022), processing and developing new ideas and visions about the future that allow new forms of public innovation (Meijer 2018).

Operational abilities are those frequently described as the managerial and administrative abilities to deliver in practical terms: executing and exploiting the possibilities in actionable ways (Spyridaki, Kleanthis et al. 2020); as well as monitoring, verifying, and securing (legal) enforcement (Borzel and Buzogany 2019; Bowen and Panagiotopoulos 2020; He and Hultman 2021; Tao and Mah 2009; Li and Chan 2009; Schmid and Bornemann 2019); and shaping and embedding new routines (Kattel 2022).

Coordination abilities are typically seen as routines for collaborating and connecting with other organisations (Mu, Jia et al. 2018; Bissix and Rees 2001). They refer to the ability of PSOs to stimulate and orchestrate multi-stakeholder participation, communication, and social engagement (George and Reed 2016; Hessevik 2021; Strasser, de Kraker et al. 2019).

Learning and reflexivity abilities are a public organisation’s ability to develop and incorporate new understandings and adjust its own action accordingly, through adaptation and re-consideration (Monstadt and Wolff 2015). Sometimes learning and reflexivity abilities are subsumed under analytical abilities; other times, the literature considers them distinct.

Having considered this discussion in the literature, we define abilities here as the set of routines, practices, and procedures of the organisation in the enactment of the organisation’s change agency. Naturally, those routines have to do with the various ways in which the organisation mobilises and utilises its situated resources as it enacts its defined roles.

Table 1 summarizes the conceptualization or roles, resources and abilities.

6. Towards a holistic framework of transformative capacity

Understanding that the transformative capacity of a PSO is its capacity to enact path-breaking change agency (seeking to overcome heavy technological lock-ins and barriers in system transformation), we have three theoretical considerations. First, that the transformative capacity of a PSO is not static, but the result of the continuous interaction between the roles, resources, and abilities as three constitutive elements. Thus, the question we seek to answer is how they interact. Second, that a PSO’s transformative capacity co-

Table 1
Conceptualizing Roles, Resources and Abilities.

Constitutive element	Types according to the literature
Roles	Promoters and champions of visions Designers of green transformations Mediators in conflicts Partner-builders Enablers of wide societal participation <i>(Purposeful roles maintaining, changing and/or disrupting institutions)</i>
Resources	Human resources Financial resources Data and information resources Physical/natural resources Political mandates Network resources Cultural resources Legitimacy resources
Abilities	Analytical abilities (exploring, studying, investigating...) Operational abilities (exploiting, managing, executing...) Coordination abilities (collaborating, connecting, communicating...) Learning and reflectivity abilities (incorporating new understandings, adjusting...)

Own Source

evolves through time with the phases that sustainability transitions' pathways might go through. And third, that a PSO might be able to build its transformative capacity by a gradual expansion of the PSO's constitutive elements.

6.1. Transformative capacity as interactions between roles, resources, and abilities

Beginning with the first theoretical consideration, the transformative capacity of a PSO is defined by how it enacts the interactions between the three constituent elements, creating specific interactions that carry transformative change agency. In other words, the way it enacts the interactions is not a static feature.

As we saw earlier in the context of transformative capacity, we understand roles as those that a PSO actively assumes when pursuing transformative change. These are enacted in the interlinkage with its resources and abilities. Hence, a PSO might have a relatively good availability of resources (financial, human, data, political mandate, etc.) and well-established routines, but without a clear self-definition of roles and specific tasks that purposely seek directional change, those resources and abilities might be to no avail for sustainability transitions. This is because sustainability transitions require purposeful action to overcome heavy technological lock-ins, incumbents' opposition, and other important hurdles. Likewise, some PSOs might have reduced resources and less developed abilities; yet, a clear and determined purposeful definition of roles might carry on transformative change agency by mobilising these scarce resources and by (rapidly) re-configuring the routines in PSO's everyday work. This consideration suggests that roles are necessary conditions, while resources and abilities are sufficient conditions for a PSO's transformative capacity. This is a hypothesis that would need to be empirically examined in the future.

It is important to admit that some PSOs might not have any transformative capacity at all if their roles, resources, and abilities are severely limited or never unfolded. Nevertheless, this should not lead us to automatically assume that a PSO's transformative capacity is static, as it is the result of the continuous interactions between the PSO's roles, resources, and abilities; and might change through time. Nor should we assume that transformative capacity takes only one possible form, as similar PSOs might enact transformative capacity in different ways according to variations of these interactions.

How might we conceptualise that diversity of interactions? One way of considering it theoretically would be to take the starting point from a PSO's roles, which we hypothesise are necessary conditions for a PSO's transformative capacity. One PSO might combine various roles which, taken together, seek to enact transformative change. For example, a local government (the public administration implementing city council political decisions) engaged in the acceleration of renewable energy sources might simultaneously enact roles as lead user, initiator, facilitator, and negotiator (all of them combined are the PSO's institutional work towards transformative change). As a *lead user*, it can use its control over the local utility to actively push to phase-in renewable energy sources and phase out fossil sources in the production of district heating. As an *initiator*, it can install solar panels on the roofs of its own municipal schools and elderly homes. As a *facilitator*, it can create new and foreseeable approval procedures while stimulating third parties (e.g. citizens, local firms, energy developers) to invest in renewable energy locally. As a *negotiator*, it can actively lobby the national level public administration to allow for a specific interpretation/adaptation of national regulations that would ease these initiatives. The intensity and breadth of a PSO's roles, combined, might have path-breaking effects locally and perhaps also nationally.

Clearly, the enacting of each of these roles is linked to the PSO's resources and abilities. To be sure, local governments are the administrative branch of politically elected city councils, and for that reason, the social legitimacy behind the political mandate associated with the local green transition goals is an important resource for a PSO, though it is not always determinant. By contrast, in situations with low social legitimacy or a high level of conflict around those local goals, a PSO might have limited socio-political resources to mobilise. Financial and human resources are also important, mainly when a PSO acts as *initiator* because actions like installing solar panels on the roofs of municipal buildings are financially costly and require staffing. Without those resources, a PSO might not be able to enact that role. Similarly important is a PSO's operational ability because the operation of those solar panels requires specific technical verification and maintenance procedures which are new to the PSO.

Less demanding in terms of financial resources is the role of *facilitator* because these are mainly third-party investments. However, that role requires PSO data and network resources, as it needs access to relevant information and expertise, allowing municipal planners to assess and eventually give (or not) permission to install those third-party investments. Likewise, this role requires good coordination abilities across various PSO units, aligning administrative criteria and legal-technical interpretation/development of local rules, as well as managing third-party expectations around key legal enforcement aspects associated with those permissions.

Overall, the larger the number of transformative roles a PSO assumes, the more demanding the types of resources it needs to mobilise and the types of abilities it needs to develop. This brings us to two further considerations, the process of transformation and the building of transformative capacity. We deal with them in the next two sub-sections.

6.2. The co-evolution between transformative pathways and pso roles, resources, and abilities

We revert now to questions about the process of transformation. Since the seminal work of Geels and Schot about different pathways to sustainability transitions, the literature has largely acknowledged that transformative change is not about one single type of pathway (Geels and Schot 2007). Moreover, alternative pathways to achieve the same endpoint differ in terms of lead actors and policy mixes, given the different timing and forms of barriers to overcome (Rogge, Pfluger et al. 2020). Deep transformations take time and accelerating them requires overcoming a significant number of barriers, not least imagining and finding technologies and solutions that do not yet exist. For this reason, the literature offers an endless list of possible barriers and drivers, all depending on the idiosyncrasies of specific transformative pathways, and specific needs for accelerating transitions.

This is related to the 'sense of direction' of transformative agency, and therefore of PSOs roles, resources and abilities. Hence, in the

early phases of transformative change, a PSO might act as an initiator and lead user, as mentioned above. Yet PSOs are not always in the lead, as other pathways are led by societal or market actors. In such situations, a PSO's transformative capacity roles are mainly to act as a facilitator (encouraging others to engage) and to prevent others (or themselves) from becoming barriers. The central position of some PSOs are crucial in this regard. For example, in the shipping sector, a sustainability transition involves private ship-owners' replacement of fossil fuelled ships with new vessels that sail on zero-emission fuels. Maritime regulatory agencies are PSOs, which approve ships in order to ensure maritime safety. Without their approval, no zero-emission fuel ships can set sail, and the PSO is crucial for deployment of green technologies in the shipping sector. Existing regulations are attuned to fossil fuel technologies, and the legal-technical expertise of the maritime regulatory authorities is crucial in redefining the regulatory framework, acting as early negotiators at international and national regulatory levels. Once the framework is clarified and settled to enable new fuels, the agencies start approval work of each new ship. Maritime regulatory agency needs to mobilize new resources (such as new data and external expertise about new technologies), while developing its own internal analytical abilities to engage in approval work. In later phases of the transition, when the zero-emission ships are operating, the maritime agency verifies and monitors safety. This requires the agency to develop yet another set of operational abilities because these ships' safe operations differ radically from fossil-fuelled ships. All in all, the transformative roles, resources, and abilities of the maritime agencies differ over the different phases of the transition pathway (Taudal Poulsen and Borrás).

Much of the literature underlines that transformative change is rarely a linear, conflict-free, or costless process. Depending on how and when the tensions unfold, a PSO might take various roles, engaging to minimise these tensions to avoid the transition getting delayed or derailed. In the early phases, a PSO might act as a negotiator between different opponents. It might also act as a promoter of specific approaches, actively endorsing one side in the contention. In both cases, whether acting as a negotiator or as a promoter of a specific side, a PSO needs to mobilise its own legitimacy resources (based on the credibility that it is working towards the public interest), and it must build a convincing narrative. This might not be easy at times. Likewise, it needs strong communication and coordination abilities, to manage that communication. Later, a PSO might also engage in a role as a mitigator, seeking to find ways of compensating the negative effects of transition. This might require a PSO to mobilise financial resources and operational abilities, for reimbursing/compensating them, as well as data resources and analytical abilities for evidence-based interventions about which societal groups are most affected and how to best compensate them.

All the above suggests there might be a co-evolution between the stages of the transition processes and the transformative capacity of a PSO, both changing through time. Whereas we have seen that it might change through time, we cannot assume that a PSO's transformative capacity is automatically expanding and growing. This brings us to the last theoretical consideration of this article about building transformative capacity.

6.3. Building transformative capacity in public sector organisations

A third theoretical consideration is about building transformative capacity. We take as the starting point from PSO's roles, assuming they are a necessary condition for a PSO's transformative capacity in the enactment of purposeful change agency. Following this, we can then assume that building transformative capacity in a PSO is not an automatic process. To some extent, transformative capacity is built from inside the PSO itself, naturally in relation to the wider governance, and public administrative context in which the PSO operates. Hence, two further considerations might be relevant here: capacity-building as a process of gradual expansion of its constitutive elements; and capacity-building as a process related to public leadership.

Starting with the first, we can theorise that transformative capacity is built through an interactive process of expanding a PSO's own constitutive elements, namely roles, resources, and abilities. Their interaction means they might (or might not) gradually support each other, expanding in terms of breadth and intensity. The notion of ambidexterity as exploiting and exploring abilities might be relevant to explore in this regard (Gieske, van Buuren et al. 2016). Building transformative capacity is not a PSO's mere response to external socio-political demands in the mechanistic implementation of collective targets. To a certain degree it is a strategic move of the PSO (triggered by the PSO itself or by its principal – a ministry, etc.) to create a more powerful contextual positioning in terms of enacting transformative action. 'Powerful contextual positioning' relates to our earlier discussions about power in relational terms (Avelino and Wittmayer 2016), that is a PSO's real influence over other external actors in the system and over the institutional framework of the system.

The second consideration has to do with public leadership. All organisations, including public sector organisations, have leaders, and the exercise of leadership is relevant to the functioning of the organisation. When dealing with transformative capacity in sustainability transitions and defining the roles of the PSO, public leadership matters. This has to do not only with the interpersonal skills of the individual leaders as they motivate others and set specific organisational goals; it has also to do with the overall organisational dimension of leadership where employees are (self-)aligned in working synergistically. This is a reason why public leadership (or the lack thereof) in sustainability transitions is an emerging topic (Lindvall 2023; Braams, Wesseling et al. 2022). It is worth noting at this point the distinction in the public administration literature between political leadership, that is exercised by (democratically elected) politicians and political groups, and public leadership, that is exercised by managers in public sector organisations. This paper focuses on the latter, and therefore we are more concerned with public leadership than with political leadership. We acknowledge that political leadership is important in sustainability transitions. When such political leadership results in clear and ambitious climate targets, this becomes a political mandate which is a fundamental resource for PSOs transformative capacity (see Section 5.2). In other cases, however, political leadership might not engage, leaving PSOs with a different room for manoeuvre which would require mobilizing implicit rather than explicit mandates, and unfolding specific directional roles circumventing political apathy or resistance. This has to do with the relationship and tensions between political and public authorities.

7. Conclusions

Public sector organisations (PSOs) are central to sustainability transitions, but the literature on transformative capacity of PSOs remains disjointed. To drive forward the emerging research agenda of PSO transformative capacity in sustainability transitions, we conducted a review of the literature, identified the various conceptual approaches and built a higher-order conceptual framework. We carried out a scope review of 121 selected publications to capture key conceptualisations in three literature strands, analysed their strengths and shortcomings and identified key insights in order to advance theorising and conceptual development.

Our findings show two key insights. First, we identified two main perspectives on capacity: one that defines capacity as the potential of an organisation based on its resources, defined by its situation in a governance system; and another that defines capacity in action-oriented terms as the organisation's own abilities to enact transformative change. The latter perspective is associated with capability, a notion that denotes the specific routines of an organisation to perform diverse tasks. Acknowledging that both are crucial, we suggest that the capacity of an organisation is about the interaction between its resources (as situated assets internal and external to the organisation) and its abilities (as the routines, practices, and procedures of the organisation to use those resources). See Fig. 2.

The second key insight has to do with the *transformativeness* in transformative change. Considering that sustainability transitions require path-breaking change, the literature takes a process-oriented perspective on transformation. For this reason, the literature largely understands transformative agency as the purposeful and directional enactment of change. We elaborate on these key findings, suggesting to conceptualise transformative capacity as the interaction between a public sector organisation's enactment of directional roles, its situated resources, and its abilities (see Fig. 3).

In terms of theoretical implications and contributions, this article elaborates on three theoretical considerations resulting from the above. First, that the transformative capacity of a PSO is neither static nor binary, but is defined by the interactions between roles, resources, and abilities, taking many possible different forms. How can we conceptualise that diversity of interactions? We take as the starting point that roles are necessary conditions, and resources and abilities are sufficient conditions for a PSO's transformative capacity. A PSO's enactment of change agency to overcome the heavy barriers towards sustainability transitions require directionality, and therefore the organisation's own interpretation and purposeful enactment of various (new) roles that, combined, might be more or less transformative. These combinations of roles require the mobilisation of specific situated resources and organisational abilities. The article provides examples of these combinations of roles and their interactions with specific resources and abilities in Section 6.1.

The second theoretical consideration is the co-evolution between a PSO's transformative capacity and sustainability transitions' pathways. There is a widespread acknowledgement in the literature that sustainability transitions do not follow one single pathway, and that transitions are not free from costs and opposition. The transformative capacity of PSOs vary along this diversity of pathways and across time. In different transition pathways, a PSO will have different roles. Depending on how those transformative roles are combined, the PSO will require diverse sets of situated resources and organisational abilities. Likewise, the different phases of transitions' pathways need various combinations of roles, resources, and abilities. Hence, we propose the theoretical consideration that there might be a co-evolution between the transformative capacity of the PSO, and the types of pathways and of its phases. However, we cannot assume that such co-evolution happens automatically.

This brings us to our third theoretical consideration about building transformative capacity. We suggest that a PSO's transformative capacity-building is the process by which its constitutive elements are expanded; and we suggest that public leadership is important in that regard. Building transformative capacity in a PSO is not only a matter of providing it with more resources. It is also an inside-out

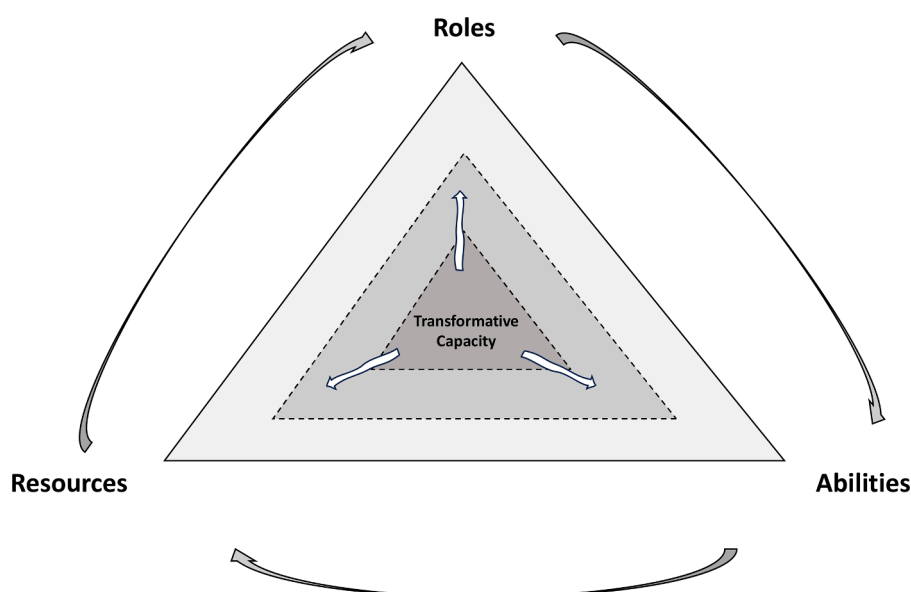


Fig. 3. The three constitutive elements of public sector transformative capacity.

move of the PSO itself, seeking to define its own roles, resources, and abilities, to gain a stronger positioning in a specific sustainability transition pathway. This is why the leadership in the PSO is important. Public leadership is not only about the interpersonal skills of the leading individual motivating and setting courses of action, but also about the (self-)alignment of employees towards transformative change.

Overall, our higher-order conceptual framework of PSOs transformative capacity, based on roles, resources, and abilities, offers the opportunity for a more granular empirical research endeavour to understand what specific interactions of transformative capacity elements are at play. The three theoretical considerations elaborated in the previous section of this article offer concrete clues towards a future research agenda based on a holistic framework of transformative capacity. Such an agenda is an empirical research endeavour asking questions about how the roles, resources, and abilities of public sector organisations interact in the enactment of change agency; asking questions about the co-evolution between transformative pathways and the unfolding of these roles, resources, and abilities; and asking questions about how transformative capacity is built through time. Each of these three questions brings forward a number of aspects that deserve careful study. Comparative studies could bring key insights in this regard. For example, studying variations in the transformative capacity of similar public sector organisations (i.e. two municipal public organisations) in the same socio-political and economic context (in the same country, and with similar urban system features) and in the same socio-technical system (energy transition). Variations of their transformative capacity will indicate clues about specific conditions, contrasting expectations about what roles/resources/routines are essential for transformative capacity. A second line of research could focus on barriers and lock-ins, asking how PSOs use transformative capacity to overcome different types of barriers and lock-ins in current socio-technical systems? Such a study could take the starting point in the nature of the barriers, and examine comparatively PSOs' capacity as change agents, or their limits thereof. A third avenue for a future research could be to compare transformative capacity across socio-technical systems. Key questions are how and to what extent the nature of these socio-technical systems matters for the exercise and development of transformative capacity as change agency. A fourth research agenda could empirically examine the impact of various leadership strategies to enhance transformative capacity, given the relevance of public leaders and managers to define courses of organisational action. Last, but not least, a fifth research agenda could investigate the transformative capacity of public sector organisations that are facing particularly severe challenges of resource scarcity. This is particularly relevant for public sector organisations that have experienced a rapid resource reduction the past decades, and/or that have always been endemically resource-constrained due to wider socio-economic challenges (particularly low and middle-low income countries).

At the practical level, this conceptual framework could be adapted to a self-reflective tool for public leaders and civil servants, who are searching for concrete clues to make their organisations fit-for-purpose in specific sustainability transitions' pathways. More concretely, they could use it to reflect upon and identify specific elements (roles, resources, abilities) that need to be strengthened and changed, allowing for a more targeted and context-embedded capacity-building efforts in public sector organisations.

CRedit authorship contribution statement

Susana Borrás: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Stine Haakonsson:** Writing – review & editing, Visualization, Formal analysis. **Christian Hendriksen:** Writing – review & editing, Validation, Formal analysis. **Francesco Gerli:** Writing – review & editing, Validation, Formal analysis. **René Taudal Poulsen:** Writing – review & editing, Validation, Formal analysis. **Trine Pallesen:** Formal analysis. **Lucas Somavilla Croatto:** Formal analysis. **Susanna Kugelberg:** Validation. **Henrik Larsen:** Validation.

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.

Data availability

All data is provided in the appendices

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Appendix 1: Detailed methodology

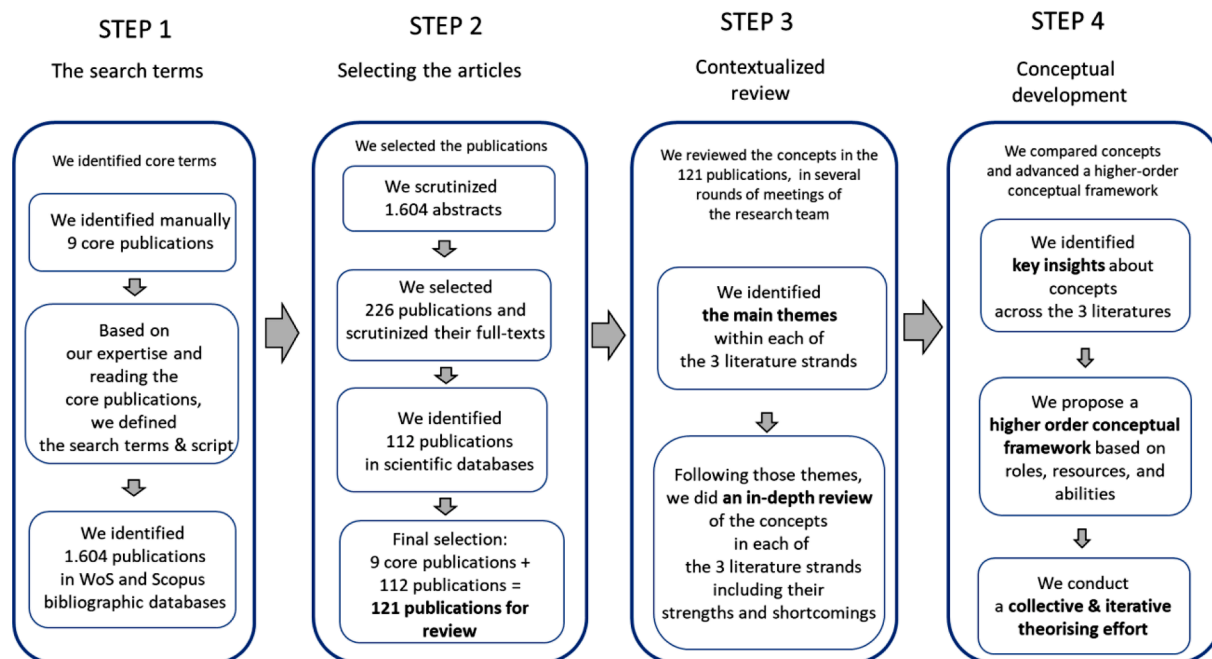
General about rigor, internal consistency, and relevance

As mentioned in [Section 2](#), we have paid careful attention to ensure the methodological quality of this theoretical literature review, and in this regard, we have followed the specific approach suggested by experts in literature reviews. More concretely, we have secured the rigor, the internal consistency and the relevance of our literature review in all its process.

Rigor refers to the thoroughness of the documentation about the search, selection, and synthesis process of the literature review. This refers to the soundness in the choices made along the way ([Paré, Trudel et al. 2015](#)). To secure the rigor of this review, we followed specific steps, and made careful decisions about screening, selection, organization, and reporting of the reviewed articles. Below we provide a detailed account of the different steps and the criteria used in each of them, showing that the whole process has followed carefully designed criteria in a rigorous manner. **Internal consistency** is another important aspect of the methodological quality of literature reviews. It refers to the consistency of the processes undertaken in relation to the features that characterize the type of review chosen from the beginning. In this article, we follow the guidelines and features of a “theoretical review”, according to the approach suggested by [Paré et al.](#) (see [Section 2](#) of the paper). More concretely, these authors suggest that a theoretical literature review has the following features: it defines research questions with a broad scope, it undertakes a comprehensive search strategy, it uses conceptual and empirical primary sources, it defines an explicit study selection, and it uses content analysis or interpretative methods for analyzing the findings. Our study is consistent with these features, as we have carefully followed each of them: our two research questions are broad and suitable for the overall aim of the review; we undertook a comprehensive search strategy (see below about Step 1); it used primary sources (scientific publications on the topic); defined explicit inclusion/exclusion criteria to guide the selection process (see below about Step 2); and underwent two cycles of coding, based structural coding (see below about Step 3). The third aspect that defines the methodological quality of the review has to do with the **relevance** of the literature review. This is related to the ability of the literature review article to answer convincingly its own research questions. We have defined these questions upfront (see [Section 1](#)). Our literature review is relevant, as we have carried out an encompassing analysis of the findings, which has allowed us to identify trends, as well as thinness in the literature. Following from that, we have developed a conceptual framework about the transformative capacity of public sector organizations based on three core elements: their roles, resources and skills; which serves to advance research in this field.

The Steps

As indicated in [Section 2](#) of the paper, and illustrated in [Fig. 1](#), our literature review followed 4 overall Steps:



In this appendix we provide additional information about the choices and criteria used in Steps 1 and 2, because these are the steps about the selection of the publications that were reviewed.

Regarding Steps 3 and 4 of the review process, [Sections 2, 3, 4, 5 and 6](#) of the paper provide all the details.

STEP 1: The search terms

In several iterative meetings, the research team and the expert librarians brainstormed and discussed the core search terms and their overall logical interactions. This served to provide a final list of search terms, and to undertake a script-based search in Scopus and Web of Science bibliographic databases with a time span from January 2000 to July 2023, yielding 1604 publications.

This time period is highly relevant due to the fact that the turn of the millennium represented a watershed in terms of how social, political, and academic debates have addressed the grand challenges of climate change and environmental sustainability.

The research team discussed the theme of the literature review from the perspective of their different backgrounds, their expertise in the field, and from the inspiration of a number of relevant background texts (see the list in Appendix 2).

In several iterative meetings, the research team generated a list of terms in order to guide the bibliographic search: the list contained terms that are synonyms to the three core topics of the search, namely, green/environmental sustainability, public sector/organizations, and capacity. The logic of the search was to find articles that are explicitly referring to all these three topics at once.

Interacting with two specialized librarians, the list of terms was further discussed and simplified. The terms were truncated with * to capture different word endings. The librarians recommended to conduct the search focusing on identifying those terms in the titles, abstracts, and keywords of articles, because this will yield outputs with lower levels of noise.^j

We followed as well the librarians' recommendation to limit the search according to specific subject areas in the bibliographic databases, rather than to limit the search to specific journals. The reason is that this will allow to find relevant articles in a wider range of journals, which is relevant given the various strands of literature dealing with the topic. The subject areas in the bibliographical dataset Scopus were: environmental sciences, social science, business management and accounting, decision science, and multidisciplinary. We used similar subject areas in the other bibliographical dataset we used, namely, Web of Science.

Together with the librarians, we tested different versions of search scripts in order to identify which script yielded less noise. The script used:

((TITLE-ABS-KEY ((transition* OR transformation OR innovation*) W/2 (green OR sustainable)) OR TITLE-ABS-KEY (decarboni*) OR TITLE-ABS-KEY ("Socio-technic*" OR sociotechnic*) W/2 (system* OR niche*)) OR TITLE-ABS-KEY ("living lab*" OR livinglab) W/3 (sustain* OR green)) OR TITLE-ABS-KEY ((green OR sustainab* OR renew*) W/1 energy) OR TITLE-ABS-KEY (environment* W/2 (governance OR policy OR sustain*))) AND (TITLE-ABS-KEY (((transform* OR change OR policy OR governance OR urban OR administrati* OR enforcement OR implement* OR transfer* OR regulat*) W/2 (capacit*)) OR "transformative capabili*" OR "dynamic capabili*") AND (LIMIT-TO (SUBJAREA, "ENVI") OR LIMIT-TO (SUBJAREA, "SOCl") OR LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "DECI") OR LIMIT-TO (SUBJAREA, "MULT")))

We first run the script in the bibliographical database Scopus in the time period (2000-October 2021), and we re-run the same script in the database World of Science. After removing duplicates, and publications without clear author names or incomplete references, the final output for screening was 1.174 publications. In the Summer 2023 we re-run the same script to update the search covering the period from October 2021 to July 2023.

STEP 2: Selecting the publications

The inclusion and exclusion criteria were carefully discussed and refined to ensure the research team had a calibrated understanding of them. In the second sub-step we uploaded full-texts of the remaining 226 articles to a dedicated software program and engaged in a further selection based on reading the full papers. The full-text selection was based on the same exclusion criteria as in the screening (see Appendix 1), which resulted in a final selection of 112 studies for review (see the list of selected publications in Appendix 2).

Overall aim guiding the selection of the publications: We want to review the literature about the capacity of public sector organizations in sustainability green transitions, with the aim at developing a consistent review, and at advancing the conceptual framework in the field.

Two sub-steps:

- **Scrutinizing titles and abstracts:** We first screened/scrutinized the titles and abstracts of the 1.604 publications. Out of those, we selected 226 publications.
- **Scrutinizing and selecting full texts:** Thereafter, we screened/scrutinized those 226 publications, reading their full text. Out of those, we finally selected 112 final publications for the review.

Inclusion and exclusion criteria

We used the following inclusion and exclusion criteria for both sub-steps above.

a) Type of publication:

Inclusion:

^j Noise refers to search outputs that have a disproportionate amount of non-focused results.

- We only include acknowledged publications: articles in journals, or chapters in books of academic nature.
- We only include articles older than 2000.
- We include publications with clear authorship.

Exclusion: Hence we exclude opening letters in special issues (those too general, not really providing in-depth conceptual approach), editorial letters (too generic), grey publications (f.ex. assessment reports, think-tank reports, etc.), or full books (we are interested in the specific chapters conceptualizing capacity); we exclude non-authored publications (with no clear author, or no specific author names); we exclude publications earlier than 2000.

a) Thematic assessment:

We include theoretical, conceptual and empirical articles (we will review the way in which they use the concepts ‘capacity’, ‘capability’, ‘competences’)

We include articles about sustainable transitions/green transformation/sustainability/green innovation, and similar; not about economic growth or transformation of industrial sectors.

We include articles dealing with ‘public sector organizations’, which can be understood as: governments, municipalities, public administrators, agencies, public actors, or similar.

We include articles on ‘governance’, ‘policy’, ‘organizations’ capacity.

Hence **we exclude** studies about economic growth/industrial transformation: we are interested in green/ecological/sustainability transformation; We exclude articles talking about capacity, capacity-building or capability-building at the very end of their analysis, and/or only in relation to ‘policy advice/practical implications’: f.ex.: a publication with generic remarks like “there is a need of capacity-building” in the conclusion section is to be excluded. We are interested in studies that explicitly analyze empirically or conceptually capacities/capabilities as a central part of their study and analysis, etc., not articles mentioning ‘capacity’ as policy advice.

We exclude as well publications which are not truly examining capacity, but mostly oriented towards assessing success, effects, effectiveness of policies, etc.: It is not the determination of empirical ‘success’ that interest us: it is the concepts and conceptual framework about capacity that is the aim of our review and hence selection criteria: We are interested in publications (theoretical and/or empirical) that explicitly develop/use concepts related to the capacity/capabilities in processes of sustainability green transitions.

Appendix 2: Reviewed Publications

The list of manually selected core publications in Step 1

1. Borrás, S. and J. Edler (2020). "The roles of the state in the governance of socio-technical systems' transformation." *Research Policy* 49(5).
2. Breznitz, D., D. Ornston and S. Samford (2018). "Mission critical: the ends, means, and design of innovation agencies." *Industrial and Corporate Change* 27(5): 883–896.
3. Geels, F. W. (2020). "Micro-foundations of the multi-level perspective on socio-technical transitions: Developing a multi-dimensional model of agency through crossovers between social constructivism, evolutionary economics and neoinstitutional theory." *Technological Forecasting and Social Change* 152.
4. Haddad, C. R., V. Nakić, A. Bergek and H. Hellsmark (2022). "Transformative innovation policy: A systematic review." *Environmental Innovation and Societal Transitions* 43: 14–40.
5. Kivimaa, P., W. Boon, S. Hyysalo and L. Klerkx (2019). "Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda." *Research Policy* 48(4): 1062–1075.
6. Köhler, J., F. W. Geels, F. Kern, J. Markard, E. Onsongo, A. Wieczorek, F. Alkemade, F. Avelino, A. Bergek, F. Boons, L. Fünfschilling, D. Hess, G. Holtz, S. Hyysalo, K. Jenkins, P. Kivimaa, M. Martiskainen, A. McMeekin, M. S. Mühlemeier, B. Nykvist, B. Pel, R. Raven, H. Rohracher, B. Sandén, J. Schot, B. Sovacool, B. Turnheim, D. Welch and P. Wells (2019). "An agenda for sustainability transitions research: State of the art and future directions." *Environmental Innovation and Societal Transitions* 31: 1–32.
7. Teece, D. J., G. Pisano and A. Shuen (1997). "Dynamic capabilities and strategic management." *Strategic Management Journal* 18 (7): 509–533.
8. Weber, K. M. and H. Rohracher (2012). "Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework." *Research Policy* 41(6): 1037–1047.
9. Wu, X., M. Ramesh and M. Howlett (2018). *Policy Capacity: Conceptual Framework and Essential Components. Policy Capacity and Governance. Assessing Governmental Competences and Capabilities in Theory and Practice.* X. Wu, M. Howlett and M. Ramesh. Cham, Springer International Publishing: 1–25.

The list of the 112 publications selected using search terms and script:

1. Aguilar, M.G., Jaramillo, J.F., Ddiba, D., Páez, D.C., Rueda, H., Andersson, K., Dickin, S., 2022. Governance challenges and opportunities for implementing resource recovery from organic waste streams in urban areas of Latin America: insights from Chía, Colombia. *Sustainable Production and Consumption* 30, 53–63. 10.1016/j.spc.2021.11.025
2. Anadon, L.D., Chan, G., Harley, A.G., Matus, K., Moon, S., Murthy, S.L., Clark, W.C., 2016. Making technological innovation work for sustainable development. *Proc Natl Acad Sci U S A* 113, 9682–9690. 10.1073/pnas.1525004113
3. Arshad, M., Yu, C.K., Qadir, A., Rafique, M., 2023. The influence of climate change, green innovation, and aspects of green dynamic capabilities as an approach to achieving sustainable development. *Environ Sci Pollut Res Int* 30, 71,340–71,359. 10.1007/s11356-023-27,343-0
4. Arts, B., Leroy, P., 2006. Institutional processes in environmental governance: Lots of dynamics, not much change?, in: Arts, B., Leroy, P. (Eds.), *Institutional Dynamics in Environmental Governance*. Springer, Dordrecht, The Netherlands, pp. 267–282. 10.1007/1-4020-5079-8_13
5. Avelino, F., Wittmayer, J.M., 2016. Shifting Power Relations in Sustainability Transitions: A Multi-actor Perspective. *Journal of Environmental Policy & Planning* 18, 628–649. 10.1080/1523908x.2015.1112259
6. Banjongprasert, A., 2022. Understanding the Adaptive Capacity of Actors in Environmental Governance: The Case of Trans-boundary Movement of Waste Electrical and Electronic Equipment. *Croatian International Relations Review XXVIII*, 62–89. 10.2478/CIRR-2022-0004
7. Barnes, M.L., Datta, A., Morris, S., Zethoven, I., 2022. Navigating climate crises in the Great Barrier Reef. *Global Environmental Change* 74. 10.1016/j.gloenvcha.2022.102494
8. Beck, S., Jasanoff, S., Stirling, A., Polzin, C., 2021. The governance of sociotechnical transformations to sustainability. *Current Opinion in Environmental Sustainability* 49, 143–152. 10.1016/j.cosust.2021.04.010
9. Benoit, P., Clark, A., Schwarz, M., Dibley, A., 2022. Decarbonization in state-owned power companies: Lessons from a comparative analysis. *Journal of Cleaner Production* 355. 10.1016/j.jclepro.2022.131796
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12. Bissix, G., Rees, J.A., 2001. Can strategic ecosystem management succeed in multiagency environments? *Ecological Applications* 11, 570–583. 10.1890/1051-0761(2001)011[0570:CSEMSI]2.0.CO;2
13. Blythe, J.L., Cohen, P.J., Eriksson, H., Harohau, D., 2022. Do governance networks build collaborative capacity for sustainable development? Insights from Solomon Islands. *Environ Manage* 70, 229–240. 10.1007/s00267-022-01,644-5
14. Boer, H., 2013. Governing ecosystem Carbon. *Global Environmental Politics* 13, 123–143. 10.1162/GLEP_a_00201
15. Borgström, S., 2019. Balancing diversity and connectivity in multi-level governance settings for urban transformative capacity. *Ambio* 48, 463–477. 10.1007/s13280-018-01,142-1
16. Börzel, T.A., Buzogány, A., 2019. Compliance with EU environmental law. The iceberg is melting. *Environmental Politics* 28, 315–341. 10.1080/09,644,016.2019.1549772
17. Bos, J.J., Brown, R.R., 2014. Assessing organisational capacity for transition policy programs. *Technological Forecasting and Social Change* 86, 188–206. 10.1016/j.techfore.2013.09.012
18. Bowen, F., Panagiotopoulos, P., 2020. Regulatory roles and functions in information-based regulation: a systematic review. *International Review of Administrative Sciences* 86, 203–221. 10.1177/0,020,852,318,778,775
19. Bryan, T.K., 2016. Capacity for climate change planning: assessing metropolitan responses in the United States. *Journal of Environmental Planning and Management* 59, 573–586. 10.1080/09,640,568.2015.1030499
20. Castan Broto, V., Trencher, G., Iwaszuk, E., Westman, L., 2019. Transformative capacity and local action for urban sustainability. *Ambio* 48, 449–462. 10.1007/s13280-018-1086-z
21. Chaudhury, A., 2020. Role of intermediaries in shaping climate finance in developing countries-lessons from the green climate fund. *Sustainability (Switzerland)* 12. 10.3390/SU12145507
22. De Laurentis, C., Pearson, P.J.G., 2021. Policy-relevant insights for regional renewable energy deployment. *Energy, Sustainability and Society* 11. 10.1186/s13705-021-00,295-4
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