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The organizational ecosystem change model for sustainability and justice

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Addressing complex societal challenges like sustainability and justice requires significant coordinated action within and across organizations. But existing theories for understanding organizational change generally focus on change within a single organization. This perspective misses important interconnectivity and dependencies that organizations have with other entities that both facilitate and impede organizational change. We explore these critical interconnectivities and dependencies and propose an Organizational Ecosystem Change Model (OECM) that considers how organizational change occurs within an ecosystem of organizations. We illustrate the relevance of this model by applying it to an organization's attempt to change in response to complex sustainability challenges that require the federal ecosystem of organizations to incorporate energy and environmental justice values into their work. Through interviews and analyzing official agency documents and internal archival documents with OECM, we demonstrate that organization change is (1) affected by the nature of hierarchy within the ecosystem, (2) requires significant coordination across the ecosystem, and (3) warrants codifying new organizational norms and processes that can create ecosystem-wide support for change. OECM model and our empirical application advance our understanding of organizational change theory and offer practical insights for organizational ecosystems dealing with similar change-related tasks to address complex sustainability challenges.

KEYWORDS

ecosystem, organizational change, environmental justice, energy justice, sustainability, federal agencies

1 Introduction

Complex environmental and societal problems that warrant sustainability and justice solutions require coordination and collaboration between multiple organizations, and multiple stakeholders at multiple levels (Fadееva, 2005; Pattberg and Widerberg, 2016; Brasier, 2023; Gomez, 2023; Mirkow et al., 2023). To address these concerns, organizations undergo organizational change for sustainability and justice which requires changing from their present state to a more desirable state that is sustainability and justice-aligned (Lozano, 2013; Barreiro-Gen et al., 2022). However, due to these inter-organizational links, this organizational change process for sustainability and justice cannot be understood by analyzing a single organization (MacDonald et al., 2019). Additionally, since existing change theory literature has tended to focus on change within single organizations (Lewin, 1947; Judson, 1991; Kotter,

1995) and thus fails to provide adequate theoretical support for understanding organizational change for sustainability and justice.

These traditional single-organization approaches have tended to focus on how an individual organization goes through the process of change and how such change is institutionalized within the organization itself. Consequently, what is missing from this lens is attention towards how organizations are typically nested within a complex system of highly interconnected and dependent organizations. Organizations of all sorts—government, private business, publicly traded companies, to nonprofits—have long affected and shaped each other (Ahrne et al., 2007). This interconnectivity and dependency forms an ecosystem of organizations, which is defined as organizations that “share common or complementary features” and exchange information and other resources (Mars et al., 2012). These interdependencies thus determine and affect the ability of each organization to change. As such, organizational change should be considered within the context of organizations across the ecosystem, each of which can either facilitate or hinder movement (Mars et al., 2012; Connolly and Dolan, 2013; Mars and Bronstein, 2018). As complex sustainability problems necessitate collaboration and coordination among a variety of organizations, developing a more holistic ecosystem perspective becomes imperative (Sargut and McGrath, 2011; Wittneben et al., 2012; MacDonald et al., 2019; Kenis and Raab, 2020). Similarly, addressing justice also requires collaboration and cooperation beyond organizations in the justice system, within and across public-private organizations (Mirkow et al., 2023; Kolb et al., 2020). This research develops the Organizational Ecosystem Change Model (OECM) to bring in these significant inter-organizational dynamics which help explain organizational change for sustainability and justice. OECM builds on existing single-organizational change research and shifts the unit of analysis from individual organizations to an ecosystem of organizations, focusing on the interconnections between organizations within complex networks. OECM thus better accounts for the complexity and collaboration that can explain how sustainability and justice are addressed by organizations.

Our research develops OECM to answer the question: How does an organization ecosystem perspective— as opposed to an individual organization perspective— enhance our understanding of organizational change in response to complex societal problems? To illustrate the model, we apply OECM to examine a federal agency ecosystem that is changing to respond to expectations to integrate justice and specifically energy and environmental justice (EEJ) considerations into federal programs. We focus on the Water Power Technologies Office (WPTO), which is part of the US Department of Energy, and the ecosystem of organizations within which it lives. The case illustrates the organizational barriers and opportunities to incorporate justice principles across an organization ecosystem and provides important insights for similarly networked organizations that are trying to advance change and incorporate principles of sustainability and justice within their work.

We begin by discussing traditional organizational change models to understand their limitations, and why developing OECM is needed. We then articulate the components of OECM and how change occurs within an organizational ecosystem before applying OECM model to a practical case that is developed through numerous interviews and significant archival data.

2 Understanding organization change

Van de Ven and Poole (2005) provide an overview of how traditional organization change models function. They suggest that change can be studied either as a variation in a single variable within the organization or as a narrative about the process of change across the organization. Lewin (1947) put forth one of the earliest organizational change theories which has been used widely to understand organizational change (Vora, 1992; Batras et al., 2014). It proposes that change can be explained through the three progressive steps of *unfreezing*, *moving*, and *refreezing*, and involving critical change agents (i.e., individuals responsible for creating change) at each step (Lewin, 1947). These steps of change in Lewin’s model involve creating dissatisfaction with the initial state and then rebuilding organizational processes, norms, and rules within the organization that align with the changed state leading to lasting change.

Lewin’s model has been subject to criticism for various reasons leading to change theorists improving over the model to enhance its practical adaptability for understanding organizational change (Todnem, 2005). Judson (1991) and Kotter (1995) provided early extensions to Lewin’s work by seeking to understand resistance to change and potential mistakes that could derail the process of change, respectively. Other responses to Lewin’s model have involved considering the pace at which change occurs (Weick and Quinn, 1999) or the context of change by linking exogenous factors to an organization’s design which then cause change (Burke and Litwin, 1992). However, these extensions have focused on internal organizational change and continued to overlook criticisms of Lewin’s model that emphasize the importance of inter-organizational dynamics, role of conflict (Bartunek and Woodman, 2015), and organizational leadership (Hussain et al., 2018). These aspects are an outcome of the broader system of highly interdependent and interconnected organizations within which an organization functions, and influence any one organization’s ability to change. OECM addresses this research gap and presents a model for analyzing organizational change in contexts like sustainability and justice where these interconnections and complex interactions between organizations are of utmost relevance to the individual organization’s process of change (Fæste et al., 2019).

3 Organizational ecosystem change model

Borrowing from ecology and biological ecosystems, organizational ecosystems focus on the interdependence in organizational behavior. The notion of an “ecosystem” to understand organizational interactions and dependencies has been used in multiple fields, including industrial ecology, business, platform management, and multi-actor-network perspectives. More formally, *organizational ecosystems* are defined as emergent phenomena of nested structures that contain a wide range of diverse actors and organizations that are bound by the provision of a product or a service (Mars et al., 2012; Tsujimoto et al., 2018). Moreover, ecosystem metaphor captures complex organizational interactions and relationships providing a more suitable perspective for addressing modern problems like climate change, sustainability, and justice (Fæste et al., 2019).

OECM extends Lewin’s change model (1947) to encompass an ecosystem of organizations. Criticisms of Lewin’s model often identify that the model neglects the multifaceted nature of organizations, relational dynamics across organizations, organizational politics and conflict (Kanter et al., 1992; Burnes, 2004; Bartunek and Woodman, 2015). OECM attempts to address these criticisms of Lewin’s model by going beyond Lewin’s analysis bound of an individual organization, and considering the broader ecosystem within which the individual organization is embedded. OECM thus recognizes the importance of these interdependencies and relationships across the ecosystem, which are significant influences in organizational change. It emphasizes the shape and the structure of the ecosystem by understanding the flow of information and resources and the hierarchy that prevails in the organizational ecosystem which in turn influences the process of change in the organizational ecosystem. In OECM, it is aspects of these ecosystem-related elements that are emphasized as markers of the different stages of change. While OECM’s reliance on networks in the process of change is similar to actor-network theory, the two conceptualize change in fundamentally different ways. OECM pays attention not only to the network but also to the facets shaped by individuals within the network like the flow of information, the flow of resources, and the hierarchy within the ecosystem. We thus consider an individual’s autonomy, decision-making capacity, and the influence these factors bear on the process of change within the organization to which the actor belongs.

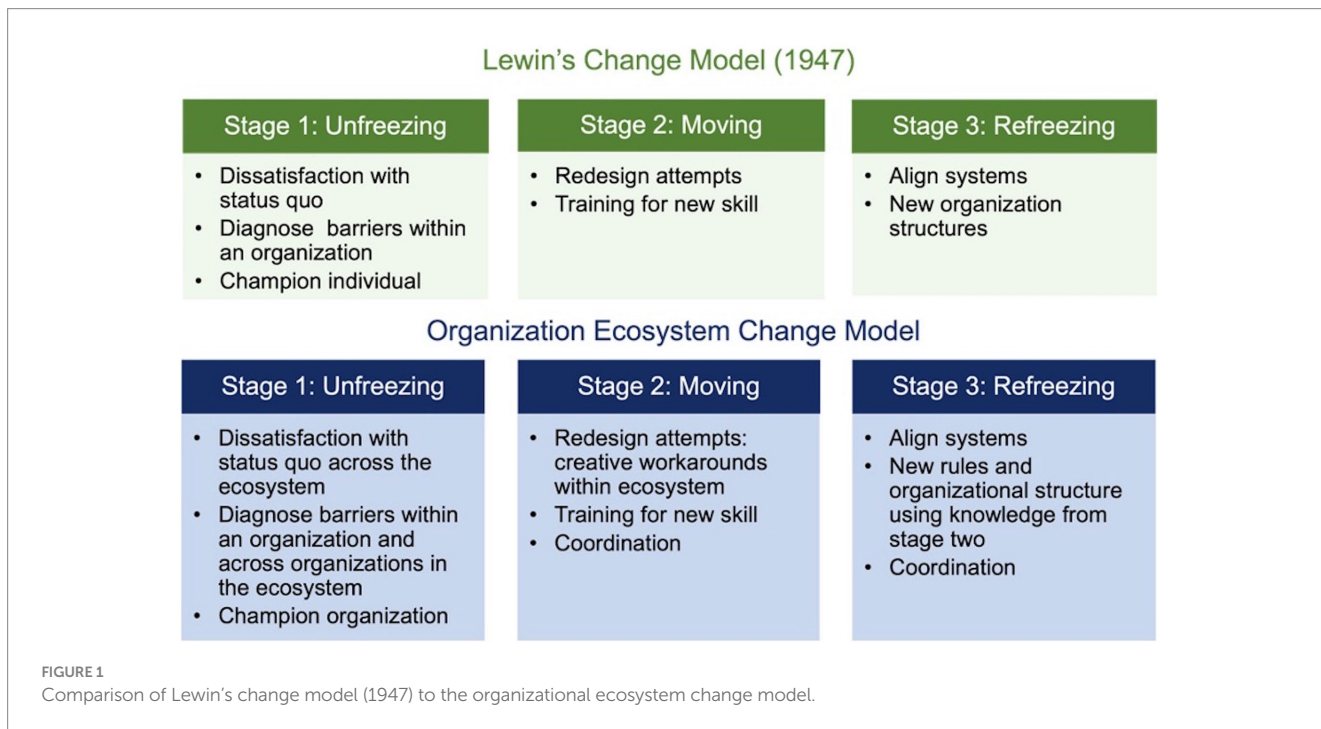
To illustrate OECM model, we first describe the critical components of Lewin’s model and then juxtapose them to the critical components of OECM (see Figure 1) before then applying the model to change within.

The first step, *unfreezing*, involves creating dissatisfaction amongst members of an organization concerning the status quo. Status quo is defined as the current notions (sentiments), informal organizational guidelines (norms), and skillsets/resources (capabilities) that build out the way things are done within an organization. Lewin’s model

acknowledges the role of individual champions or change agents who are dissatisfied and more inclined towards change, however, it does not delve into this aspect and role of leadership in detail (Levasseur, 2001; Spector, 2007; Cummings et al., 2015; Hussain et al., 2018) like other change theorists like Lippitt (Brotman et al., 1958).

In OECM, *unfreezing* emphasizes the ecosystem as a whole, encompassing dissatisfaction with the status quo and diagnosing internal barriers across the ecosystem. Within an ecosystem of organizations, inertia prevents individual change agents alone from furthering change; there is a need for a larger effort at the organizational level. Thus, OECM moves beyond champion individuals and also past Lewin’s limited understanding of the role of leadership in organizational change (Hussain et al., 2018), and introduces the concept of a champion organization as a key element in the first stage of change across organizational ecosystems. A champion organization assumes the responsibility of leading the change by identifying issues with the status quo and diagnosing internal barriers across the ecosystem, thereby expediting the unfreezing process. Champion organizations can also offer valuable insights for other organizations in the ecosystem changing. These organizations are typically characterized by two features. First, they tend to harbor more numbers of individual employees who support ecosystem-wide change. Second, champion organizations tend to demonstrate behavior that indicates they are more receptive to change and are trying to align with the changed state earlier than the rest of the ecosystem. Champion organizations also align with the sustainability change concept of “multiplier firms” that can facilitate and catalyze change for sustainability across organizations and within industries (Edmondson et al., 2015).

Unfreezing is followed by *moving*, which consists of attempts to redesign the organization and retrain for new skills. Lewin’s change theory discusses redesign attempts as “new strategically aligned behaviors” and as the act of “redesigning behavioral patterns” (Spector, 2007). This definition presents redesign attempts as an alteration to



existing behaviors within the organization that are conforming to the changed state. Redesign attempts are originally defined as “new strategically aligned behaviors” (Lewin, 1947) and as the act of “re-designing behavioral patterns” (Spector, 2007).

OECM adds nuance to this definition of *moving* by emphasizing what leads to the redesign attempt in an ecosystem. By including the mechanism for a redesign attempt, OECM brings in some temporal and inter-organizational dynamics, which Lewin’s model fails to do (Bartunek and Woodman, 2015), into the process of change. OECM posits that these redesign attempts happen due to the characteristics of the ecosystem. Under OECM, redesign attempts are new strategically aligned behaviors that emerge due to the restrictions to change imposed by the nature and hierarchy of the ecosystem. By paying attention to how and why redesign occurs due to the nature and hierarchy of the ecosystem, OECM recognizes the structural barriers to change within an ecosystem. Factors that shape the nature of the ecosystem (such as formal and informal forms of power) and hierarchy within the organizational ecosystem are thus viewed as determinants of redesign attempts. This perspective on redesign attempts lends information about structural barriers that may not be as apparent in the first stage where only the individuals working within the ecosystem self-diagnose ecosystem-wide barriers to change. This redefinition of redesign attempts also helps identify what rules and norms act as inhibitors to change across an ecosystem. This information can help isolate these unsupportive rules and norms which can be specifically altered and realigned with the change state to create ecosystem-wide change in later stages. When changing for sustainability is met with a lack of support from leadership and the governance structure, quick fix solutions like redesign attempts might lead to haphazard change and warrant realignment across the ecosystem (Smith and Sharicz, 2011). Such realignment of rules and norms requires coordinated retraining across ecosystem organizations and within individual organizations to acquire new skills and knowledge. Internal barriers (diagnosed across the ecosystem and within the organizations in the previous step) can also serve as helpful guidelines in designing these training efforts as well.

The third (and final) stage of ecosystem change focuses on *refreezing*. In this stage, new systems and structures are codified and aligned to create a new status quo thereby leading to lasting change. Refreezing in OECM manifests as not only internal alignment within each organization that is a part of the ecosystem but also alignment across all the organizations in the ecosystem. The new rules and structures build from knowledge acquired in stage one but also from the motivations behind redesign attempts in stage two. These efforts require significant coordination across the ecosystem organizations, thereby creating buy-in for change and ensuring that all organizations can move together in this final stage and create sustained change. In the absence of coordination, if one organization advances while others lag, a champion organization can emerge to overcome the barriers created due to the unaligned organizations. Without coordination, the system may regress to earlier stages, impeding progress.

4 Sustainability and justice

Sustainability finds its origin in intergenerational equity (Clark and Miles, 2021); the Brundtland commission describes sustainable development as meeting “the needs of the present without

compromising the ability of future generations to meet their own needs” (Brundtland, 1987). Sustainability thus also pays careful attention to distributive equity (Burchardt and Craig, 2008). Principles of distributive equity also form a key cornerstone of the definition of energy and environmental justice (EEJ)¹ (Sovacool and Dworkin, 2015; Jenkins et al., 2016) demonstrating how inextricably sustainability and justice/EEJ are linked. Due to these important synergies achieving sustainability requires a deeper integration of principles of justice (Salem, 2019; Siciliano et al., 2021). Incorporating EEJ principles in sustainability practices will lead to more just, equitable and sustainable outcomes that abide by the intergenerational equity principle of sustainability (Clark and Miles, 2021).

In terms of implementing sustainability and justice related efforts, research has also shown that implementation of sustainability efforts has been successful in cases where EEJ ideals of community action and empowerment were considered (Agyeman et al., 2002). More importantly, recognizing how sustainability and EEJ are inseparable, sustainability scholars have also widely regarded achieving EEJ as an initial and fundamental step in the process of developing a sustainable world and thus called for more focus on EEJ within sustainability research (Bullard et al., 2001; Agyeman et al., 2016). Thus, understanding how EEJ-related organizational change (organizational change that aims to move the organization into a state that is more EEJ-aligned) is addressed by an ecosystem of organizations not only provides a stepping stone towards understanding how sustainability related change is addressed by the ecosystem but also allows for important lessons to be shared across both forms of change due to the essential intersections between EEJ and sustainability.

5 Applying OECM: a federal agency case study

To illustrate OECM’s relevance, we apply it to the organizational ecosystem in which the Water Power Technologies Office (WPTO) is nested, an ecosystem significantly motivated by sustainability and other value-based changes. WPTO is engaged in research, development and deployment of technologies for advancing marine energy, hydropower and pumped storage with the aim of ensuring a “flexible, reliable” energy grid (WPTO, 2022d). The Office is undergoing a process of change in response to President Biden’s Justice40 Initiative Executive Order requiring that “40 % of the overall benefits of federal investments in climate and clean energy” be given to disadvantaged communities (Young, 2021). Federal organizations,

¹ EEJ literature defines the principles of EEJ to include distributive justice, procedural justice and recognition justice. Distributive justice deals with the distribution of material outcomes which include both the benefits and the costs of programs, policies, and projects (Sovacool and Dworkin, 2015). Procedural justice involves ensuring that the procedures that govern the above distributions are equitable in nature and engage all involved stakeholders in a fair, non-discriminatory manner (Jenkins et al., 2016). Recognition justice can be understood as the attempt to not overlook or misrecognize affected stakeholders, and trying to avoid an intentional or otherwise lack of recognition for divergent perspectives that are rooted in the diverse origins of every stakeholder (Jenkins et al., 2016).

including WPTO, must respond to these expectations by determining relevant programs and pathways to meet goals from the order.

The WPTO ecosystem was chosen for an application of OECM for three reasons. First, due to the crucial interconnections between EEJ and sustainability, using OECM to understand how the WPTO ecosystem is engaging with EEJ related organizational change potentially offers significant lessons for other federal organizations looking to engage with both justice and sustainability.

Second, WPTO functions within an ecosystem of organizations, as part of the U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE), and as managing the work of the National Renewable Energy Laboratory (NREL), which creates interdependencies and interactions that affect its ability to change. WPTO has demonstrated significant policy and programmatic entrepreneurship in the past with its use of innovation prizes and challenges to further renewable technology development (EERE, 2023a), in ways that have provided EERE and DOE as a whole new ideas for accomplishing its mission.

Third, WPTO's projects have some existing alignment with EEJ values (Oonk et al., 2023), but must undergo a process of more substantive change to meet growing EEJ requirements. The WPTO ecosystem, therefore, serves as an ideal case of an organizational ecosystem changing. In the next subsections, we describe the WPTO ecosystem and illustrate the applicability and value of OECM.

5.1 WPTO's organizational ecosystem

Figure 2 depicts the WPTO ecosystem we study, which includes DOE, EERE, WPTO, NREL, and other regional partners, who are integral to WPTO's operations and process of change. Within this ecosystem and its hierarchy, as a federal agency, DOE holds the most financial and rulemaking power. DOE is a leader in US federal

energy policy through funding foundational research and development of energy technologies and the development and dissemination of information for decision-making (Ribicoff, 1977). DOE consists of 12 program offices and guides the work of 17 national labs that direct and support the US energy system. Under the DOE's Office of the Secretary, there exists the Office of Under Secretary for Science and Innovation, within which exists the Office of Energy Efficiency and Renewable Energy (EERE), under which WPTO lives.

EERE focuses on clean energy and energy efficiency technologies (EERE, 2022b). As a part of the various offices under the DOE, EERE receives funding through the annual Energy and Water Development and Related Agencies appropriations bill (Congressional Research Service, 2023) (see Figure 2, arrow 1). DOE makes budget requests to Congress every fiscal year to receive funding for NREL and WPTO (DOE, 2022) (arrows 2 and 3). EERE funds renewable energy programs across its offices and funds spent on marine and hydropower are done via WPTO (EERE, 2023c) (arrow 4). The National Renewable Energy Lab (NREL) is a part of the national laboratories network that conducts research funded through EERE (DOE, 1998) (arrow 5). In the case of certain technical assistance programs run by WPTO, WPTO also provides funds (which it requests from Congress) to national laboratories like NREL (arrow 6) in exchange for NREL providing technical assistance (WPTO, 2022a).

WPTO and NREL provide information like performance reports and experiential knowledge back to DOE through EERE (arrows 7 and 8). These along with information from other offices and programs under the EERE also make their way back to the DOE (arrow 9). DOE also provides EERE with non-financial resources like information, knowledge, and human resources (arrow 10).

In terms of non-financial resources, NREL provides technical assistance through regional partners such as the Coastal Studies Institute and Spark Northwest (external to DOE) (arrow 11) who assist prospective

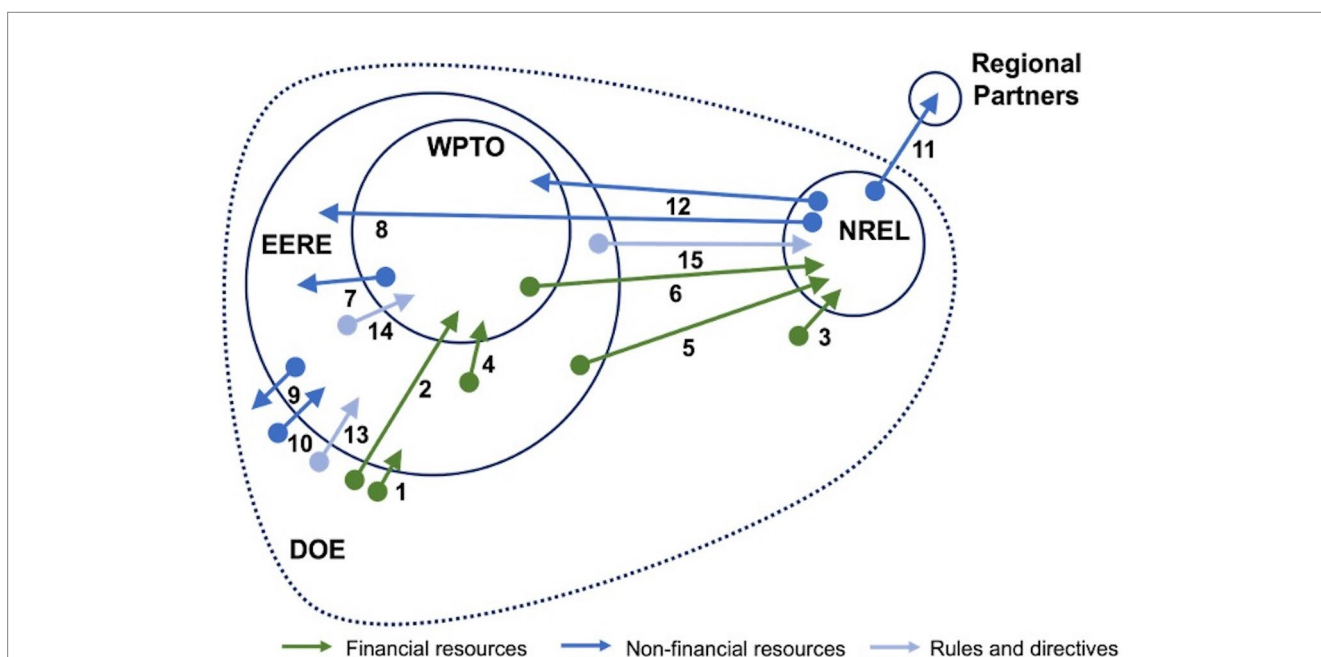


FIGURE 2 The WPTO ecosystem. The blue dotted curve indicates the DOE's scope. Non-financial resources include information inside the dotted blue curve and technical assistance between NREL and the regional partners.

applicants with applying to WPTO-NREL led programs (EERE, 2023b). Additionally, while WPTO also provides financial resources to NREL (arrow 6), NREL and WPTO work as partners (arrow 12).

The numerous offices, national labs, and organization stakeholders represent an organizational ecosystem interacting around clean energy technology policy. DOE makes the rules and directives that percolate across the ecosystem due to the ecosystem's nested nature (arrow 13). Thus rules made by DOE apply to EERE, WPTO, and NREL and are also reinforced through the rules and directives between these organizations (arrows 14 and 15). By providing funds (arrows 1, 2, and 3) and directives (arrows 13, 14, and 15) that define how WPTO and NREL work, the DOE holds significant power within this ecosystem and is most capable of setting the stage when it comes to the process of change. However, other non-financial flows within the ecosystem make the interactions within it more convoluted.

Organizational change within this WPTO ecosystem is affected by these interdependencies that come from the different offices and actors interacting within this ecosystem, thus making this case extremely well suited for the application of OECM. The sections below describe our approach to assessing OECM using this case.

5.2 Research methods

To understand the process of change in the WPTO ecosystem, we relied on two major sources of data: official agency documents and interviews with employees within the ecosystem. We aimed to capture both the formal relationships and the informal interactions that influence the ecosystem's change process. We assessed the case in two ways: one, using Lewin's change model which allowed us to note the shortcomings associated with Lewin's, followed by using OECM to demonstrate why the application of OECM is more relevant for an organizational ecosystem.

5.2.1 Data collection analysis

Our assessment used a multi-method approach involving interviews and document analysis. The interviews provided critical insights into the ecosystem's actual operations, whereas the document analysis helped us identify the formal boundaries and rules governing the ecosystem.

We conducted 21 semi-structured interviews across the WPTO, DOE, NREL, and regional partners from October 2021 to March 2022. All interviews were conducted virtually. Details of the interviewees are included in [Supplementary Table 1](#). The vast majority of employees affiliated with EERE are affiliated with one of the many offices or sub-offices within EERE, such as WPTO. In the context of our organizational ecosystem focused on WPTO, interviewing WPTO employees captured the most relevant interactions and relationships pertinent to our analysis. In other words, interviewing WPTO employees also captures the EERE perspective. These interviews spanned seniority levels, areas of work, and disciplinary backgrounds. We used purposive sampling methods to identify the initial sample of interviewees based on representing the various concentrations of work under WPTO (i.e., hydropower, marine energy, strategy & analysis, and operations) and then used snowball sampling to identify more interviewees.

Interviewee selection criteria considered the "revolving-door" employment nature in federal ecosystems, where employees from one

organization are temporarily assigned to work for another. Employees thus gain insights about other organizations across the ecosystem. By blurring organizational boundaries, the revolving door phenomenon influences interactions and the change process within the ecosystem. Speaking to such employees added to the ecosystem aspect of this analysis because these individuals could not only talk about their organization but also about the interconnectedness within the ecosystem. Therefore, we specifically chose interviewees associated with revolving-door employment, recognizing the significance of their perspectives in an analysis of organizational ecosystems.

5.2.1.1 Interview and document analysis

Our interview questions were designed to explore interconnections and dependencies within the ecosystem, the role of individual employees, and their perceptions of the EEJ-related organizational change. We asked respondents to describe their typical workday, their organization's motivating principles, their target stakeholders, and their considerations for EEJ within their work. OECM constructs were identified through answers to these and other questions such as:

Is energy justice a consideration in your current job/role? What are the biggest hurdles to incorporating energy and environmental justice concerns into your work and the organizations work? Who has the authority to institute changes in your office and organization? Who would need to lead any changes towards meeting EEJ goals? Are there instances in which EEJ was a part of decision-making, project development, and or deployment?

In addition to anonymized transcripts from these interviews, we also included data from 134 official agency documents, including congressional statutes, executive orders, strategic and performance plan reports, annual reports, fiscal year reports, technical reports, press and media reports, project applicant materials, and websites. Documents were included if they addressed the formal and informal relationships between the three organizations of interest and defined their relationship with the regional partners. The purpose of this data source was to understand the ecosystem's formal relationships, rules, and hierarchy as defined by directives.

Through deductive qualitative analysis (Saldana, 2021) in Dedoose, we developed and used codes that mapped onto OECM constructs such as markers for the stage of change like the status quo, sentiments towards the status quo, barriers within organizations and across ecosystem, identifying champion organization, redesign attempts, retraining, and new rules to analyze our data. Answers to some specific interview questions, such as the ones on authority and hurdles, i.e., How does your organization identify and work with stakeholders? How should that change? Please describe a typical day in your position? Also mapped to deductive codes for ecosystem relationships, information, and financial flows. Results from this coding process using OECM constructs informed our understanding of organizational change in the WPTO ecosystem.

6 Results

Based on the data we collected, our analysis using OECM illuminates that the WPTO ecosystem shows all of the signs of the first, unfreezing stage of organizational ecosystem change and is in the

second, moving stage. We present our results as mapped to Figure 1, thus demonstrating the utility of OEMC.

6.1 Stage 1: unfreezing

Our results indicate that the WPTO ecosystem shows (1) signs of dissatisfaction with the status quo as it relates to EEJ; (2) an ecosystem-wide diagnosis of internal barriers that are creating roadblocks for the ecosystem to change into being more EEJ-aligned; and (3) change agents and a champion organization exists in the ecosystem.

6.1.1 Characteristics of the status quo and dissatisfaction

Understanding whether or not there is dissatisfaction with the status quo requires first knowing what the ecosystem’s status quo is, which is what is highlighted in Figure 3. Two main themes characterize the status quo: First was the dominant theme of advancing research & development (R&D) and technology with 17 out of 18 interviews identifying this theme as important to their current work or as an aim of their current work. Advancing R&D and technology consists of technical goals and values like commercialization of technologies, helping further research, and energy cost reductions.

Second was the slightly less but still dominant theme of non-technology values which correspond directly to EEJ principles (see footnote 1) as shown in Figure 3. In mapping to EEJ principles, these values are representative of the state that this ecosystem is trying to change into, i.e., being more EEJ-aligned. Fifty percent of the sample addressed the importance of working with communities (which maps to EEJ principles such as recognition and procedural justice) for the implementation of projects as a part of their work. Acknowledging the societal and environmental impact of the work that the interviewees do engages with distributive justice, which 44% of the sample was concerned about in their daily work. Thirty-three of the sample interviewed recognized water’s value as being beyond an energy source and considered it an aspect of their work. In short, there is ecosystem-wide support for EEJ values. While all 18 interviewees agree that EEJ principles are important values, almost all

interviews ($n = 17$) also identified a lack of organizational norms and capabilities to support EEJ as a problem within the ecosystem. In other words, there is dissatisfaction with the *degree* to which EEJ values show up in the existing status quo because there is an ecosystem-wide acknowledgment that existing organizational capabilities and norms are not enough to support EEJ values. It is important to highlight that if we were to study the status quo of any of the organizations within this ecosystem in isolation, the findings would have been misleading. Results from a single organization analysis would have either shown only a focus on advancing technological values or would have altered the extent to which different non-technology values show up, in both cases misrepresenting the actual status quo within the organizational ecosystem which relates to how the process of change plays out in the ecosystem.

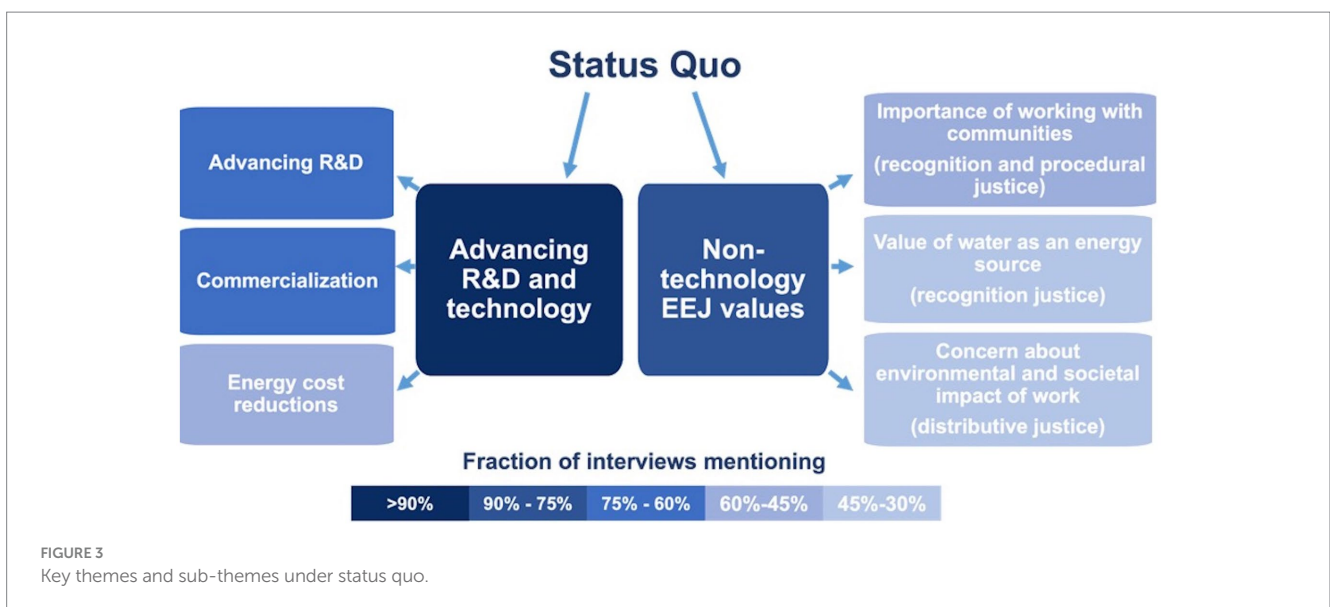
6.1.2 Diagnosing internal barriers

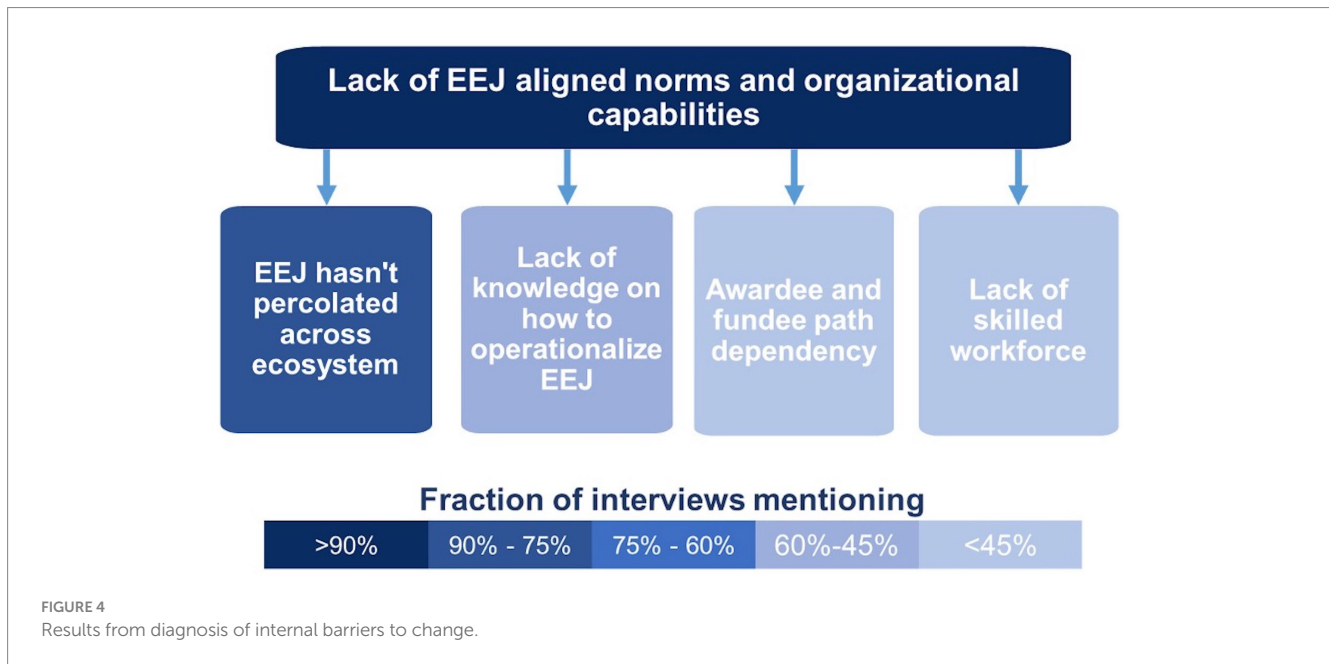
Our interviewees provided insight into the nature of the lack of EEJ-related organizational norms and capabilities and identified ecosystem-wide barriers to being more aligned with EEJ values. We present these four sub-themes in Figure 4.

Twelve out of 18 interviewees believe that EEJ has not percolated across the ecosystem while half the interviewees recognized that a lack of knowledge about how to operationalize and incorporate EEJ acts as a barrier within the ecosystem, preventing it from changing. As Interviewee 10 describes it:

“[Incorporating energy and environmental justice is] a tough one. It’s...something that I have thought about a lot in the last few months because that is a question that we are grappling with actively, [which] is how to incorporate some of these goals into our day-to-day work and the things that we scope or choose the fund and you know the way we go about managing things. I think a lot of people are philosophically on board and in line with you...with the goals, but they are just like...Help me understand how to do this.”

The awardee and fundee path dependency category refers to how entities that have been historically awarded funds continue to





be awarded in the future because they are the ones who have built the resources and skills to be successful applicants and competitors through previous successful award applications. As an organizational norm, continued reliance on awardee and fundee path dependency violates EEJ principles of procedural and recognition justice. This in turn affects the extent to which the ecosystem changes to incorporate these EEJ principles.

Finally, the lack of skilled workforce necessary for changing into being EEJ aligned was also a concern flagged by interviewees. For example, an interviewee involved in human resources said:

"I can tell you though it is really hard on researchers and staff to do this. That is why they need help and support, they really do...so I should hire people like you, other folks who are sociologists, or other folks who can understand technologies and can do that work with these communities. They can then help them build out the DEI portion of their plans." (Interview 2).

Each of these barriers highlight some norm or capability within the organizational ecosystem that needs to be addressed to move forward with the process of change. Using OEMC allows us to look at the whole ecosystem to identify these barriers. Doing so provides knowledge about how widespread the efforts for change need to be for them to succeed.

Organizationally, different employees (either in different locations or different roles) tend to have differing perspectives on the same issues (Ostroff et al., 2005; Pernkopf-Konhäusner and Brandl, 1992). Further, employees in different roles anticipate and have different needs based on their roles and responsibilities. In Figure 5, we dissect the theme of lack of organizational norms and capabilities according to the type of employee. The interviewees were grouped into five categories depending on their role: senior leadership, technology managers, program/project managers, strategic innovation and outreach, and the cross-cutting support team. Lack of EEJ percolation emerged as a common missing capability across all categories of employees. However, only specific types of employees, i.e., support

team, technology managers, and senior leadership identify awardee and fundee path dependency. Similarly, only specific types of employees identify a lack of skilled workforce as an issue. It is important to note that different categories of employees tend to belong to particular organizations, like the support team tends to be affiliated with DOE while technology managers are more likely to be from WPTO. Focusing only on a single organization would have thus led to a restricted understanding of these barriers and led to building solutions that would have reduced efficacy. As was the case with diagnosing the status quo, it is only because OEMC focuses on the ecosystem as its unit of analysis that we can have as much of a holistic perspective on the prevalent barriers to change.

6.1.3 Change agents and champion organization

While Lewin's change theory considers the presence of champion individuals/change agents as a marker of the first stage of change, OEMC extends this to posit the concept of a champion organization. OEMC defines a champion organization as an organization within the ecosystem that is leading the mantle of change. By assessing variables such as which organization change agents most commonly belong to and which organization is indicating a greater acceptance of the change, this analysis isolated WPTO as the champion organization in this ecosystem.

To contextualize what a champion organization means, we first define change agents. Change agents are the individuals who "undertake the task of initiating and managing change in an organization" (Lunenborg, 2010). They are responsible for challenging the status quo and thus creating perturbation in the first stage of change. In our analysis, we found five such change agents in our sample. These change agents were trying to orient to change, i.e., being EEJ aligned and were going against the status quo's limited focus on EEJ values. An interviewee was categorized as a change agent if they had tried to go against the status quo by focusing on a non-technology/EEJ value in their work or by responding to a lack of EEJ capabilities and creating an outcome that was more EEJ-aligned. As interviewee 3 (who is categorized as a change agent) expressed,

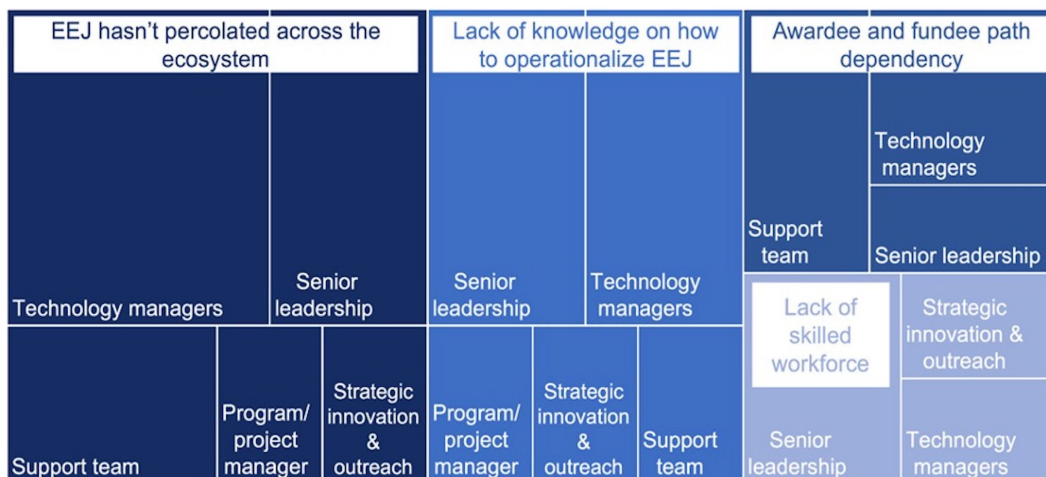


FIGURE 5
Breakdown of how different employees identify different sub-themes in the diagnosis of internal barriers. The size of the boxes defined by the dotted lines corresponds to the number of employees.

"[F]ive or six years ago we started to realize that those advancements were following a pattern of inequity that I am not comfortable following, and I cannot leave the field until we do better. That's why I do this work." (Interview 3).

Another interviewee was categorized as a change agent because they developed an outcome aligned with the changed state when they noticed the lack of EEJ-oriented organizational norms in the form of awardee and fundee path dependency.

Four out of the five change agents identified by our interviewees belong to WPTO. These change agents also cite the environment at WPTO as a reason behind fostering their innovative behavior. Additionally, nearly 40% of the sample recognized that WPTO is an organization that has already been moving towards the changed state by addressing EEJ in some form. Interviewees identify supportive leadership, room for creativity due to the nascency of marine and hydropower technologies, and hires from diverse backgrounds as reasons behind the uniqueness of WPTO and its role in being the change-oriented champion organization within the ecosystem.

6.2 Stage 2: moving

Figure 1 shows OECM's three conditions for the second stage of change: redesign attempts, training for new skills, and coordination. The WPTO ecosystem fulfills one of these requirements—redesign attempts, placing it in the second stage of OECM.

6.2.1 Redesign attempts

In previous sections, we mentioned that OECM defined redesign attempts as new, strategically aligned behaviors resulting from ecosystem-imposed restrictions on change. Interview data identified three offerings from the WPTO ecosystem that fit this description: Energy Transitions Initiative Partnership Project (ETIPP), the Waves to Water prize, and Small Business Innovation Research (SBIR). 40% of the sample mentioned these projects as examples of EEJ-aligned outcomes in their interviews. Here, we describe these projects and report the results from their assessment as redesign attempts.

ETIPP is a technical assistance program intended to work alongside and help remote, island, and island communities build energy resilience. ETIPP relies on regional partners to assist these communities with filing applications for requesting technical assistance under ETIPP (EERE, 2022a). Waves to Water is a \$3.3 million innovation competition prize that seeks to use wave energy-powered, small, modular desalination to provide water in disaster relief situations and to remote coastal communities. SBIR is a competitive grant competition for small businesses that meet certain eligibility requirements and use these grants for the development and commercialization of innovative research. These eligibility requirements ensure that this grant is open only to small businesses and special application assistance is also available for specific minorities (WPTO, 2022b; United States Government, 2023). Based on OECM's definition of redesign attempts, each project was assessed for two broad types of indicators to determine the extent to which it qualifies as a redesign attempt (Figure 6).

The first set of criteria addresses whether the project emerged due to change agent behavior and a diagnosis of internal barriers to change in the ecosystem. If the development of each of these projects is indeed driven by these ecosystem factors then they can provide lessons for the next stage of change. All three redesign attempts emanated due to change agent behavior but each one has a different type of change agent behavior associated with it. While ETIPP was created and SBIR was modified based on an internal diagnosis of barriers, Waves to Water was not entirely guided by such an internal diagnosis. The development of ETIPP and SBIR stemmed from change agents being cognizant of a lack of EEJ alignment in existing programs and a lack of EEJ capabilities within the ecosystem. In the case of ETIPP, change agents wanted to change the precedent for community engagement, and in developing application procedures for SBIR, change agents wanted to encourage first-time applicants, women-owned, small businesses, and provide grant application assistance to reduce awardee/fundee path dependency. It is important to note that the SBIR program itself is not an outcome of the WPTO ecosystem but rather it is SBIR's topical focus which is within the purview of the WPTO. Waves to Water also demonstrates this absence of EEJ values leading to its development albeit to a limited extent,

Indicators	Redesign attempts		
	ETIPP	Waves to Water	SBIR
Change agent behavior			
(1) Result of change agent behavior?	Y	Y	Y
(2) Correction on basis of barrier diagnosis?	Y	P	Y
EEJ-focus			
(3) EEJ intentionality to redesign attempt?	Y	P	P
(4) EEJ-aligned metrics?	P	N	P
Legend: Y = Yes, N = No, P = Partial			

FIGURE 6
Grading redesign attempts on redesign criteria.

since it has been a product of wanting to engage the public with WPTO's work (Oonk et al., 2023) and in part engaging diverse applicants.

The second set of criteria checks the extent to which the redesign attempts demonstrated being an example of changed organizational behavior, i.e., being EEJ-oriented. This set thus includes the extent to which (3) the organizational intention behind the project is aligned with the changed state, and (4) the kind of metrics collected from these projects, which indicates what data are valued by the ecosystem. All three cases demonstrate varying degrees of EEJ-related intentionality. ETIPP actively engages with communities and also relies on regional partners who have a better knowledge of remote, island communities, thus addressing procedural and recognition justice concerns. Waves to Water addresses distributive and recognition justice concerns since it is in part motivated by wanting to engage with remote coastal communities but this engagement is more passive. Finally, SBIR has not been created to focus on EEJ values but due to its focus on small businesses and marginalized groups that do not historically compete or receive grant funding, it addresses certain EEJ elements of recognition and distributive justice.

Despite this varying EEJ intentionality, none of the projects use metrics that completely align with EEJ principles, indicating the ecosystem does not value this information. Metrics aligned with EEJ principles would pay more attention to EEJ principles like evaluating equitable distribution of project benefits, building inclusive processes that rely on feedback from vulnerable groups, and evaluating how the recognition needs of such vulnerable groups are met through the project. Success within ETIPP is measured by assessing whether a project is funded or not; the program thus does not place as much value on EEJ metrics such as communities' feedback or whether the processes guiding ETIPP have been upholding EEJ principles. In the case of Waves to Water, there is little data collected on the applicants' previous experiences or any active methods used to encourage first-time applicants. SBIR does target participation from traditionally disadvantaged groups and small business owners by only considering these groups as eligible (WPTO, 2022b) but this does not involve active engagement such as collecting and incorporating feedback from applicants. It is important to note that SBIR is an old program that runs across multiple government agencies (United States Government, 2023) not just WPTO, which is why the redesign aspect of SBIR cannot be necessarily attributed to the WPTO ecosystem. WPTO

however does have control over the topical focus of SBIR which it has used to focus on EEJ topics, thereby indicating redesign attempt behavior—this is elaborated upon in the discussion section.

7 Discussion

We juxtapose OEM against Lewin's change model to underscore the merits of using OEM for analyzing the process of change in a more realistic organizational ecosystem as against a single organization change model.

7.1 Barriers to change: understanding the status quo

OEM helps analyze how values become dominant for an entire ecosystem, as is apparent in the status quo with the technology values being widespread across the ecosystem. When a value is not defined at a higher level in the ecosystem, it is less likely to be prevalent throughout the ecosystem, and in the rare case when such a value does show up at lower levels, it will be less widespread. In the WPTO case, this can explain why technology values show up more prominently in the status quo than non-technology values.

In the case of the WPTO ecosystem, DOE is the highest-level organization. DOE's mission states "advance U.S. national security and economic growth through transformative science and technology innovation that promotes affordable and reliable energy through market solutions and meets our nuclear security and environmental cleanup challenges" and its five strategic goals include a focus on cutting-edge research (DOE, 2017). Building on this, WPTO's mission also revolves around "enabl[ing] research, development, and testing of new technologies to advance marine energy as well as next-generation hydropower and pumped storage systems for a flexible, reliable grid" (WPTO, 2022d). WPTO however does mention an EEJ-adjacent value such as actively engaging with its stakeholders and seeking their input. Such a value does not show up in DOE's mission or strategic goals which could be a possible explanation for why it shows up only in half the interviews while technology-related values show up in 17 out of 18 interviews. Non-technology values that map directly to EEJ principles are less frequent in our analysis.

To promote a more EEJ-oriented ecosystem, higher-level organizations must codify EEJ values to elevate their prominence. Smith and Sharicz (2011) also identified this issue with other cases of sustainability organizational change where top leadership and governance adopting sustainability values could lead it to becoming a strategic focus and thereby solidify the process of change. This technology value prevalence also demonstrates how certain organizations in the ecosystem hold more power in determining the ecosystems' values. Resource flow within an ecosystem of organizations dictates the agency of associated organizations (Bor and Cropper, 2023). Interview data corroborates this ecosystem hierarchy, with DOE holding financial and operational power in the WPTO ecosystem. Additionally, success of organizational change is affected by the degree of adoption or resistance from within the organization, making it necessary to have employees and organizations within the ecosystem also invested in the process of change (Albrecht et al., 2020). Therefore, due to the

interconnectedness and resource flows that govern organizational ecosystems, it is imperative for high-level parts of an ecosystem (in this case, DOE) to take steps to create this buy-in toward change. As long as the process of change is applied across all elements of the ecosystem, the process of change will cut across the ecosystem and leads to long-term, enduring outcomes (Lozano and Garcia, 2020).

7.2 Opportunities for change: change agents and champion organizations

Shifting the unit of analysis from an individual organization to an organizational ecosystem also provides deeper insights into what is truly needed for lasting change. The breakdown of missing capabilities by employee type in Figure 5 helps drive this point further and holds significance for two reasons. First, in terms of hiring decisions, it helps understand a prospective problem that might hinder developing change-related capabilities. For example, in the WPTO ecosystem, an individual responsible for hiring who does not recognize the lack of EEJ skilled workforce as an issue consequently will not hire such staff thereby impeding the process of changing into being more EEJ aligned.

Second, the results in Figure 5 also foreshadow what type of employee is more likely to emerge as a change agent and develop redesign attempts that push the process of change forward. Consequently, this helps identify what kinds of hires need to be encouraged for an ecosystem to change. Change agents are the “only individuals dissatisfied with the status quo” and are “motivated to alter their patterns of behavior” (Spector, 2007) by going against the status quo (Lunenburg, 2010). This is corroborated by our analysis where we find that employees who recognize a specific type of limitation to being EEJ aligned—such as awardee and fundee path dependency—are the ones that are motivated by these limitations and try to develop creative solutions to address this problem via redesign attempts. In our chosen case, this is illustrated in two parts: (1) half of the interviewees who identify awardee and fundee path dependency as an issue are from the cross-cutting support team that works across the ecosystem (see Figure 5); and (2), more than any other employee type, change agents tend to belong to this cross-cutting support team (40% of change agents in our analysis). This indicates that individuals in the cross-cutting support team are the ones who are more likely to see issues with the status quo and thus also try to correct it through change agent behavior. Another important detail is that change agents develop solutions within the ecosystem to problems that emerge due to the nature of the ecosystem. These motivations behind redesign attempts are discussed in more detail in the following subsection about redesign attempts.

Our analysis determines WPTO as the champion organization within this ecosystem which implies that certain practices within WPTO are encouraging change and should be replicated across the ecosystem. This analysis isolates practices unique to WPTO like supportive leadership, diversity in hires, and support for creativity and innovation can be used as lessons and benchmarks for other organizations in the ecosystem. We find that change agents are hired from different backgrounds, they leverage existing relationships outside of their organization and across the ecosystem and they tend to belong to a particular organization. This understanding of change agents and champion organizations is important to encourage more of such behavior which could further the unfreezing and moving steps.

7.3 Redesign attempts

Using OEMC helps understand the ecosystem-related motivations behind redesign attempts which in turn helps isolate ecosystem elements that are roadblocks to the process of change. In particular, the three WPTO programs we analyzed (ETIPP, Waves to Water Prize, and SBIR) were all attempts to overcome the lack of EEJ orientation in funding opportunity announcements (FOAs), a key vehicle by which WPTO supports technology R&D. FOAs are the norm for funding opportunities, making up almost 33% of the volume of WPTO’s funding opportunities in 2022 (WPTO, 2022c) and are more commonly used across all EERE offices (Interview 5). They tend to support research, development, and demonstration activities.

However, interviewees associate FOAs with cumbersome processes and heavy barriers to entry, hindering creativity and encouraging redesign attempts. FOA announcements have to be approved by various federal and Congressional offices such as Communication and Intergovernmental Affairs. This convoluted process and the organizational barriers attached to FOAs end up encouraging redesign attempts. Interviewee 5 says:

“And prizes were introduced as this kind of low barrier to entry opportunity for entrepreneurs, researchers... Whereas kind of on the other end of that spectrum, FOAs— another funding mechanism available to all of the EERE offices— those are really high barriers to entry.”

ETIPP emerged as an attempt to move beyond the barriers imposed by existing FOAs and enhance community engagement through regional partners working with communities on identified needs. SBIR also arose as change agents sought to correct awardee and fundee path dependency, with the SBIR process being less rigid and more accessible compared to FOAs. However, SBIR is a federal government-wide program and is decades old. WPTO’s contribution to SBIR as a redesign attempt is evident in the newer rounds addressing topics of a just and equitable energy transition (WPTO, 2021).

OEMC also helps provide plausible context for how the organizational ecosystem behaves and interacts with the process of change because it shifts the unit of analysis away from the single organization and to the ecosystem. For instance, the ecosystem’s goal constraint can explain why despite some degree of EEJ intentionality associated with redesign attempts, these redesign attempts lack overall EEJ alignment. For example, ETIPP, which aims to engage with vulnerable communities (EERE, 2022a), has a lack of overarching goals related to community and stakeholder engagement in the ecosystem hinders effective processes and metrics for this objective.

Analyzing these redesign attempts offers valuable insights into the change process in the ecosystem. Change agents work around rigid ecosystem-wide processes like FOAs to create outcomes aligned with change. However, the lack of EEJ-related goals at higher levels in the ecosystem hampers redesign attempts’ success, resulting in a lack of capabilities and EEJ-related metrics. Ecosystem-wide coordination around change through higher-level goals that reflect these changed state values can echo through the ecosystem’s lower levels and across outcomes, creating meaningful change.

7.4 OEMC vs. Lewin's model: stage of change

When applying OEMC, our analysis reveals that the WPTO ecosystem is in the second stage of change. While both Lewin's and OEMC would diagnose the WPTO ecosystem as being in the second stage of change, OEMC adds important insights that Lewin's change model would have missed.

First, OEMC defines the status quo and identifies barriers across the ecosystem instead of just within a single organization. By doing so it takes a realistic perspective on organizational change and emphasizes the importance of ecosystem-wide coordination, thereby recognizing what is needed for change to endure. For instance, if a single organization change model were to be used for analyzing the process of change in the WPTO ecosystem, we would have an incomplete and partial picture of the status quo and the barriers to change. Any attempts towards change, guided by such results would be thwarted because, in the real world, WPTO is shaped by the interactions and interdependencies of the organizational ecosystem it lives in. Using OEMC we can understand how in the case of the WPTO ecosystem, WPTO, the champion organization, is attempting to change while facing ecosystem constraints and a lack of coordination toward EEJ alignment within the ecosystem. If we had used Lewin's change model and studied only WPTO we would have concluded that WPTO is progressing in the process of change, neglecting how its change process is impacted by the rules, policies, and legacies of the higher-level organization, namely DOE, because of the interdependencies between the organizations. Unless there can be ecosystem-wide change that is nurtured and protected at the highest levels, the long-term survival of this change can be put into question. It is important to understand that EEJ-related change is new and uncharted territory for most federal agencies including the DOE which is why there is a greater need for such an analysis to aid DOE and other organizations dealing with such a task. These findings are thus meant to help push the process of change forward and help the WPTO ecosystem wrangle with the newness of EEJ-related change.

Second, OEMC goes beyond Lewin's identification of change agents and gives greater consideration to the role of leadership and employee responses to change by identifying champion organizations and examining why redesign attempts emerge. Identifying champion organizations strengthens the importance of leadership in the organizational change process and understanding why redesign attempts emerge centers employee perspectives to change. Lewin's model largely ignores both of these aspects and is criticized for doing so (Hussain et al., 2018). Additionally, leadership and employee response have been considered extremely important in more recent studies that examine organizational change in response to global challenges (Hussain et al., 2018; Islam, 2023). Highlighting a champion organization helps OEMC identify organizational behavior that is more conducive to change and thus can be mimicked by other organizations within the ecosystem.

Beyond extending Lewin's change model, OEMC and its application also provide important contributions to the organizational change literature. First, change theorists recognize the importance of the external environment in influencing change agents and, therefore the first stage in the process of change (e.g., Pettigrew et al., 1992; Batras et al., 2014). OEMC builds on this suggestion and is more explicit about its inclusion of this external organizational environment,

thereby identifying the influence of these factors in every stage of organizational change. Second, OEMC furthers individual organization-focused organizational change studies that identify the importance of networks but only at the individual employee level (e.g., professional and informal networks and, interpersonal relationships) (Battilana and Casciaro, 2012, 2013; Pallotti et al., 2023), by considering macro-level networks across organizations. OEMC thus helps us understand why studying an ecosystem of organizations and coordination across that system is imperative for sustained organizational change. The results of our case study also support other empirical studies that underscore the importance of understanding organizational networks which share resources, create coordination and therefore create successful organizational change (Cross et al., 2007; Brown and Heitner, 2023). Skipping organization change steps and neglecting the complex nature of the setting in which an organization exists can create the illusion of quicker change but in fact is often detrimental to change (Kotter, 1995). Rather, the organization's broader ecosystem needs to be coordinated to align systems within and across these networked organizations. Anecdotal information suggests that within the ecosystem, conversations surrounding certain retraining, and reskilling efforts are starting to happen. Cross-cutting groups coordinating change efforts across the EERE would be useful for this task. However, coordinating these networks requires learnings from redesign attempts, the barrier diagnosis, and knowledge about constraints imposed by the hierarchical nature of the ecosystem.

8 Conclusion

Given its complexity of sustainability and justice, understanding how organizations change requires adopting an ecosystem approach that incorporates the inter-organizational networks in which these organizations are embedded. OEMC recognizes this and extends prior change theory research by considering the importance of collaboration, networks, and external settings and how they can both facilitate and constrain organizational change. It offers a much needed theoretical lens that shifts the unit of analysis from an individual organization to the ecosystem of organizations within which the organization is embedded. This shift embraces the important influences of external factors that affect individual organizations and sheds light on how inter-organizational networks, hierarchies, and flow of resources in these networks affect organization change.

Although both Lewin's and OEMC would diagnose the Water Power Technologies Office ecosystem in the same stage of change, OEMC provides additional crucial insights for organizational change for sustainability and justice. First, by adopting an ecosystem perspective, we identify key governance and leadership organizations with financial power in the ecosystem that must drive the change process by codifying new goals and ecosystem-wide institutional processes. Second, temporary fixes like redesign attempts only highlight constraints to change in the ecosystem and must be studied and addressed via coordination to prevent unsustainable change. Finally, ecosystems must complete all the steps of each stage of change to avoid a lack of buy-in from other organizations within the ecosystem, which could limit and jeopardize the survival of change efforts.

Applying OEMC to this single case study limits the insights OEMC is capable of offering. However, extending OEMC to other cases can ensure its further refinement, thereby improving its theoretical and

practical usefulness for understanding sustainability and justice. While federal mandates around sustainability have not been as pervasive as EEJ related policy pushes, due to the synergies between EEJ and sustainability, using OECM to understand how ecosystems of organizations respond to justice-oriented policy pushes provides insight on what federal ecosystems of organizations might expect when confronted with such policy asks in the future. Applications of OECM to cases like the WPTO ecosystem also integrate public policy and organizational studies, fostering collaboration between these two fields and providing practical lessons for both disciplines (Bozeman, 2013). In today's increasingly interconnected world where organizations addressing complex problems seldom exist in silos, applications of OECM can extend beyond federal ecosystems and policy mandates. Future applications of OECM must include other non-federal ecosystems where the individual organization depends on, contributes to and is thus shaped by the ecosystem of organizations within which it exists. By examining various types of resource flows and different hierarchical structures within an ecosystem, this future work can offer valuable insights into how ecosystem-wide factors influence organizational change. In doing so, these studies will also provide a more nuanced understanding of the role of power in the organizational change process.

Data availability statement

The anonymised raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Arizona State University Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because verbal consent was obtained and recorded prior to the start of every interview.

Author contributions

MK: Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing.

References

- Agyeman, J., Bullard, R. D., and Evans, B. (2002). Exploring the Nexus: bringing together sustainability, environmental justice and equity. *Space Polity* 6, 77–90. doi: 10.1080/13562570220137907
- Agyeman, J., Schlosberg, D., Craven, L., and Matthews, C. (2016). Trends and directions in environmental justice: from inequity to everyday life, community, and just Sustainabilities. *Annu. Rev. Environ. Resour.* 41, 321–340. doi: 10.1146/annurev-environ-110615-090052
- Ahrne, G., Brunsson, N., and Hallström, K. T. (2007). Organizing Organizations. *Organization* 14, 619–624. doi: 10.1177/1350508407080303
- Albrecht, S. L., Connaughton, S., Foster, K., Furlong, S., and Yeow, C. J. L. (2020). Change engagement, change resources, and change demands: a model for positive employee orientations to organizational change. *Front. Psychol.* 11:531944. doi: 10.3389/fpsyg.2020.531944

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/frsus.2025.1390230/full#supplementary-material>

- Barreiro-Gen, M., Lozano, R., Carpenter, A., and Bautista-Puig, N. (2022). Analysing sustainability change management in government owned companies: experiences from European ports. *Soc. Responsib. J.* 19, 1037–1050. doi: 10.1108/SRJ-04-2022-0165

- Bartunek, J. M., and Woodman, R. W. (2015). Beyond Lewin: Toward a Temporal Approximation of Organization Development and Change. *Annu. Rev. Organ. Psychol. Organ. Behav.* 2, 157–182. doi: 10.1146/annurev-orgpsych-032414-111353

- Batras, D., Duff, C., and Smith, B. J. (2014). Organizational change theory: implications for health promotion practice. *Health Promot. Int.* 31, dau098–dau241. doi: 10.1093/heapro/dau098

- Battilana, J., and Casciaro, T. (2012). Change agents, networks, and institutions: a contingency theory of organizational change. *Acad. Manag. J.* 55, 381–398. doi: 10.5465/amj.2009.0891

- Battilana, J., and Casciaro, T. (2013). Overcoming resistance to organizational change: strong ties and affective cooptation. *Manag. Sci.* 59, 819–836. doi: 10.1287/mnsc.1120.1583
- Bor, S., and Cropper, S. (2023). Extending Meta-organization theory: a resource-flow perspective. *Organ. Stud.* 44, 1939–1960. doi: 10.1177/01708406231185932
- Bozeman, B. (2013). What organization theorists and public policy researchers can learn from one another: publicness theory as a case-in-point. *Organ. Stud.* 34, 169–188. doi: 10.1177/0170840612473549
- Brasier, K. (2023). Addressing wicked environmental problems through engaging stakeholders | Institute of Energy and the environment. Available online at: <https://iee.psu.edu/news/blog/addressing-wicked-environmental-problems-through-engaging-stakeholders> (Accessed February 5, 2024).
- Brotman, R., Lippitt, R., Watson, J., and Westley, B. (1958). The dynamics of planned change. *Am. Sociol. Rev.* 23:341. doi: 10.2307/2089259
- Brown, B. A., and Heitner, K. L. (2023). “Obstacles and resistance to organizational change in the new post- COVID-19 environment” in *Managing Successful and Ethical Organizational Change*. eds. D. Belias, I. Rossidis, C. Papademetriou, A. Masouras and S. Anastasiadou (IGI Global), 167–195.
- Brundtland, G. H. (1987). Our common future: report of the world commission on environment and development: our common future. Available online at: <https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf> (Accessed February 10, 2024).
- Bullard, R. D., Agyeman, J., and Evans, B. (2001). *Just Sustainabilities: Development in an unequal world*. Milton, UK: Taylor & Francis Group.
- Burchardt, T., and Craig, G. (2008). Social justice and public policy: Seeking fairness in diverse societies. Available online at: <http://muse.jhu.edu/book/79751> (Accessed February 10, 2024).
- Burke, W. W., and Litwin, G. H. (1992). A causal model of organizational performance and change. *J. Manag.* 18, 523–545. doi: 10.1177/014920639201800306
- Burnes, B. (2004). Kurt Lewin and the planned approach to change: a re-appraisal. *J. Manag. Stud.* 41, 977–1002. doi: 10.1111/j.1467-6486.2004.00463.x
- Clark, S. S., and Miles, M. L. (2021). Assessing the integration of environmental justice and sustainability in practice: a review of the literature. *Sustain. For.* 13:11238. doi: 10.3390/su132011238
- Congressional Research Service (2023). DOE Office of Energy Efficiency and Renewable Energy FY2024 appropriations. Available online at: <https://sgp.fas.org/crs/misc/IF12236.pdf> (Accessed August 1, 2023).
- Connolly, J., and Dolan, P. (2013). Re-theorizing the ‘structure–agency’ relationship: Figurational theory, organizational change and the Gaelic Athletic Association. *Organization* 20, 491–511. doi: 10.1177/1350508412446101
- Cross, R. L., Parise, S., and Weiss, L. M. (2007). The role of networks in organizational change. *The McKinsey Quarterly*, 3, 28–41.
- Cummings, S., Bridgman, T., and Brown, K. G. (2015). Unfreezing change as three steps: rethinking Kurt Lewin’s legacy for change management. *Hum. Relat.* 69, 33–60. doi: 10.1177/0018726715577707
- DOE (1998). The origin of new energy technologies for the 21st century. Available online at: www.ornl.gov (Accessed May 05, 2023).
- DOE (2017). Fiscal year (FY) 2018 DOE annual performance report /FY 2020 annual performance plan contains. Department of Energy.
- DOE (2022). Department of Energy FY 2023 congressional budget request. Department of Energy.
- Edmondson, A. C., Haas, M., Macomber, J., and Zuzul, T. (2015). “The role of multiplier firms and megaprojects in leading change for sustainability” in *Leading sustainable change: An organizational perspective*. eds. R. Henderson, R. Gulati and M. Tushman (Oxford: Oxford University Press).
- EERE (2022a). About the energy transitions initiative partnership project | Department of Energy. Available online at: <https://www.energy.gov/eere/about-energy-transitions-initiative-partnership-project> (Accessed November 1, 2022).
- EERE (2022b). About the Office of Energy Efficiency and Renewable Energy | Department of Energy. Available online at: <https://www.energy.gov/eere/about-office-energy-efficiency-and-renewable-energy> (Accessed November 11, 2022).
- EERE (2023a). About the wave energy prize. *Energy*. Available online at: <https://www.energy.gov/eere/water/about-wave-energy-prize> (Accessed August 26, 2023).
- EERE (2023b). Energy transitions initiative partnership project—partner network. *Energy*. Available online at: <https://www.energy.gov/eere/energy-transitions-initiative-partnership-project-partner-network> (Accessed July 31, 2023).
- EERE (2023c). Water power technologies office budget. *Energy*. Available online at: <https://www.energy.gov/eere/water/water-power-technologies-office-budget> (Accessed August 1, 2023).
- Fadeeva, Z. (2005). Promise of sustainability collaboration—potential fulfilled? *J. Clean. Prod.* 13, 165–174. doi: 10.1016/S0959-6526(03)00125-2
- Faeste, L., Reeves, M., and Whitaker, K. (2019). The science of organizational change. Available online at: <https://www.bcg.com/publications/2019/science-organizational-change> (Accessed February 10, 2024).
- Gomez, L. (2023). Governments and companies must collaborate on sustainability. Available online at: <https://www.weforum.org/agenda/2023/03/radical-collaboration-for-a-sustainable-future-the-case-for-sustainability-collaboration/> (Accessed February 5, 2024).
- Hussain, S. T., Lei, S., Akram, T., Haider, M. J., Hussain, S. H., and Ali, M. (2018). Kurt Lewin’s change model: a critical review of the role of leadership and employee involvement in organizational change. *J. Innov. Knowl.* 3, 123–127. doi: 10.1016/j.jik.2016.07.002
- Islam, M. N. (2023). Managing organizational change in responding to global crises. *Glob. Bus. Organ. Excell.* 42, 42–57. doi: 10.1002/joc.22189
- Jenkins, K., McCauley, D., Heffron, R., Stephan, H., and Rehner, R. (2016). Energy justice: a conceptual review. *Energy Res. Soc. Sci.* 11, 174–182. doi: 10.1016/j.erss.2015.10.004
- Judson, A. S. (1991). *Changing behavior in organizations: Minimizing resistance to change*. Cambridge, Mass: Blackwell Business.
- Kanter, R. M., Stein, B., and Jick, T. (1992). *The challenge of organizational change: how companies experience it and leaders guide it*. New York: Maxwell Macmillan.
- Kenis, P., and Raab, J. (2020). Back to the future: using organization design theory for effective organizational networks. *Perspect. Public Manag. Gov.* 3, 109–123. doi: 10.1093/ppmgov/gvaa005
- Kolb, D. G., Dery, K., Huysman, M., and Metiu, A. (2020). Connectivity in and around organizations: waves, tensions and trade-offs. *Organ. Stud.* 41, 1589–1599. doi: 10.1177/0170840620973666
- Kotter, J. P. (1995). Leading change: why transformation efforts fail. Available online at: <https://hbr.org/1995/05/leading-change-why-transformation-efforts-fail-2> (Accessed March 1, 2023).
- Levasseur, R. E. (2001). People Skills: Change Management Tools—Lewin’s Change Model. *Interfaces* 31, 71–73. doi: 10.1287/inte.31.5.71.9674
- Lewin, K. (1947). Frontiers in group dynamics. *Hum. Relat.* 1, 5–41. doi: 10.1177/001872674700100103
- Lozano, R. (2013). Are companies planning their Organisational changes for corporate sustainability? An analysis of three case studies on resistance to change and their strategies to overcome it. *Corp. Soc. Responsib. Environ. Manag.* 20, 275–295. doi: 10.1002/csr.1290
- Lozano, R., and Garcia, I. (2020). Scrutinizing sustainability change and its institutionalization in organizations. *Front. Sustain.* 1:1. doi: 10.3389/frsus.2020.00001
- Lunenburg, F. C. (2010). Managing change: the role of the change agent. *Int. J. Manag. Bus. Adm.* 13, 1–6. Available at: <https://nationalforum.com/Electronic%20Journal%20Volumes/Lunenburg,%20Fred%20C.%20Managing%20Change%20The%20Role%20of%20Change%20Agent%20IJMBA,%20V13%20N1%202010.pdf>
- MacDonald, A., Clarke, A., and Huang, L. (2019). Multi-stakeholder partnerships for sustainability: designing decision-making processes for partnership capacity. *J. Bus. Ethics* 160, 409–426. doi: 10.1007/s10551-018-3885-3
- Mars, M. M., and Bronstein, J. L. (2018). The promise of the organizational ecosystem metaphor: an argument for biological rigor. *J. Manag. Inq.* 27, 382–391. doi: 10.1177/1056492617706546
- Mars, M. M., Bronstein, J. L., and Lusch, R. F. (2012). The value of a metaphor. *Organ. Dyn.* 41, 271–280. doi: 10.1016/j.orgdyn.2012.08.002
- Mirkow, A., Monsjou, K. Von, Gibson, C., and Mariani, J. (2023). End-to-end justice. Deloitte Insights. Available online at: <https://www2.deloitte.com/xe/en/insights/industry/public-sector/government-trends/2023/collaboration-modernizing-the-justice-system.html> (Accessed February 6, 2024).
- Oonk, D., Kaul, M., Maurer, B., and Karwat, D. M. A. (2023). Public value mapping to assess and guide governmental investments in energy and environmental justice: studying the United States Department of Energy. *Renew. Sust. Energy Rev.* 188:113765. doi: 10.1016/j.rser.2023.113765
- Ostroff, C., Shin, Y., Kinicki, A. J. (2005). Multiple perspectives of congruence: Relationships between value congruence and employee attitudes. *J. Organ. Behav.* 26, 591–623. doi: 10.1002/job.333
- Pallotti, F., Mascia, D., and Giorgio, L. (2023). A multilevel study of social networks and collective reactions to organizational change. *J. Organ. Behav.* 44, 1109–1128. doi: 10.1002/job.2687
- Pattberg, P., and Widerberg, O. (2016). Transnational multistakeholder partnerships for sustainable development: conditions for success. *Ambio* 45, 42–51. doi: 10.1007/s13280-015-0684-2
- Pettigrew, A., Ferlie, E., and McKee, L. (1992). Shaping strategic change - the case of the NHS in the 1980s. *Public Money Manag.* 12, 27–31. doi: 10.1080/09540969209387719
- Pernkopf-Konhäusner, K., and Brandl, J. (1992). “Variations in evaluative repertoires: Comparing employee perspectives on training and development in Germany and Russia”, *Pers. Rev.* 40, 589–606. doi: 10.1108/00483481111154450
- Ribicoff, A. A. (1977). S.826 - 95th congress (1977-1978): an act to establish a Department of Energy in the executive branch by the reorganization of energy functions within the Federal Government in order to secure effective management to assure a coordinated national energy p. Available online at: <http://www.congress.gov/> (Accessed May 05, 2023).

- Saldana, J. (2021). The coding manual for qualitative researchers. Available online at: <https://us.sagepub.com/en-us/nam/the-coding-manual-for-qualitative-researchers/book273583> (Accessed August 26, 2023).
- Salem, H. S. (2019). No sustainable development in the lack of environmental justice. *Environ. Justice* 12, 140–157. doi: 10.1089/env.2018.0040
- Sargut, G., and McGrath, R. (2011). Learning to live with complexity. *Harv. Bus. Rev.* Available online at: <https://hbr.org/2011/09/learning-to-live-with-complexity> 89, 68–76, 136
- Siciliano, G., Wallbott, L., Urban, F., Dang, A. N., and Lederer, M. (2021). Low-carbon energy, sustainable development, and justice: towards a just energy transition for the society and the environment. *Sustain. Dev.* 29, 1049–1061. doi: 10.1002/sd.2193
- Smith, P. A. C., and Sharicz, C. (2011). The shift needed for sustainability. *Learn. Organ.* 18, 73–86. doi: 10.1108/09696471111096019
- Sovacool, B. K., and Dworkin, M. H. (2015). Energy justice: conceptual insights and practical applications. *Appl. Energy* 142, 435–444. doi: 10.1016/j.apenergy.2015.01.002
- Spector, B. (2007). “Theories of Effective Change Implementation,” in *Implementing Organizational Change: Theory and Practice*. 25–43.
- Todnem, R. (2005). Organisational change management: a critical review. *J. Change Manag.* 5, 369–380. doi: 10.1080/14697010500359250
- Tsujimoto, M., Kajikawa, Y., Tomita, J., and Matsumoto, Y. (2018). A review of the ecosystem concept — towards coherent ecosystem design. *Technol. Forecast. Soc. Change* 136, 49–58. doi: 10.1016/j.techfore.2017.06.032
- United States Government (2023). SBIR.gov. Available online at: <https://www.sbir.gov/> (Accessed June 12, 2023).
- Van de Ven, A. H., and Poole, M. S. (2005). Alternative approaches for studying organizational change. *Organ. Stud.* 26, 1377–1404. doi: 10.1177/0170840605056907
- Vora, J. A. (1992). Applying a theory of organization change to adopting JIT. *Omega* 20, 193–199. doi: 10.1016/0305-0483(92)90073-g
- Weick, K. E., and Quinn, R. E. (1999). Organizational change and development. *Annu. Rev. Psychol.* 50, 361–386. doi: 10.1146/annurev.psych.50.1.361
- Wittneben, B. B. F., Okereke, C., Banerjee, S. B., and Levy, D. L. (2012). Climate change and the emergence of new organizational landscapes. *Organ. Stud.* 33, 1431–1450. doi: 10.1177/0170840612464612
- WPTO (2021). WPTO SBIR STTR topics webinar for FY22 phase I. Department of Energy.
- WPTO (2022a). National Labs and water power| Department of Energy. Available online at: <https://www.energy.gov/eere/water/national-labs-and-water-power> (Accessed October 31, 2022).
- WPTO (2022b). Small Business Innovation Research (SBIR) and small business technology transfer (STTR) programs. Available online at: <https://www.energy.gov/eere/water/small-business-innovation-research-sbir-and-small-business-technology-transfer-sttr> (Accessed October 30, 2022).
- WPTO (2022c). Water power funding opportunities|Department of Energy. Available online at: <https://www.energy.gov/eere/water/water-power-funding-opportunities> (Accessed December 20, 2022).
- WPTO (2022d). Water power technologies office|Department of Energy. Available online at: <https://www.energy.gov/eere/water/water-power-technologies-office> (Accessed April 13, 2022).
- Young, S. D. (2021). Memorandum for the heads of departments and agencies interim implementation guidance for THE Justice40 initiative. Available online at: <https://ceq.doe.gov/docs/ceq-regulations-and-guidance/regs/ej/justice.pdf> (Accessed May 05, 2023).