

Vanguard Projects as Intermediation Spaces in Sustainability Transitions



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Abstract

In response to climate change issues, increasing numbers of *vanguard* projects are being established to help governments achieve sustainability goals through rapid technology development. We focus on the *transition intermediation* literature to argue that vanguard projects, as *intermediation spaces*, enable core and external project actors to assume intermediary characteristics to align, negotiate, and pursue policy level goals beyond the remit of conventional project goals. We contribute to project studies by providing a macrolevel contextualization of vanguard projects in the wider sociotechnical transitions debates. We suggest that transition intermediation is key for understanding projects and their achievement of wider policy goals.

Keywords

vanguard projects, intermediation, sociotechnical transitions, sustainability

Introduction

There is a broad consensus that climate change is among the most significant challenges that all governments, economies, and societies will need to tackle in the next decade. Achieving sustainability targets, including net-zero carbon by 2030, will require governments to closely cooperate with the private sector and research institutes (Geels & Schot, 2007; Kuhlmann & Rip, 2014; Savaget et al., 2019). This approach will include numerous projects of different scales with prominent technology innovation features to achieve net-zero targets and address climate change (Koch-Ørvad et al., 2019; Morris, 2017). However, while the achievement of net-zero targets will ultimately be driven by projects, we still see very little reference to the role of projects in their wider context. Meanwhile, this contextualization has been analytically captured by the recent scholarly work on sustainability transitions.

The aim of this article is to extend the project studies debate by exploring the role of projects as intermediation spaces facilitating sustainability transitions, which are defined as “long-term, multi-dimensional, and fundamental transformation processes through which established sociotechnical systems shift to more sustainable modes of production and consumption” (Markard et al., 2012, p. 956). In particular, we focus on vanguard projects as a specific class of projects established to explore new markets and build capabilities through development of new technologies or services (Laurila & Ahola,

2021). Such vanguard projects are often large scale and bring together actors from a range of sectors and disciplines to develop capabilities and absorb them into their permanent organizations (Davies & Brady, 2016). Because achieving sustainability targets requires cross-disciplinary approaches, vanguard projects are increasingly found on the critical path of sustainability transitions.

To understand the role of vanguard projects in sustainability transitions, we draw on the sociotechnical transitions literature that has thrived in identifying contextual levels that influence technology innovations and their impact on policy and practice (Geels & Schot, 2007; Savaget et al., 2019). While sociotechnical transitions literature addresses low-carbon and sustainability transitions (Bolton & Foxon, 2015; Bulkeley et al., 2014; Geels, 2011; Geels et al., 2017; Scrase & Smith, 2009), and several studies discuss use of the sociotechnical transitions framework to explain project phenomena, the existing literature does not explicitly explore the role of vanguard projects in sustainability transitions (Brooks, 2017; Gil et al., 2012; Hodson et al., 2013). Based on this, the following research question is posed:

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How do Vanguard Projects Serve as Intermediation Spaces and Help Facilitate Sustainability Transitions?

We suggest that vanguard projects have an important role in sustainability transitions through catalyzing and developing technological innovations driven by policy goals (e.g., net-zero carbon) contextualized within a broader landscape (e.g., climate crisis). For example, renewable energy infrastructure projects, such as geothermal systems and wind farms, can replace oil and gas infrastructure, eliminating greenhouse gas emissions and achieving sustainability objectives. Similarly, the construction and expansion of mass transit systems can result in net greenhouse gas reductions by shifting user transport patterns. Individually and together, these projects require the identification, adoption, and implementation of emerging and mature technologies to achieve their sustainability impact (Kennedy et al., 2014).

Vanguard projects that drive sustainability transitions comprise multiple parties that collaborate toward a common output (Ahola, 2018; Gulati et al., 2012; Manning, 2017). Those multi-actor arrangements, however, rely on the cooperation of core and external project actors. As such, vanguard projects can be understood as open systems (Davies, 2017) with a heavy dependency on external environmental factors. Vanguard projects have a polycentric governance that features no clear hierarchy or center of control (Gil & Pinto, 2018). Instead, a broad cooperative arrangement is in place suggesting that core and external project actors become key resources, a sharp contrast to the traditional notion of key project roles limited to core project actors only (Zwikael & Meredith, 2018). Vanguard projects and their cooperative arrangements enable innovation across diverse teams and different organizations' boundaries, which ultimately drives the transition toward sustainability goals.

In this article, we argue that the key for vanguard project cooperation is the intermediation of goals, actions, and resources across and between diverse actors who can be located within and outside the strict, traditional boundaries of the project. As such, the theoretical aim of this article is to develop and unpack the concept of intermediation and, more specifically, the role of the vanguard project as an intermediation space in sustainability transitions, with the intention of organizing ideas into a coherent structure that helps interpret complex organizational phenomena (Shapira, 2011). Our argument is illustrated with a vignette of a vanguard project with sustainability objectives: the Ivanpah Solar Electric Generating Power System in the Mojave Desert. The vignette describes the emergence of an intermediation space where technological innovations create change that drives a sustainability transition.

Vanguard Projects in the Context of Sociotechnical Transitions

Projects are conventionally defined as vehicles of controlled change that deliver specific outputs within time, cost, and

quality constraints (Morris, 2013). In line with this concept, there is a core group of roles, which are typically considered in a project organization. For example, in a recent piece, Zwikael and Meredith (2018) distinguish between the *funding* and *performing* categories of core project processes using principal-agent theory as the theoretical basis. This work consolidates the core project roles: funder, champion, owner, steering committee, and user on the principal side; and project manager, project team, program manager, sponsor, and project management office on the agent side. Outside the core project organization conceptualization, the *contextual perspective* of project studies explores a variety of arrangements that allow projects as temporary organizational forms to be structured and executed within evolving contexts. The contextual perspective of project studies helps us understand how projects achieve controlled change within their historical (Engwall, 2003), organizational (Grabher, 2004), and institutional (Levitt & Scott, 2017) contexts. For example, there is a stream of contextual project research that focuses on settings and variables that determine a *project ecology* as "a relational space" (Grabher & Ibert, 2011, p. 176) that embeds the project organizing activities through key individuals, commercial or public organizations, and institutions (Grabher, 2004). Similarly, the stream of work on *project networks* suggests that multiple organizations come together to deliver projects within conditions of uncertainty and complexity (Ahola, 2018; Manning, 2017). The contextual perspective is part of the project studies' commitment to embracing a wider understanding of projects, including their long-term operational, societal, and environmental implications (Davies, 2017; Gerdal & Söderlund, 2018; Kreiner, 1995; Levitt, 2011; Morris, 2013).

The contextual perspective in project research suggests that as projects become increasingly complex, they are delivered in arrangements that require sophisticated cooperation among a variety of actors that span organizational and institutional domains beyond the conventional boundaries and responsibilities of the project organization. This is particularly the case for *vanguard projects*, which are defined as novel, challenging, and highly uncertain projects that organizations undertake beyond their existing capabilities so they can venture into new markets as well as develop new technologies and services (Brady & Davies, 2004; Frederiksen & Davies, 2008). Such first-of-a-kind projects are important for the strategic positioning of organizations as they offer important sources of capability development that can be embedded, utilized, and commercially exploited in their business-as-usual projects (Davies & Brady, 2016). Vanguard projects reflect exploratory activities of strategic importance for the organization (Lenfle et al., 2019), which is why vanguard projects are often discussed in the context of the front end of projects (Samset & Volden, 2016; Williams et al., 2019; Zerjav et al., 2021) before a project is sanctioned for execution.

The literature on vanguard projects, to date, is comprehensive. It is not our intention to provide a review of vanguard projects or conventional projects and core project roles here.

However, there is no significant coverage of the *role* of vanguard projects in their broader organizational, institutional, and policy contexts. Vanguard projects—typically delivered in multiparty settings among a diverse range of actors with disparate interests, goals, and agendas—can lead to transformational outcomes and drive a sustainability transition. As such, we use the sociotechnical transitions literature to achieve a macro-level contextualization of the role of vanguard projects in sustainability transitions. The sociotechnical transitions framework describes how change is structured over time to enable shifts from one sociotechnical state to another (Markard et al., 2012). This theoretical perspective is useful for illuminating the evolution of systems where technological innovation developments are intertwined with their social aspect. The same configuration is often found in vanguard projects undertaken to achieve sustainability objectives, which suggests a strong alignment between ideas from sociotechnical transitions literature with the notion of vanguard projects for the realization of sustainability policy-level objectives.

We contextualize vanguard projects using the multilevel perspective (MLP) of sociotechnical transitions literature (Geels, 2011; Geels & Schot, 2007) that conceptually delineates three distinct analytical levels, across which a transition occurs. Those levels include (1) the *landscape* that reflects the external context and structural long-term trends that initiate and maintain momentum in the transitions process (Papachristos, 2011); (2) the *regime* as a relatively stable (policy) space where institutions and organizations operate through relationships, normative rules, routines, institutional arrangements, and artifacts (Geels, 2004); and (3) the *niche* as a dynamic space of experimentation where innovations are developed to thrive before they can be scaled up and implemented within the regime (Raven et al., 2010). The MLP framework has been used to describe the evolution of policy and social contexts where new technologies emerge and are adopted to achieve a new state (Bolton & Foxon, 2015; Geels, 2011).

In this way, the role of vanguard projects is to help align the heterogeneous actors across the analytical levels of the transition. Once the transition has occurred, a new sociotechnical system—a new state—will emerge comprising of a set of embedded technologies, which were previously niche, a dominant organizational and institutional regime and a new, emergent sociotechnical landscape. Similarly, achievement of a sustainability transition will result in the commercial deployment of low-carbon technologies (often enveloped within a vanguard project), expansive policies supporting and encouraging projects with sustainability features, and a shift toward lower carbon emissions. The negotiation of goals and the alignment of heterogeneous actors in a vanguard project operating in the context of a sociotechnical transition require the capability to integrate core and external project actors across the levels of the transition. This involves *transition intermediation*, which we define as a process where core and external actors and resources align and organize in ways that enable the translation of objectives, actions, and project outcomes across the

levels of the transition. Understanding how intermediation works across the analytical levels of sociotechnical transitions is key for illuminating the role of vanguard projects in sustainability transitions.

Intermediation in Sociotechnical Transitions and Vanguard Projects

The MLP of the sociotechnical transitions literature discusses the notion of intermediation as a process of negotiation and alignment between the disparate actors in the sociotechnical transition (Howell & Shea, 2001). Here, specific actors are discussed as intermediaries in the sociotechnical transitions process. They are referred to as middle actors (Parag & Janda, 2014), hybrid actors (Elzen et al., 2012), and boundary spanners (Smink et al., 2015); they typically sit between product manufacturers and product users, entrepreneurs and adopters, and idea generators and funders (Kivimaa, 2014). Beyond their relational work, intermediaries facilitate transitions through their capability to identify common issues and build networks between various actors and organizations. But they are also necessary for aggregating, exchanging, and circulating knowledge resources as well as brokering and managing partnerships (Geels & Deuten, 2006). As such, intermediation occurs across the various levels of a sustainability transition. Foundational work on the presence of transition intermediaries in sociotechnical transitions has greatly expanded since 2018. Now, scholars discuss the dynamics among five types of transition intermediaries: systemic, regime-based, niche, process, and user intermediaries (Kivimaa et al., 2019a). While each of these intermediaries plays a specific role in the sustainability transition, they continuously interact and create the conditions for *authentic deliberation* between core and external project actors, which may have previously occurred in different networks.

Systemic intermediaries stand at the forefront by playing the role of translating sustainability objectives into concrete initiatives, project scope, and resource flows (Hodson et al., 2013). As such, systemic intermediaries include nongovernmental organizations (NGOs), local government agencies, and service providers—those capable of working on all levels of the sociotechnical transition and promoting its agenda (Kivimaa et al., 2019a). Systemic intermediaries in global cities can, for example, leverage logistics networks, economies of scale, and local knowledge to right-fit solutions for their own populations (Hodson & Marvin, 2010). Systemic intermediaries have become increasingly critical in mediating between the regime and technological innovation niches by deploying resources, negotiating stakeholder priorities, and enacting local policies (Hamann & April, 2013; Hodson et al., 2013; Hodson & Marvin, 2010; Mignon & Kanda, 2018). Since systemic intermediaries were first identified in the sociotechnical transitions literature, scholars have noted that systemic intermediaries are found organizing in ecosystems where they coexist

and interact with complementary intermediaries (Kanda et al., 2020; Kivimaa, 2014; Kivimaa et al., 2020; Parag & Janda, 2014).

In contrast to systemic intermediaries, regime-based and niche intermediaries operate from their respective sociotechnical transition levels. Regime-based intermediaries are established by regime actors and operate in the interest of the regime. Government-affiliated climate change agencies as well as research foundations and regulatory organizations are considered regime-based intermediaries because of their mandate to provide information to, and oversight of, multiple niches from the regime level (Bush et al., 2017; Kivimaa et al., 2019). In doing so, these intermediaries can facilitate the emergence of several niches for the purpose of regime objectives. Regime-based intermediaries are outsiders to the niche and yet rely on niche intermediaries for their highly specialized, expert knowledge of specific technologies. In turn, niche intermediaries are often characterized by their ability to facilitate knowledge learning not only within, but also across, similar niches to promote the transition of a technology within a niche and into the regime (Gliedt et al., 2018; Hargreaves et al., 2013). Industry organizations, research labs, and standardization committees are recognized as niche intermediaries. Niche intermediaries operate within a specific niche and oversee specific experiments and technological innovations within that niche.

Systemic, regime-based, and niche intermediaries are defined by their locations in the sociotechnical transition. The last two types of intermediaries—process and user intermediaries—are defined by their role in a sociotechnical transition. The process intermediary is seen as a neutral actor that ensures specific projects are managed within the niche so that they respond to transition needs. Within a sociotechnical transition, process

intermediaries can often be consultants and architects because of their daily involvement with the project and overall understanding of the project's location within the transition (Bessant & Rush, 1995). Process intermediaries interact with core project actors, such as project managers, to progress a project, coordinating between vertical and horizontal design elements without necessarily prioritizing an institutional agenda (Kivimaa et al., 2019; Kivimaa & Martiskainen, 2018). On a daily basis, the process intermediary facilitates knowledge diffusion about project operations within and between different projects and “translat[es] wider transition dynamics to specific local contexts” (Manders et al., 2020, p. 185).

In contrast to the process intermediary, the last intermediary, the user intermediary, operates outside the boundaries of the sociotechnical transition. Advocacy groups, building managers, user clubs, and internet discussion forum moderators are all user intermediaries. The user intermediary thus represents the interests of end users and ensures that the transition serves their interests (Barnes, 2019).

In summary, the intermediation literature suggests different actors will have different but complementary intermediary roles, which bring about the capability to operationalize and drive the transition within and across the MLP framework. Table 1 summarizes the transition intermediaries that are critical for sociotechnical transitions.

A transition will take place when different intermediaries interact at specific points in time. At these strategic moments, intermediaries have extensive reach to perform their four main roles: network building, articulating expectations, knowledge diffusion, and project implementation and arbitration (Kivimaa, 2014; Van Boxstael et al., 2020). The capability of intermediaries to deliberate authentically and perform, whether together or apart, is increasingly important. Intermediary success is determined by the local context, phase of the transition, and the resources available (Manders et al., 2020; Van Boxstael et al., 2020). Intermediary interactions often occur in mediating spaces, “user assemblages” or “interaction arenas” (Kivimaa et al., 2019b). However, despite the growing intermediation literature, these spaces have not yet been defined, discussed, and conceptualized, or linked to projects more broadly and vanguard projects more specifically.

In this article we define mediating spaces, user assemblages or interaction arenas, as *intermediation spaces* to contextualize agency carried by intermediaries. We argue that these intermediation spaces are key for motivating the multiactor cooperation that enables innovation to thrive in a vanguard project with sustainability goals. In this way, vanguard projects become a *context* that enables vision formation and implementation through intermediary interactions across core and external project actors (Kampelmann & Hollebeke, 2016; Martiskainen & Kivimaa, 2018). As an *intermediation space*, the vanguard project allows intermediaries to translate project objectives into sustainability outcomes from the niche to the

Table 1. Summary of Transition Intermediaries

Intermediary	Primary Function	Examples
Systemic intermediaries	Promote a sustainability transition agenda	Governments, NGOs, service providers
Regime-based intermediaries	Facilitate the emergence of niches for regime objectives	Research foundations, regulatory organizations
Niche-based intermediaries	Facilitate technological innovation for the niche's development and its transition to the regime	Labs, standards organizations, industry organizations
Process intermediaries	Coordinate with project actors to maintain and progress the project	Architects, consultants
User intermediaries	Represent end user interests and priorities in technological innovation and its integration in the regime	Advocacy groups, building managers, user clubs

regime and, ultimately, the landscape level. As a result, vanguard projects play an important role in contextualizing intermediary interactions and reflect the spaces where intermediary tensions are reconciled.

In developing the understanding of vanguard projects as intermediation spaces, it is important to emphasize that there is no clear-cut distinction between transition intermediaries (Kanda et al., 2020) and core/external project actors (Zwikael & Meredith, 2018) in the way there is a distinction between core project processes and transition intermediation. Core project processes, such as project definition and implementation, are at the heart of project organization, whereas transition intermediation translates goals and objectives across transition levels. Intermediation then becomes the process that arises only when core and external project actors interact and align their interests and agendas in the context of a vanguard project that is in, or has the potential to, transition. Core and external project actors can be involved in core project processes but become intermediaries only when the potential of the vanguard project as an intermediation space is recognized, and the project is managed with a view of transitioning across the MLP levels.

New policies that are designed at the regime level will address landscape trends, such as the sustainability agenda (Bos & Brown, 2012; Pahl-Wostl, 2007). These policies can be operationalized through project scoping and definition. The vanguard project then begins to attract and organize actors and resources, thereby inviting “authentic deliberation between disparate stakeholders and interests” (Hamann & April, 2013, p. 20) to enable implementation. Most visibly, the vanguard project provides the space where technological innovation will take place and where the interests and agendas of core and external project actors will be negotiated and will need to be aligned to drive the project through the transition. The vanguard project becomes the vehicle for technological innovations to develop and take hold within the regime and, by implication, the landscape. A vanguard project can encompass not just one, but multiple, technologies (e.g., magnetic levitation transport, geothermal heat exchange, underground waste suction tubes, etc.). In this way, vanguard projects provide *the incubation room* for innovation that will later be linked to sustainability objectives (Gil et al., 2012), which are in motion at the sociotechnical landscape and regime levels.

Transition intermediaries are responsible for organizing regime resources for project deployment. Moreover, core and external project actors rely upon (and indeed, undertake) intermediation to align a project beyond traditional project objectives, within a regime’s larger goals. Thus, vanguard projects with sustainability-driven outcomes depend on intermediaries to achieve these outcomes. Having now defined the distinction between project actors and the process of transition intermediation, we next focus on unpacking the core roles that transition intermediaries undertake for a vanguard project: building social networks, articulating expectations and learning processes, and exploring across dimensions.

Intermediaries Build Social Networks Around and Within Projects

A vanguard project is typically located between the niche and the regime in the MLP framework, and involves core project actors as well as actors external to the project. Each of these actors can assume an intermediary role in the realm of the transition. The involvement of transition intermediaries may be tangential or direct, near or within the project. Regime intermediaries (such as regulators that monitor pollutants and govern environmental resources), niche intermediaries (such as those subject matter experts who manufacture cleaner technologies), and user intermediaries (such as building operators) are involved in the project, but also enable and support interactions and interdependencies as part of the transition. Their actions need to be coordinated to ensure the technological innovation is developed within the vanguard project in the niche and then further integrated within the regime. In recent intermediation literature on the delivery of low-energy buildings, for example, projects were found to create temporary organizations where intermediaries came together to facilitate niche markets, implement new practices, support new business models, and facilitate building use post-construction (Kivimaa & Martiskainen, 2018). As such, the project became the space where new relationships were brokered and interests were aligned, creating new social networks (Hodson & Marvin, 2010).

Vanguard projects also support and help frame intermediary interaction (South et al., 2017). For example, project managers coordinate with process intermediaries because they understand daily project activities and regime-level dynamics (Manders et al., 2020). This becomes increasingly challenging with sustainability-driven projects that attract both core project actors and external environmental and community actors who are more likely to have interests that expand beyond the traditional project management triangle of time, cost, and quality. Here, the literature on intermediaries suggests that core and external project actors provide transparency and coordination among subject matter experts from within and outside the traditional project boundaries, and become transition intermediaries as they facilitate the dilution of traditional project boundaries and the integration of silos throughout the transition (Besner & Hobbs, 2008; Guo et al., 2014). In other words, the vanguard project is not only instrumental in ensuring collaboration within the project boundaries, it is also the intermediation space that extends the project in the transition and calls for a level of transparency from those actors not directly involved in the project but affected by it. The visibility of transition intermediaries within the intermediation space emphasizes an advanced level of interaction and collaboration. Wider, broader, and more extensive social networks multiply the number and amplify the intensity of interactions among intermediaries as sustainability goals overlay project goals.

Intermediaries Articulate Expectations and Visions During Project Formation

Early phases of project organizing begin to create an intermediation space, where intermediaries envision the future of the

project throughout the transition and refine expectations during project selection in relation to technology pipelines and innovative delivery strategies that meet sustainability outcomes. Authentic deliberations among disparate actors begin in early project phases and involve conversations related to actor needs, expectations, and requirements that drive strategy development. Intermediaries can set and communicate expectations early due to their ability to navigate and understand context between the levels of the transition, specifically the technological niche and regime. In turn, these expectations frame the priorities and boundaries of the collaboration among project actors who will become intermediaries in the transition. Intermediary expectations also help articulate and distinguish among plans, approaches, and strategies that are acceptable and ones that are not as the project interacts across the sociotechnical niche and regime and vice versa (Elzen et al., 2012; Klerkx & Aarts, 2013).

As intermediation spaces, vanguard projects are the organizing structure where common expectations can effectively resolve challenges and reduce barriers for intermediaries to act collaboratively within the project and throughout the transition. Kreiner (1995) first suggested that a project's context is not only unique, it is ever-changing, citing evolving customer preferences. Without the project structure, intermediaries must juggle their objectives within an uncertain, unpredictable, and constantly evolving environment (i.e., the landscape and regime of sociotechnical transitions) without a space within which they can engage with one another (Ivory & Alderman, 2005). Inherently, vanguard projects for sustainability objectives already mediate between "loosely coupled systems depending on the interaction of various professions (architects, planners, building services, etc.)," project objectives, industry requirements, and professional standards, such as building codes and design standards (Rohracher, 2001, p. 143).

The most effective way of aligning interests of intermediaries is setting clear objectives that drive specific project scoping processes. At the beginning of a project, resources are available and there is a greater opportunity for design changes (Edkins et al., 2013; Morris, 2009; Samset & Volden, 2016). The sociotechnical transitions literature suggests that during early project phases project actors become niche and regime intermediaries who, along with systemic intermediaries, work in concert to align project objectives between the technology's capabilities and the transitions' needs (Kivimaa et al., 2019a). During early project phases, niche intermediaries articulate early expectations based on the technological innovation, while development and process intermediaries connect context-specific regime priorities and local projects (Kivimaa et al., 2019a). The project as an intermediary space allows for this interaction to occur and creates the potential for the vanguard project to drive and traverse the transition. As a project progresses, intermediaries evolve. Niche intermediaries embed themselves within a project, and systemic intermediaries align actors by deploying resources, negotiating stakeholder priorities, and enacting local policies (Kivimaa et al., 2019a), which could

remain divorced from core project practices previously. These shifts occur as project resources dwindle and the design is locked in. It is at these later stages of the front end that user intermediaries concerned about user adoption and use of the project have more limited involvement in pushing design decisions (Hamann & April, 2013). Here, the process intermediary ensures that the project progresses toward its objectives, constantly interacting with other intermediaries and navigating the transition toward achieving sustainability objectives (Kivimaa & Martiskainen, 2018). Project expectations are defined early and lay the ground for deliberation, interaction, and alignment of goals that will be relevant throughout the levels of the transition.

Intermediaries Learn Processes and Explore Dimensions Within Project Boundaries

The emergence of the vanguard project as an intermediation space catalyzes communication and the dissemination of knowledge, as well as the assessment and evaluation of the technological innovation (Kivimaa, 2014). The refinement of project objectives is a balancing act where intermediaries exchange and process knowledge to better understand how to allocate resources and identify the investments needed across project dimensions (Bessant & Rush, 1995). More specifically, the project organization facilitates a process by which niche and regime intermediaries can determine a set of objectives that are technologically realistic and reasonably achievable (Kivimaa & Martiskainen, 2018). The vanguard project will emerge when resources are matched and funneled into the delivery of specific project objectives, which also sets the transition in motion (Geels & Schot, 2007). Project actors use those resources and learned processes to achieve agreed upon goals and appropriately size the technological niche through project scoping. Understanding the role of transition intermediaries from a resourcing perspective becomes key as vanguard projects rely on the wide network of contributors, which implies that involvement and support of transition intermediaries are necessary preconditions for the project to progress throughout the transition.

As project objectives solidify, resources are organized in categorical and temporal ways that prevent project actors from depleting resources unnecessarily (Eskerod & Vaagaasar, 2014; Lundin & Soderholm, 1995). At the same time, the presence of the process intermediaries (as those who know the day-to-day project dynamics) takes a prominent role as regime and niche-based intermediaries retreat. This retreat represents the movement from project planning to project delivery. When project objectives are policy oriented, as seen in sociotechnical transitions, the involvement of process intermediaries in deliberations becomes increasingly necessary (Turner & Müller, 2004). As the project progresses, intermediaries use their expertise to explore various dimensions within each project phase, connecting project outcomes to the broader multilevel context.

Table 2. Summary of ISEGS Transition Intermediaries

Intermediary	Primary Function	ISEGS Intermediaries
Systemic intermediaries	Promoted the transition agenda to renewable energy sources by supporting right-fit solutions (i.e., ISEGS) for California's long-term energy needs	California's Public Utilities Commission, California's Energy Commission, PG&E, and Southern California Edison
Regime intermediaries	Financially and logistically supported the emergence of solar thermal power for regime objectives (i.e., the Green Power Plan)	U.S. Department of Energy, Bureau of Land Management
Niche intermediaries	Developed the niche innovation (i.e., utility scale, solar thermal power) for transition to the regime	BrightSource Energy
Process intermediaries	Executed and operated the ISEGS project	NRG Energy, Bechtel, and Google
User intermediaries	Scrutinized the development and integration of solar thermal technology into California's energy system	State Building and Construction Trades Council of California, Building & Construction Trades Council of San Bernardino and Riverside, and local environmental advocacy groups

Even though the sociotechnical regime and landscape are uncertain and unwieldy, the project provides a structured space defined by scope and phasing, early expectation setting, and resource allocation. Because of these project features, the vanguard project as an intermediary space allows the contextualization of complex knowledge interactions spanning core project actors and external actors, in particular intermediaries, to achieve goals that support sustainability transitions.

The next section provides a vignette that illustrates the role of a vanguard project as an intermediation space within large-scale sustainability transitions. The vignette illustrates the conditions under which project actors assume the role of transition intermediaries in vanguard projects. The vignette also illustrates how the vanguard project allowed intermediation for the purposes of building stakeholder networks, aligning expectations, and facilitating exploration at multiple dimensions for low-carbon transitions. We discuss intermediation in the context of the project, differentiate it from core project processes undertaken by other actors, and identify the intermediation dynamics of interaction and collaboration that led to the realization of important sustainability objectives of the project.

Project Intermediation Vignette: The Ivanpah Solar Electric Generating System

Ivanpah Solar Electric Generating System (ISEGS) is a vanguard project located in Ivanpah, approximately five miles from the California-Nevada border, on federal land managed by the Bureau of Land Management. This 392-megawatt solar complex is currently the largest concentrated solar power (CSP) plant in the world. Based on BrightSource Energy's low pressure turbine (LPT) solar thermal technology, ISEGS uses 352,000 mirrors to focus the sun's rays on three boilers mounted atop towers (BrightSource Limitless, 2015; Danelski, 2017). These boilers generate steam to power turbines, which produce electricity for more than 140,000 homes in California during peak hours of the day.

The project uses CSP, which, at the time the project was proposed, was at a stage where it could have been commercially adopted. Sitting outside the technological niche, CSP was attractive to the Obama administration's broader agenda of reducing the United States' carbon footprint and developing alternative-energy projects on public lands. However, the technology had not been adopted within the regime and remained relatively unproven. ISEGS thus became a temporary project organization capable of navigating the space between socio-technical transition levels. Once approved in 2010, the administration pumped millions of taxpayer dollars into the Bechtel-led project, including US\$1.6 billion in loan guarantees and US\$600 million in federal tax credits (Danelski, 2017). Upon its completion in 2013, ISEGS nearly doubled the United States' solar thermal energy production and was projected to reduce carbon dioxide (CO₂) emissions by more than 400,000 tons per year (Department of Energy, 2017).

However, since NRG Energy commenced operations of the facility in 2013, the project has experienced a handful of controversies. In its first full year of electricity generation, ISEGS produced only 45% of its annual production goal, and the plant took nearly four years to reach its production goal of 940,000 megawatt hours a year (Danelski, 2017). Additionally, the facility has been using increasing amounts of natural gas, a greenhouse-gas-emitting fuel, to heat its systems at night and keep electricity production stable during periods of cloud cover. Struggles to meet its electricity contract with the California Public Utilities Commission, a 2016 fire, and the collapse of photovoltaic panel (PV) prices have also left many critics still questioning the hard economics of the project (Zhang, 2016).

Yet despite these initial challenges, ISEGS served as an intermediation space, one that built stakeholder networks, aligned expectations, and facilitated exploration at multiple dimensions to achieve a low-carbon outcome. The energy generated from ISEGS's solar thermal technology, a technological innovation, remains central to the goals of utilities like PG&E and Southern California Edison, which must contract 33% of

their electricity from renewable sources by 2020 and 50% by 2030, respectively (Danelwski, 2017). On a global scale, the executive vice president of NRG Energy, Tom Doyle, also “see[s] Ivanpah changing the energy landscape by proving that utility-scale solar is not only possible, but incredibly beneficial to both the economy and in how we produce and consume energy (Overton, 2014).” Naturally, the ISEGS project highlights three key ways in which projects serve as intermediation spaces in multilevel transitions. These aforementioned roles are discussed in the following sections.

The ISEGS project highlighted an important characteristic of vanguard projects. Because climate agendas often affect both local and global environments, projects tend to grapple with a wide array of project actors, who in the context of sociotechnical transition become intermediaries. This was no different for ISEGS, a project that set in motion a diverse set of interactions among disparate intermediaries. Table 2 outlines these ISEGS transition intermediaries involved in facilitating the sociotechnical transition.

This project thus became a crucial intermediation space for aligning, negotiating, and managing disparate interests; fostering collaboration; and delivering integral national and regional climate change policies.

Intermediaries Built Social Networks Around and Within ISEGS

Because the project relied on a technology, which had never been used before on such a large scale, it attracted both global recognition and significant regional backlash. In this way, the project became a space with a certain level of transparency for those affected but not directly involved in the project. As a result, worldwide media attention and local activists flocked to the project to deliberate and contend with the project’s objectives and technology. This visibility of the project thus created a critical space for authentic deliberation, interactions, and collaborations to take place among intermediaries, thereby facilitating the low-carbon transition. Criticisms regarding the technology and economics of the project from user intermediaries and regime intermediaries also helped assess and improve the technology innovation for integration within the regime (Zhang, 2016). For example, one identified advantage of CSP projects is their ability to be paired with thermal storage to allow for energy production when the sun sets or is obstructed. Although ISEGS does not boast thermal storage, BrightSource Energy used information gleaned from the project’s operations to include thermal energy storage in subsequent facilities overseas, such as the Huanghe Qinghai Delingha Solar Thermal Power Project in China (Ballard, 2019).

By creating an environment where new relationships could be brokered and interests could be aligned, ISEGS was able to ultimately overcome a variety of early operational challenges, including poor electricity generation ramp up and capacity issues, a small fire, which temporarily shut down one

of the plant’s towers, and collapsing PV panel prices. Now, ISEGS generates enough energy to power 140,000 homes. ISEGS has also demonstrated its staying power and ability to deliver on its regime level objectives, successfully doubling America’s solar thermal energy production.

This illustrates the importance of interactions among disparate project actors within the intermediation space of the project. The collaboration needed for ISEGS to progress necessitated an intense level of intermediation, whereby different types of intermediaries (i.e., niche, regime-based, systemic, process, and user) authentically deliberated and reconciled disparate interests during the project’s design and implementation (Hamann & April, 2013).

Intermediaries Articulated Expectations and Visions During ISEGS’ Formation

In vanguard projects, the open system environment forces project actors to integrate and seek alignment with regime policies. Disparate actors must make concerted efforts to select the right technological niche(s) for the regime policy and objectives. ISEGS illustrates the importance of this intermediation early on in the project. In these early phases, the niche and regime intermediaries (BrightSource Energy and the U.S. Department of Energy) worked in concert with the systemic intermediaries (i.e., California’s Public Utilities Commission, California’s Energy Commission, PG&E, and Southern California Edison) to align the project’s objectives with the technology’s capabilities and the needs of the transition.

At the outset, the design of ISEGS underwent numerous changes to optimize the viability of solar thermal production while minimizing the impact on several protected plant species and desert tortoises in the region. For example, after securing US\$1.6 billion in loan guarantees from the Department of Energy, BrightSource agreed with the California Energy Commission and the Bureau of Land Management to revise its initial design to reduce the overall footprint of the project by 12% (Overton, 2014). Yet, despite these design changes, ISEGS was still able to align its energy production with California’s long-term, low-carbon energy mandates. Because the project also fit strategically within America’s broader agenda (i.e., Clean Power Plan) to reduce carbon dioxide emissions from electrical power generation by 32% by 2030, ISEGS was able to contribute to regime-level objectives.

While the application of such a novel, alternative-energy technology did have its challenges, early-stage alignment between the technological niche and the sociotechnical regime proved to be critical in offering the right intermediation space for this CSP project to flourish. This was only possible because NRG Energy and Bechtel’s early involvement limited unrealistic expectations. As process intermediaries, NRG Energy and Bechtel connected context-specific regime priorities with the realistic limitations of the niche technology being deployed. At the same time, they had to craft a special

transport system that would allow the project to meet its delivery targets. This involved well-coordinated planning and innovative solutions to help maximize efficiencies. At the same time, the ISEGS project incorporated first-of-its-kind elements, which tested the existing capabilities of engineering teams and craft labor (Overton, 2014). However, early alignment between the technological niche and the regime objectives ensured ISEGS progressed toward its goals. Clear objectives also drove the specific scoping tasks and prevented complementary intermediaries from competing unnecessarily. Throughout this process, NRG Energy and Bechtel constantly interacted with other intermediaries to navigate the evolving context of the project. For example, Bechtel executed a project labor agreement with the State Building and Construction Trades Council of California and the Building & Construction Trades Council of San Bernardino and Riverside counties to ensure California's locally unionized labor force would benefit from the ISEGS project (Overton, 2014). Through these instances of intermediation, the project was able to provide structure within a dynamic environment and “[bring] together an unusual coalition of industry veterans and newcomers” despite “fac[ing] some unexpected environmental opposition” (Overton, 2014).¹

Intermediaries Learned Processes and Explored at Multiple Dimensions Within ISEGS' Boundaries

Finally, technological niches typically require the right resources or *sizes* to buffer against uncertainty and project risk. In vanguard projects, the size of the technological niche needs to be defined early enough in the project to account for this uncertainty. ISEGS offers a clear illustration of the importance of how intermediaries helped determine the right *sizing* of the technological niche through knowledge sharing and exploration at multiple dimensions. In the scoping phase, intermediaries exchanged and processed knowledge to refine the project's size, goals, and resources requirements. This involved numerous design iterations and revisions to accommodate more stringent environmental conservation guidance for desert tortoises after the Western Watersheds Project filed a lawsuit against the Bureau of Land Management and U.S. Fish and Wildlife Service (Overton, 2014). The Bureau, as a regime-based intermediary, was responsible for overseeing logistical and regulatory hurdles that would affect the project's development. Given their experiences outside of the project boundaries, they were able to bring in knowledge and expertise that informed environmental processes. Even with these constraints, the objectives set by policy and utility actors in the regime were preserved: produce enough electricity for more than 140,000 homes by 2013 and help California utilities achieve 33% renewable electricity by 2020. Because intermediaries could explore at the niche and regime levels, integrating new knowledge with policy objectives, they could clarify the technological

niche's evolution for the sociotechnical transition. As such, the project's scope became clear: build a 392-megawatt solar complex in the Mojave Desert to double America's solar thermal energy production.

However, building the largest CSP plant in the world came with a host of complications at the regime level, including contractual partnerships with California's Public Utilities Commission, renewable energy market disruptions resulting in the collapse of PV panel prices, and a 2016 fire caused by maintenance issues. By managing and overcoming these local, regional, and national dynamics, the project became a contested space where resources from the regime level were employed alongside technical innovations to resolve its supply chain challenges, design decisions, and the prototyping issues that arose during project delivery (Overton, 2014). The intermediaries were able to explore at multiple dimensions and learn processes that facilitated the project's progress and eventual success.

Under such difficult circumstances, transition intermediaries worked together to ultimately *size* the technological niche and its boundaries. As the largest solar thermal power plant in the world, the 392-megawatt solar complex became a global case study for other governments looking to adopt risky but potentially groundbreaking, alternative-energy technologies.

Implications of Understanding Projects as Intermediation Spaces for Sustainability Transitions

Our work provides a new macrolevel contextualization of vanguard projects as intermediation spaces for sustainability transitions. This is in line with previous contextual studies emphasizing projects within their broader context by focusing on the wider socioeconomic and historical environments of the project (Engwall, 2003), the front end of the project (Edkins et al., 2013; Morris, 2009), interorganizational project networks (Ahola, 2018; Manning, 2017), project business (Wikström et al., 2010), and project ecologies (Grabher & Ibert, 2011). However, these project studies do not articulate the process of bringing together organizations and actors meaningfully in the context of broader policy and strategic goals that projects are meant to deliver.

This article proposes the conceptual idea of vanguard projects as intermediation spaces and contributes to this contextual stream of project enquiry, providing additional nuance to understanding how conventional project roles and activities (Zwikael & Meredith, 2018) change in the context of sustainability transitions. As vanguard projects with sustainability goals are conceived within an open system environment (Davies, 2017), they progress through intermediaries who integrate the niche and the regime through policy creation, project selection and scoping, and throughout project implementation as the transition is in motion. In particular, it becomes clear that the role of transition intermediaries and the role of the project as an intermediation space is invisible, with the conventional focus on the core project actors only.

The vignette suggests that transition intermediation extends much beyond the core project processes as defined in Meredith and Zwikael (2018) and involves both project core and external actors, which get activated as different types of transition intermediaries at different points in time. Specifically, core project actors assumed roles of regime, niche, and process intermediaries, depending on their embeddedness in the policy and strategic (regime), operational execution (process), or technology development (niche) domain. At the same time, external project actors, such as regulatory bodies, local community organizers, and trade union representatives assumed the roles of systemic, niche, and user intermediaries. The vignette demonstrates that a focus on the core project organization and roles is not sufficient to understand the role of a vanguard project in sustainability transitions. By contrast, a wide focus on a diverse set of actors is needed to understand the intermediation process of negotiation and goal alignment across the different sociotechnical levels, which, as the vignette shows, are likely to drive the transition toward sustainability goals. In this way, as project actors assume the role of intermediaries, they contribute to the realization of the much wider transition agenda as opposed to the narrow agenda of project execution as their focus shifts beyond the niche to the regime, process, and landscape levels that can transform sustainability goals from rhetorical to operational practices.

The roles of core and external actors, and how they become transition intermediaries, are left out of the extant research on sociotechnical transitions (Kivimaa et al., 2019a). This is arguably because of the perceived limited interactions project actors undertake within the regime space (Hodson & Marvin, 2010). Our work confirms that a project architect or consultant may operate in a silo, provide services as stipulated by contract, and fulfill core project actor responsibilities. It proposes, however, that the same architects and consultants can take on intermediary roles and build social networks; become involved with early expectation setting; and explore, learn, and exchange knowledge with a view on enabling vanguard projects to drive a transition (Bessant & Rush, 1995; Kivimaa et al., 2019a). The ability for any actor to take on intermediary roles is also supported in the vignette where core project actors such as BrightSource Energy and Bechtel took on important intermediary roles to enable interaction of the project between the niche and regime levels.

Moreover, our work explores the role of vanguard projects in sociotechnical sustainability transitions. We suggest that vanguard projects serve as intermediation spaces that create preconditions for cooperation arrangements. As such, vanguard projects support and facilitate technological innovation of the kind needed for the sustainability transitions to occur along the lines of Geels and Schot (2007). Project scope and phasing draw boundaries and create the timing of where and when intermediaries come to influence technological developments. In this intermediation space, projects enable intermediaries to convene, negotiate, and learn from each other, which helps project actors extend project objectives during sustainability transitions.

Transition intermediation in vanguard projects implies strong capability building for the project actors and a strong potential for learning of an explorative nature (Brady & Davies, 2004; Tillement et al., 2019), a phenomenon broadly in line with recent literature on exploratory and hybrid projects (Lenfle, 2012; Lenfle et al., 2019). Both core actors and external actors can learn from one another beyond the boundaries of their operational and business models. For firms participating in vanguard projects, the negotiation and alignment that occur through intermediation open up the possibility of building dynamic capabilities, informing their operations and business-as-usual processes in the context of sustainability transitions (Davies & Brady, 2016). For policy actors, regulators, community and other stakeholder groups, interaction that happens through intermediation helps to refine their agendas, ultimately strengthening their normative, strategic, and political positions given the latest technological innovations. As a result, we suggest intermediation generates capability-building dynamics in the transition ecosystem, which would not occur in a conventional arrangement where the delivery of the project and its performance is the focus of project actors.

The preceding discussion finally raises the question: How do we establish vanguard projects in sustainability transitions? This question points to the resources and management frameworks needed to support the notion of intermediation spaces and intermediation as an activity shared among different kinds of actors.

As discussed in this article, transition intermediaries in vanguard projects can navigate across boundaries and knowledge bases to engage with core and external project actors, better understand technology options, and provide a way forward to achieve sustainability outcomes. This has an implication for how core and external actors are encouraged to interact and realize their intermediary potential. One implication of this new understanding is that prioritizing more resources at early project phases can help create and enable the intermediation space. This is broadly consistent with the work on the front end of projects, which suggests the important strategic role of these pre-project phases (Samset & Volden, 2016; Williams et al., 2019). The front-end resources must be sufficient to carry the potential of the project and the intermediaries throughout the transition, ultimately leading to effects on the landscape and emergence of trends that give rise to initiatives such as net-zero carbon goals.

Because the sustainability agenda aims to affect both the national and global policy and industry environments, vanguard projects that carry the execution of the sustainability agenda will involve numerous external project actors at different levels of the sociotechnical transition. At the regime level, these external project actors interact to set new policies and deliver resources. Project organizations are recipients of these policies and resources, making them focal points for actor engagement and debate. While the project provides a structure that guides these conversations, there is a need to dedicate substantial resourcing for the facilitation of communication and

interactions among these actors. This is in keeping with the stakeholder management stream of work in project studies (Maddaloni & Davis, 2017) and the idea of vanguard projects as multiorganizational networks where organizational hierarchies are less relevant than flatter structures of stakeholder decision-making (Ahola, 2018; Manning, 2017). As a result of this flatter structure, the vanguard project can provide means for this reconciliation and alignment of interests among actors as they work on joint outputs and aim to contribute to common policy goals that come within reach through a transition.

The myriad ways in which intermediaries can coordinate and combine resources will require the entire set of strategic, operational, and tactical skills that experts across fields can employ to see the project throughout the transition. Deliberations among multiple actors with converging and diverging agendas require prudence (Flyvbjerg et al., 2009) and the delicate handling of ethical dilemmas that may arise (Konstantinou, 2015; Konstantinou & Müller, 2016). At the same time, however, deliberations among multiple actors create the conditions for new opportunities and new approaches, which are urgently needed in the management of large-scale infrastructure investments if they are to positively impact sustainability transitions (Bolton & Foxon, 2015). Our work proposes that projects with climate goals are no longer a mechanism for realizing the localized priorities of a client, or a single actor, no matter how big or important that client is. Instead, we inherently see vanguard projects as intermediation spaces, organizing among core and external actors of which some become intermediaries to facilitate the sustainability transition. In this conceptualization, vanguard projects motivate a sustainability transition toward a more sustainable global society and economy.

In conclusion, we suggest the concept and investigation of intermediary roles and interactions, within and around projects, are very important for addressing sustainability transitions. Intermediary roles and interactions, however, can easily be overlooked in real-world scenarios where projects are increasingly interconnected and interdependent within complex multidisciplinary sociotechnical systems. As a result, understanding how projects function as intermediation spaces provides opportunities to better leverage and strategically manage project actors and ecosystem resources for the sociotechnical transition.

Future research can examine empirically how vanguard projects support intermediary interaction for the purposes of sustainability transitions. The case of Ivanpah Solar Electric Generating System begins to provide an outline for the construct of vanguard projects as intermediation spaces for sustainability transitions. However, it is clear that future empirical research is needed to elaborate on, expand, or indeed challenge the findings of our work and the construct of vanguard projects as intermediation spaces for sustainability transitions. For example, future research should explore the conditions under which intermediation emerges in vanguard projects. Analysis should be undertaken both on insightful cases of single projects and also comparative case studies of projects with different sociotechnical transition goals. This would extend the

conversation on vanguard projects to other sustainable development goals (SDGs) and other grand challenges (Kuhlmann & Rip, 2014). While those landscape-level agendas would clearly sit outside the remit of traditional project conceptualization, we suggest that it is through the process of intermediation that resources and management frameworks influence project shaping. The precise mechanics through which this occurs is subject to a future stream of research on project practices in light of landscape level trends and agendas. Our research serves as a call to action for further development of these frameworks by bringing together project studies and the sociotechnical transitions literature.

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Note

1. For overcoming such obstacles to build the world's largest CSP project, ISEGS was awarded POWER's 2014 Plant of the Year award.

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