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Review article

A framework to design and evaluate citizen engagement strategies to accelerate the energy transition

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HIGHLIGHTS

- A new framework that serves as a guide to design and evaluate novel engagement strategies.
- Seven functional requirements derived from pitfalls and lessons in existing literature.
- Gaps and opportunities in the current engagement literature are identified and discussed.

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ABSTRACT

The acceleration of the energy transition requires effective citizen participation and engagement strategies. The political significance of citizen engagement is widely recognized, as emphasized in the European Green Deal. Notably, engagement plays a crucial role in bridging the gap between society and technology. However, our research shows that engagement strategies often lack a clear theoretical foundation, fail to define causal mechanisms, and are rarely empirically tested or evaluated in context. Additionally, engagement is sometimes implemented dogmatically, without critical reflection on its necessity or effectiveness, thereby reducing its impact. To address these issues, we conducted a systematic analysis of 77 academic articles, identifying common pitfalls, key lessons, and emerging trends in engagement approaches. Based on these insights, we developed a framework comprising seven functional requirements for designing and evaluating engagement strategies. These requirements are setting clear goals, defining problems and desired outcomes, grounding strategies in engagement theory, incorporating causal mechanisms, targeting specific audiences, ensuring empirical validation, and contextual evaluation. This framework provides a structured approach for improving citizen participation efforts, ultimately contributing to a faster and more effective energy transition.

1. Introduction

Citizen engagement is a cornerstone of the energy transition. Beyond technological innovation and economic incentives, success depends on public acceptance, participation, and the alignment of policies with societal values [1,2]. Citizens are not merely end-users but social and political actors whose choices and engagement shape the direction and pace of change.

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This is evident, for example, in the residential sector, where households account for nearly 30% of EU energy consumption [3]. Despite the potential of measures such as energy-efficient retrofits, renovation rates remain low — often described as the "energy efficiency gap" [4]. This highlights how technical opportunities fall short when citizen perspectives are not adequately addressed.

These challenges underscore that the energy transition is not only a technical or economic project, but also a matter of governance and participation. Effective engagement strategies are essential to foster trust and ensure that change reflects societal needs.

1.1. Citizen engagement and participation

Although the terms 'engagement' and 'participation' are often used interchangeably in the literature, they are not the same [5–7]. Conceptual ambiguity surrounding both terms has been widely noted, and no clear consensus has yet emerged on how they should be defined or distinguished [8,9].

Following Barrett and Brunton-Smith [10], we define engagement as an internal state — such as awareness, interest, knowledge, beliefs, or attitudes toward civic or political matters. Participation, by contrast, refers to observable behaviors, such as attending meetings, signing petitions, or joining collective initiatives. This distinction is echoed by Steinhardt et al. [8], who differentiate between internal dispositions and outward actions, though with different terminology.

Awareness can be seen as a prerequisite for engagement: individuals must first recognize an issue before developing sustained interest or attitudes toward it. Engagement strategies therefore often focus on creating or deepening awareness (e.g., information campaigns or educational initiatives), even when they do not immediately translate into observable participation. Participation strategies, in turn, build on engagement by enabling or channeling that internal state into action (e.g., providing opportunities to deliberate, vote, or co-create policy). In this sense, all participation presupposes engagement, but not all engagement results in participation.

This distinction matters for understanding how strategies operate. For example, a campaign that informs citizens about the benefits of home energy retrofits is an engagement strategy aimed at raising awareness and shaping attitudes. By contrast, organizing a deliberative forum where citizens co-design retrofit policies is a participation strategy that transforms engagement into collective action. Recognizing this difference clarifies the continuum from internal orientation to external expression and helps avoid conflating strategies that target different stages of citizen involvement.

This conceptual distinction becomes particularly relevant when considering historical and contemporary frameworks for engagement. Two decades ago, there was a call for a conceptual framework for designing engagement processes [11]. While Lauber and Knuth noted a lack of clear conceptualization at the time, contemporary literature has seen significant development. The literature has been enriched by typologies of engagement and participation, addressing gaps identified in Lauber and Knuth's overview. Several theoretical typologies of engagement, outlining the function and role of engagement, already exist [12–16]. These frameworks collectively enrich our understanding of engagement processes, offering insights into their diverse dimensions and objectives.

However, a scientific framework that offers clear guidelines for designing and evaluating effective engagement strategies is still missing. Such a framework is important for structuring the design of strategies, especially given the overwhelming amount of diverse knowledge. It should be developed with practical relevance in mind, providing useful guidance to policymakers and practitioners in the position to implement engagement strategies that support the energy transition. Engagement is a tool with high potential to facilitate the necessary interplay between technology and society [2]. By offering such a framework, we aim to support both academic and practical development of citizen engagement—and, by extension, accelerate the energy transition.

1.2. Research aim

The call for a framework that provides insight into the design of engagement strategies is still relevant today [2,17]. With the substantial growth of the literature since Lauber and Knuth's call for a conceptual framework, a diverse and multidisciplinary body of academic knowledge is now available to develop such a framework. This paper therefore has two aims. First, we critically review the existing literature on citizen engagement and participation strategies focused on energy policy to extract effective elements from these strategies and identify gaps in the current literature. Secondly, based on this literature review, we aim to create a conceptual framework that will allow the user to design and evaluate citizen engagement strategies. Our main goal with this framework is that it will make strategies or interventions for citizen engagement within the energy transition more targeted, efficient and effective. This framework is useful for practitioners, and for researchers who aim to design a new engagement strategy or evaluate an existing one.

2. Methods

Our method was a constant comparison analysis [18], based on a literature review according to the PRISMA guidelines [19]. This approach made the results traceable and allowed us to approach the existing body of literature inductively and systematically. First, we outline where and how we collected our body of literature. Subsequently, we explain why we chose the search strings we used for this paper. We then discuss the criteria we used to determine the relevance for our research. Lastly, we explain how we applied the constant comparison method in a literature review.

2.1. Literature sources and search strategy

Literature was collected using the database Scopus on January 23rd, 2023, with the following search query:

ABS (“citizen” OR “household” OR “public”) AND KEY (“engagement” OR “participation”) AND ABS (“strategy” OR “intervention” OR “instrument” OR “tool”) AND ABS (“energy” OR “thermal” OR “renewable” OR “green” OR “electricity” OR “heating”) AND NOT ABS (“stakeholder” OR “review”).

It is important to note here that the term “stakeholder” has been explicitly excluded because its inclusion alongside the term “public” resulted in a considerable number of irrelevant papers, focusing on stakeholder engagement instead of citizen engagement. Without the term “stakeholder”, the query effectively included all public engagement without the stakeholder engagement. Stakeholder engagement is outside the scope of this research. Citizen engagement delves into how individual citizens can be involved with a topic or in policymaking or public problems, whereas stakeholder engagement can leave citizens out. Stakeholders are engaged, since they hold a stake as individuals or often as organizations. Therefore, stakeholder engagement is substantively different from citizen engagement. Additionally, it was decided to limit the search to articles published from 2010 onwards, to restrict the volume of research that was covered. The volume of research increased drastically, while not yielding the desired results. Given that modern research is a continuation of older work, we decided to limit the time-period. Lastly, we focused on the domains related to the energy transition. We looked at terms that were used synonymously or indicated a similar field. This way we limited the number of missed articles.

2.2. Eligibility criteria

The central unit of analysis in our study is the citizen engagement strategy. By strategy, we refer to a deliberately designed approach intended to facilitate, stimulate, or structure the active involvement of individual citizens in public decision-making or governance processes. Strategies may vary in form, scope, application, and the engagement tool, but they share the common goal of enhancing individual citizen engagement. Important to note is the difference between a strategy and a tool: A strategy is the overarching approach to achieve a goal, whereas the tool is the specific engagement instrument to be implemented in that strategy.

Our first criterion for inclusion was to use only scientific research papers, including both peer-reviewed and conference papers, as we expect that the tools and strategies in these papers were tested according to scientific principles and are more rigorously tested than non-academic papers. Second, we selected scientific reports that focus on one (or multiple) concrete strategies aimed at implementing or increasing citizen engagement. Third, we chose to include only papers that are focused on individual citizen engagement. Papers that address the engagement of organizations or stakeholders other than individual citizens were excluded. For practical reasons, we included only reports that were written in English, Dutch, or German.

2.3. PRISMA flow

A PRISMA flow diagram of the different steps taken in the literature search process, and the number of reports found, screened, and read, can be found in Fig. 1. The selection process consisted of the following five steps:

- Step 1: We screened the titles and abstracts of the 377 scientific papers found in the Scopus database. Reports were categorized as ‘relevant’, ‘not relevant’, ‘not sure’ or ’review’. The reports were categorized as ‘relevant’ if they met the eligibility criteria described in Section 2.2.
- Step 2: Two researchers crosschecked all titles and abstracts of the reports that were categorized as ‘not relevant’ or ‘not sure’, so that each of the reports was checked twice. For reports where the two researchers did not reach a consensus, a decision was made to retain them. In total, 129 papers were retained.
- Step 3: As a third step, all remaining articles were divided among six researchers to be read in full. 10 articles could not be retrieved and were subsequently removed. While reading, the researchers independently filled out a table with elements, that was developed beforehand to summarize the main findings from the studies in a structured manner (see Section A). After reading the full papers, each researcher again decided on the relevance of each paper for the review based on the previously described eligibility criteria.
- Step 4: Finally, all the papers that were categorized as ‘not sure’ were randomly divided among the same six researchers for another cross-check, resulting in a total of 77 papers being included in the analysis.

It is important to note that some papers discussed more than one engagement strategy. These strategies were then analyzed separately. In total, we analyzed 94 engagement strategies from 77 different papers.

2.4. Constant comparison coding

For the analysis of the 94 strategies described in the selected papers, we used constant comparison coding [18], which is a qualitative research method that originated from grounded theory research. Grounded theory research offers a methodology for developing theories and concepts directly from empirical data, diverging from approaches reliant on preconceived notions or established theories [20]. This approach aims to construct theories deeply rooted in the data itself, capturing the intricacies of the phenomenon under investigation.

Data collection in grounded theory research begins with the gathering of diverse and rich data, ensuring a comprehensive exploration of the research topic [18]. We achieved this by using Scopus as our search engine, with a diverse range of multidisciplinary journals. After reading the articles in the structured manner, as described in 2.3, we coded results from the table that was filled in by the researchers. This meant systematically labeling segments of our data based on their content or significance. This approach

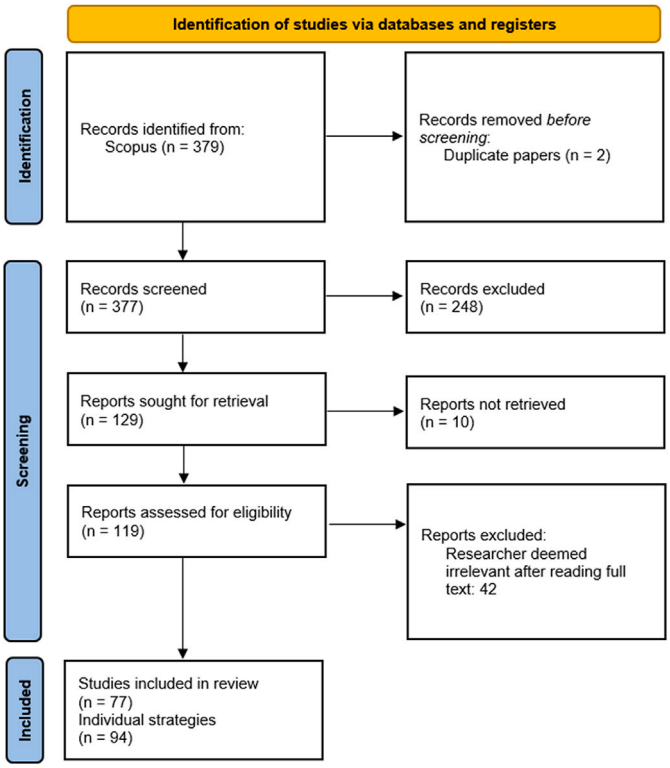

Fig. 1. PRISMA flowchart.

enabled us to cluster different articles based on content, allowing us to identify patterns and concepts [18,21]. We then coded and analyzed by means of constant comparison, iteratively coding and continuously revisiting articles to refine previous coding [18,21].

The table containing the results of this process can be found in Section B. In the columns, we present categories, codes and subcodes. Categories provide thematic outlines regarding clusters of elements present in the chosen articles, and codes and subcodes serve as more specific, meaningful labels we assign to certain articles. Codes and categories are internally homogenous, but externally heterogeneous [18], meaning that all data within a code or category should be comparable, and there should be meaningful differences between codes. If internal homogeneity cannot be warranted within a given code, subcodes allow us to be more specific and therefore maintain homogeneity. Essentially, the categories are thematic trends that appear in our body of literature. Elements and sub-elements provide insight in the specific way certain articles include these thematic categories.

The trustworthiness and rigor of grounded theory research can be established by adhering to criteria for trustworthy qualitative research [18,20]. This includes considerations for credibility, transferability, dependability, confirmability, and authenticity. To enhance credibility, we employed analyst triangulation and provided detailed descriptions of the research context and procedures for transferability. Dependability is ensured through transparent documentation of the research process, while confirmability is achieved by maintaining neutrality and addressing biases. Authenticity is fostered by valuing participant voices and experiences, although in the case of a literature review, member checking may not be feasible for every article [18]. Instead, we crosschecked a sample of the literature.

3. Constant comparison results

In this chapter, we present and analyze the results of our constant comparison analysis. The full coding trees, including all categories and elements, are provided in Appendix A. For ease of reading, we include here abbreviated versions of these coding trees. The following tables present the main categories and their associated codes, along with an additional column indicating the frequency of each code. By systematically comparing these codes across sources, similarities and differences emerge, allowing for the refinement of categories and the merging of overlapping codes. Through iterative comparisons and progressive abstraction, higher-level themes and theoretical patterns begin to emerge, grounding the analysis in the data itself.

The goals and aims extracted from the literature are summarized in Table 1, which distinguishes two primary categories: (1) the stated goals of the reviewed papers, and (2) the aims of the strategies used within those studies.

In the first category, the most frequently observed objective — appearing in approximately 48% of papers — was to present, describe, or suggest engagement strategies, often without empirically testing them. Other common goals included examining the effects of specific engagement methods, exploring public opinions, attitudes, values, or needs (particularly in relation to local issues), and conducting reviews to synthesize or map existing engagement practices.

Table 1
Abbreviated table for categories 1 and 2: Research goals and engagement purposes.

Category	Code	Frequency
Goal paper	Present/describe/suggest a strategy	51
	Gather opinions/attitudes/beliefs/values/needs on a problem	19
	Determine an effect	15
	Get overviews of existing strategies or insights	7
Aim of the strategy	Co-creation and interaction	40
	Activation	23
	Needs assessment, gathering opinions	11
	Revealed behavior as a measure for effectivity	8
	Reducing energy consumption	8
	Legitimacy	6
	Diversity	3
	Assessing novel solutions	3
	Increase wellbeing or health or quality of life and develop skills	1
	Looking at barriers and opportunities	1

In the second category, the stated aims of strategies varied widely. A substantial portion focused on fostering co-creation and interaction, emphasizing collaborative processes between citizens and stakeholders. Other frequently observed aims included promoting behavioral change (e.g., reducing energy consumption), enhancing wellbeing or quality of life, and supporting skill development. Several strategies were framed as instruments for activation or needs assessment, often with the intent of informing policy decisions. Additional aims included promoting diversity in participation, generating novel solutions, critically evaluating alternatives, and identifying barriers and opportunities for implementation. A subset of studies also sought to enhance legitimacy, suggesting that engagement was sometimes intended to strengthen the perceived fairness or democratic quality of decision-making processes.

Tables 2 and 3 present two further analytical categories: (1) the theoretical frameworks underpinning engagement strategies and (2) the causal mechanisms hypothesized to link these strategies to intended outcomes. A diverse set of theoretical frameworks was employed across the literature. While some studies referenced broad and unspecific behavioral theories, others drew on more specific models such as social representation theory [22], which explains how shared beliefs and meanings are socially constructed and maintained within groups, shaping public understanding and responses to complex issues. Motivational theories were also cited, exploring the internal and external drivers—such as goals, needs, or incentives—that influence individuals' choices and behaviors.

Operant conditioning [23,24] frames behavior as a response to consequences, suggesting that reinforcement increases the likelihood of repeated behavior, while punishment discourages it. The energy cultures framework was used to examine how everyday practices, social norms, and material settings interact to shape energy use habits.

Additional references included Citizen Science, which engages the public in the research process to democratize knowledge production and foster active participation. Smart Cities were referenced as urban ecosystems leveraging digital technologies and data to improve services, sustainability, and civic engagement. Gamification [25] was used as a strategy to enhance user motivation and engagement by incorporating game-like elements such as rewards, points, or challenges in non-game contexts.

Administrative tools such as memorandums of understanding (MoUs) served as formal agreements that outlined collaborative roles and intentions without legal enforcement. Foundational models such as Arnstein's [12] ladder of participation, which ranks the degree of citizen involvement in decision-making from tokenism to full empowerment, and the virtuous cycle framework, which describes how positive feedback loops reinforce desirable social or behavioral outcomes, were also cited. These frameworks played varied roles—some justified the chosen methods, while others provided conceptual grounding for expected behavioral or social impacts.

The analysis of causal mechanisms, as presented in Table 3, revealed considerable variation in the clarity and specificity with which they were described. In several papers, causal mechanisms were either not mentioned or only implicitly assumed. Where mechanisms were articulated, they often referred to reducing social friction, increasing trust, or fostering wellbeing. Other frequently cited mechanisms included the application of design principles, behavioral stimuli, or efforts to enhance acceptance, knowledge,

Table 2
Abbreviated table for category 3: Theoretical frameworks.

Analytical Category	Mentioned theory	Frequency
Theoretical framework	General description of theory on which the strategy is based	42
	Gamification	7
	Behavioral theories	3
	Social representation theory	1
	Motivational theories	1
	Citizen Science	1
	Energy cultures framework	1
	Arnstein	1
	Operant conditioning theory	1
	Virtuous cycle framework	1
	Memorandums of Understanding	1
	Smart Cities	1

Table 3
Abbreviated table for category 4: Causal mechanisms.

Analytical Category	Mentioned mechanism	Frequency
Causal mechanism	Not mentioned (or not explicit)	34
	Behavioral stimulus	7
	Social mechanisms	6
	Reducing social friction	2
	Design principles	2
	Increase of "wellbeing"	2
	Overcoming barriers	1
	Trust in the process	1
	Through increased knowledge	1
	Tangibility	1

Table 4
Abbreviated table for methods coding with subtotals.

Research type	Method	Frequency
Untested		13
Mixed methods		22 (subtotal)
	Case study and descriptive statistics	10
	Case study and associative statistics	5
	Interviews/focus groups and descriptive statistics	3
	Many methods	3
	Questionnaires (pre and post) and focus groups	1
Qualitative		32 (subtotal)
	Literature and case studies	6
	Focus groups/workshops and interviews	5
	Focus groups/workshops	5
	Document analysis and interviews	4
	Interviews	3
	Document analysis	3
	Interviews and observations	2
	Observations	2
	Ethnographic	1
	Surveys and focus groups	1
Quantitative		16 (subtotal)
	Associative	5
	Descriptives	4
	Pre-post test	2
	Customer surveys	2
	Inferential	1
	Simulation model	1
	ANOVA	1

or tangibility (i.e., making abstract concepts more concrete and accessible). Mechanisms aimed at overcoming barriers or engaging social processes were also noted. While some studies provided well-defined pathways linking engagement strategies to outcomes, many remained exploratory, with underdeveloped or implicit causal assumptions. This variation reflects different levels of theoretical maturity and methodological rigor across the body of literature.

Finally, Table 4 provides an overview of the research methods used in the analyzed studies. Four main categories were identified: untested, mixed methods, qualitative, and quantitative. The "untested" category includes papers that propose engagement tools or strategies without evaluating them empirically.

A large share of studies relied on qualitative methods, including interviews, observations, focus groups, document analyses, ethnographic approaches, and case studies. These methods were often used in combination, reflecting a tendency toward in-depth, context-sensitive exploration of engagement processes.

Mixed methods studies—those combining both qualitative and quantitative approaches—frequently pair pre- and post-questionnaires with focus groups or combine case studies with descriptive or associative statistical analysis. These designs aim to triangulate insights and provide a more comprehensive evaluation of engagement tools.

Only a small portion of the papers employed quantitative methods, and within this subset, many relied on basic statistical tools such as descriptive statistics, customer surveys, or associative analysis. More robust quantitative techniques—such as inferential statistics, ANOVA, simulation modeling, and pre-post testing—were used in only a limited number of cases. This suggests that while quantitative evaluation is present in the field, rigorous causal analysis remains relatively rare.

4. Discussion

The previous chapter outlined the results of our review by presenting the range of citizen engagement strategies identified in the literature. In this chapter, we move from description to interpretation. We synthesize the findings, highlight recurring themes and

shortcomings, and discuss their implications for the field. This discussion proceeds in two steps. First, Section 4.1 identifies critical themes that emerge from the literature. Then, in Section 4.2, we build on these insights to propose a framework that can guide future research and practice.

4.1. Critical themes in the literature

The literature reveals a strong emphasis on the development and conceptualization of citizen engagement strategies, yet the methods used to evaluate these strategies often fall short of providing robust evidence of their effectiveness. This gap suggests a predominantly theoretical orientation within the field, with limited attention given to empirical testing or practical implementation. While some studies effectively employed participatory approaches to gather opinions and inform policy decisions, others treated engagement more as a procedural requirement—aligning with critiques of instrumental participation that highlight the risk of engagement being used to legitimize predetermined outcomes rather than to facilitate meaningful citizen input [13,14].

Co-creation emerged frequently as both an aim and a method across the reviewed literature. However, when portrayed as an end in itself rather than a means to improve outcomes or processes, it risks becoming tokenistic. Literature warns against such instrumental framings, emphasizing that co-creation should be employed to enhance the relevance, inclusivity, and impact of policy interventions [2]. Similarly, the concept of "activation" was inconsistently defined—sometimes as a prerequisite for participation, and at other times as a goal. This ambiguity complicates replication and scaling of strategies across different contexts. As Arnstein's [12] ladder of participation underscores, activation is a foundational step in citizen engagement. Yet many studies focused primarily on later stages of engagement, neglecting populations not yet inclined or enabled to participate. This oversight risks selection bias and narrows the potential inclusivity of engagement initiatives [1,26].

Theoretical frameworks in the literature varied widely in depth and application. Some studies, such as [22], made explicit use of social representation theory to connect engagement strategies with elements of tangibility—linking new concepts to culturally familiar narratives to foster acceptance and collective identity. Other frameworks, including operant conditioning and gamification, reflect a behavioral stimulus model aimed at incentivizing participation. While such approaches are intuitively appealing, their long-term effectiveness and inclusivity remain underexplored. Evidence suggests they may disproportionately attract already-engaged individuals, exacerbating existing participation gaps rather than closing them [25,27].

A rare but notable example of a clearly defined causal mechanism is provided by [28], who addressed the problem of intangibility in sustainability discourse by linking it directly to a participatory intervention. The strategy aimed to translate abstract concepts into relatable, concrete experiences, thereby enhancing policy comprehension and public acceptance. This represents the type of theoretically grounded and empirically testable logic that is largely absent from the broader literature.

Indeed, across the reviewed studies, a recurring but often unexamined assumption is that engagement inherently leads to better policy outcomes. Yet few studies specify the mechanisms by which engagement contributes to success, nor do they isolate which aspects of the strategy drive these outcomes. This leaves many contributions exploratory in nature and lacking in practical guidance. The work of [29], which found no clear link between engagement and outcome desirability, highlights the need for greater critical scrutiny. Without well-defined causal assumptions and empirical validation, engagement strategies risk being perceived as symbolic or ineffective.

While policy initiatives like the European Green Deal emphasize citizen engagement [30], participatory approaches are often invoked as a normative good rather than critically justified. Engagement is often used instrumentally—to fulfill legal requirements or to signal responsiveness and legitimacy—rather than because it is clearly the most effective or appropriate strategy for a given context. It is commonly assumed that engagement builds trust, support, or democratic legitimacy, yet these claims are rarely tested empirically or examined systematically.

This lack of clarity has significant implications. When participation is pursued without a well-defined rationale, it risks becoming a symbolic or procedural exercise, rather than a meaningful component of policy design. As [31] notes, such instrumental or performative engagement can hinder the actual effectiveness of participatory processes, and may even contribute to engagement fatigue among citizens. Without a clearer understanding of when, why, and how engagement adds value—especially in comparison to alternatives like behavioral interventions—we risk undermining both the legitimacy and impact of participatory approaches.

Moreover, when engagement mechanisms are discussed, they are often treated in a fragmented or anecdotal manner. Barriers to participation are frequently mentioned, but are rarely integrated into a coherent theoretical framework. The recent work of [32] moves in this direction, offering a typology that recognizes the heterogeneity of citizens and the importance of tailoring engagement strategies accordingly. This points to the need for embedding engagement mechanisms more systematically in the literature.

A critical shortcoming in the field is the widespread absence of clearly defined causal mechanisms. Approximately two-thirds of the reviewed papers lacked an articulated theory of change linking engagement to specific outcomes. Even when theoretical models were cited, they often failed to specify how, why, or under what conditions the strategy was expected to succeed. This limits both the scientific credibility and the transferability of engagement tools.

Methodologically, the dominance of qualitative and descriptive approaches reveals a field focused largely on exploration and theory-building. While qualitative research is invaluable for understanding context, motivations, and emergent patterns, it is inherently limited in its ability to test causal hypotheses or produce generalizable findings [18]. The limited use of inferential statistical methods further compounds this issue. Even among the subset of quantitative and mixed-methods studies, most rely on descriptive or associative analyses, which can indicate patterns but cannot establish causality.

This underuse of causal inference techniques—such as regression modeling, quasi-experiments, or randomized controlled trials (RCTs)—represents a critical gap. As noted by [33,34], these methods are essential for testing whether observed outcomes can be

attributed to the engagement strategy itself, rather than to external factors or confounding variables. Practical and ethical constraints may partially explain the rarity of such methods in participatory research, but the lack of empirical rigor limits the credibility and scalability of many strategies.

Finally, the finding that many engagement tools remain untested underscores the need for more robust evaluation. Too often, new tools are introduced or described without follow-up assessment, which undermines both the evidence base and policymakers' ability to identify effective approaches. A more balanced integration of theoretical development, qualitative insight, and quantitative validation is urgently needed. Advancing the field will depend on articulating clear, testable mechanisms and validating them across diverse contexts using rigorous empirical methods.

4.2. Framework

In this section we present our new analytical framework, which is based on our synthesis after engaging with the literature and the lessons and pitfalls we identified in the literature. The framework is intended as a practical guide for both the design of new engagement strategies and the evaluation of existing ones. It consists of seven functional requirements, each reflecting a key condition for effective and efficient engagement.

1. The strategy should have clear and explicit goals.
2. The strategy should be based on a defined problem, and a stated desired outcome.
3. The strategy should be embedded in engagement theory.
4. The strategy should include a presumed causal mechanism.
5. The strategy should be explicitly aimed at a target audience.
6. The strategy should be empirically tested and validated.
7. The strategy should be contextually evaluated.

We further include an explanation of how the elements should be interpreted, and a brief explanation of what happens when the elements are neglected in Table 5.

While these requirements may resemble general principles of sound strategy design, they are particularly crucial in the context of citizen engagement. Unlike other forms of intervention, engagement strategies directly affect inclusivity, legitimacy, and citizens' willingness to participate. If goals are unclear or mechanisms unspecified, engagement risks becoming symbolic or tokenistic. If target groups and heterogeneity are ignored, strategies may inadvertently exclude certain populations or privilege already active minorities,

Table 5
Functional requirements, a new analytical framework.

Functional Requirement	How?	Why?	Example from literature
The strategy should have clear and explicit goals	Explain what we want to achieve and why we want to achieve it?	This gives the strategy a substantive purpose, instead of an instrumental or legal purpose	Participation is necessary to determine if opinions can be changed, and to determine if policy preferences are consistent [35]
The strategy should be based on a defined problem, and a stated desired outcome	Describe the difference between the current situation and the desired situation?	Only by determining a problem, we can attempt to solve it	Energy consumption is too high, therefore we impose price incentives, and see willingness to participate [36]
The strategy should be embedded in engagement theory	Explain why we want to engage people	Engagement is often used as a buzzword, whereas sometimes it can be desirable to nudge or boost instead	Social representation as a way of engaging citizens is essential to build perceived agency, needed for the energy transition [22]
The strategy should include a presumed causal mechanism	Describe how the strategy will lead from the current situation towards the goal	By outlining the causal mechanism, we understand if, when, how and why a certain strategy will work or not	Providing timely feedback to building occupants on energy use through Dynamic incentives will encourage more active participation in energy-saving behaviors [37]
The strategy should be explicitly aimed at a target audience	Determine what type of people you want to address, through the lens of individual heterogeneity	Individual heterogeneity means that certain strategies may only be applicable to certain types of people	6 segments that indicate different policy preferences [38]
The strategy should be empirically tested and validated	For claims of effectiveness, causally inferred empirical evidence needs to be presented	Only with casually inferred evidence can we prove effectiveness, and examine efficiency of a strategy	Structural model and a binary logistic regression to validate individual hypotheses [39]
The strategy should be contextually evaluated	Explain the limits of the strategy. Discuss to what extent it works for the heterogeneous population, and to what extent effects are conditional on other factors	This conditionality places the strategy in context, giving it a real world practicality. And providing external validity, by exploring constraints within which a certain mechanism works.	Describe the external factors that led to a dysfunctional implementation [40]

reinforcing inequalities. Finally, without careful consideration of objectives and outcomes, repeated or poorly designed initiatives can lead to participation fatigue. Asking "why engagement?" is therefore essential: engagement should be chosen not by default, but because it is the most appropriate method for achieving clearly defined aims in a given context.

From our analysis, a clear trend has emerged indicating that in research on engagement and participation strategies, currently relatively few tests on their effectiveness are conducted. Mechanisms are not delineated or validated, resulting in a lack of understanding about what works and what does not. Readers do not know under which conditions certain mechanisms or strategies are effective or on which groups these mechanisms have an impact. Behavioral literature often discusses individual heterogeneity and the necessity of targeting [41]. However, this is feasible only if researchers thoroughly understand how a mechanism operates. Hence, it is crucial to conduct more empirical testing, particularly in a quantitative manner, to facilitate the measurement of the effects of engagement and participation strategies. Researchers need to consider specific goals, target groups, mechanisms, and desired outcomes. The current paradigm within engagement literature is descriptive and instrumental, but there is a need to shift toward a focus on achieving the desired outcomes. Why do researchers and practitioners engage? What is the objective of the strategy? What exactly do we aim to influence? And whom are we targeting? Currently, there is a structural lack of attention to these matters, which often leaves us unaware of how a particular strategy works and why it does or does not work. The lack of these insights can make an engagement strategy ineffective and face inefficient.

Future engagement strategies should consider target groups, objectives, and mechanisms. It should be expected that authors and policymakers explicitly state the specific goal they are attempting to achieve and the rationale behind their engagement efforts. Furthermore, the presumed causal mechanism must be concretely reported; in other words, what is the theoretical basis for the strategy leading to the aforementioned desired outcome? Subsequently, a target group should be delineated to acknowledge individual heterogeneity. Strategies can also be tested on a broader population, but attention must be given to differences in effectiveness among various groups of people.

This framework is particularly valuable during the planning and design phase of engagement strategies. It helps ensure that key elements—such as strategic intent, target audience alignment, and the appropriate choice of instruments—are considered before implementation. By providing a conceptual foundation, the framework enables a more deliberate, transparent, and theoretically informed design process.

However, it is important to note that the framework does not address the implementation phase. It does not capture practical issues that may arise during execution, such as resource constraints, shifting stakeholder dynamics, or the adaptability of tools in real-world settings. Future research should therefore explore how strategies designed using these requirements perform in practice and how implementation-related factors may require further refinement of the framework.

5. Conclusion

This research aimed to develop a conceptual framework to assist future scientists and policymakers in designing and evaluating engagement strategies. By reviewing 77 papers on engagement strategies, we synthesized insights from diverse sources to inform our framework.

5.1. Key findings

Our findings highlight both common trends and gaps in the existing literature. A major trend is the widespread use of engagement strategies without critical reflection on their theoretical foundations or intended outcomes. Engagement is frequently treated as an end in itself rather than as a means to achieve a specific goal. This can lead to inefficient or misguided efforts, where engagement is pursued for its own sake rather than being strategically employed to address a specific challenge. When engagement lacks clear objectives, it becomes difficult to assess its impact and effectiveness.

Additionally, our review identified a common neglect of causal inference—many strategies, mechanisms, and tools are proposed but rarely tested or verified. This lack of empirical validation weakens the effectiveness of engagement efforts and increases the risk of implementing strategies that do not yield meaningful results. Without clear evidence of cause-and-effect relationships, engagement initiatives may rely on assumptions rather than data-driven insights, leading to wasted resources and missed opportunities for meaningful impact.

A third notable trend is the structural lack of well-defined target audiences. In some cases, articles mentioned broad demographic categories, such as age groups, as target audiences. However, these broad classifications do not provide meaningful insights into cognitive processes, decision-making patterns, or behavioral responses. More critically, in the vast majority of cases, the target audience was not discussed at all. Without a clearly defined audience, engagement strategies risk being too generic, reducing their effectiveness and limiting their ability to generate actionable insights.

To address these issues, we propose a new set of functional requirements that will aid researchers and practitioners in developing and assessing engagement strategies in the energy transition. A well-designed strategy should have clear and explicit goals, be based on a defined problem and a stated desired outcome, be embedded in engagement theory, include a presumed causal mechanism, be explicitly aimed at a target audience, be empirically tested and validated, and be contextually evaluated. These requirements directly respond to the trends we identified, ensuring that engagement strategies are more structured, evidence-based, and purpose-driven.

5.2. Policy implications

The framework proposed in this paper offers a structured approach for designing engagement strategies, reducing the uncertainty practitioners face. By adhering to our seven functional requirements, practitioners can systematically develop more effective strategies that avoid common pitfalls such as failing to define a target audience, lacking a causal mechanism, or overlooking empirical validation.

To make these recommendations more actionable, we suggest four key policy directions:

First, engagement strategies should be tailored for different target groups. Rather than relying on broad demographic classifications, strategies should be informed by behavioral segmentation, allowing for more precise and effective engagement approaches.

Second, empirical validation should be prioritized through pilot programs. Before large-scale implementation, engagement strategies should be tested in controlled environments to assess their effectiveness. This allows for the refinement of strategies before broader deployment.

Third, engagement strategies should integrate behavioral insights and causal mechanisms. Policies should be rooted in behavioral science and explicitly incorporate tested interventions such as social norms, default settings, or financial incentives to drive meaningful engagement.

Finally, engagement initiatives should include measurable impact assessments. Clear metrics for success should be established. These could be measurable success definitions for research purposes, or even systematically tracking behavioral changes among participants. This will provide empirical evidence of the effectiveness of engagement strategies and ensure continuous improvement.

Our framework enables policymakers to integrate these key elements into strategy design, ensuring that engagement efforts are both meaningful and impactful (see Table 5). While researchers explore innovative engagement components, policymakers can apply these insights in practice, fostering more effective citizen engagement in the energy transition.

5.3. Limitations

Despite the systematic and transparent methodology applied in this study, several limitations remain. First, we observed a strong lack of consensus in the literature regarding key terminology. Terms such as engagement and participation are often used interchangeably, despite having distinct meanings in some theoretical frameworks. Similarly, the distinction between strategy and tool is frequently blurred, with some studies referring to specific instruments as strategies, while others apply broader conceptual definitions. This inconsistency complicated direct comparisons across studies and often required us to interpret the authors' intent based on context.

As a result, the coding and synthesis of findings inevitably involved a degree of interpretive judgment. While we applied constant comparison coding, cross-checked results, and used analyst triangulation to enhance consistency and transparency, the framework we developed is still rooted in our interpretation of the literature. This introduces an inherent interpretive bias. Further empirical testing and application of the framework in different contexts are needed to validate its robustness and generalizability.

Second, as with any literature review, our findings depend on the quality and transparency of the primary studies. In cases where reporting was limited or inconsistent, it may have constrained the depth of our analysis.

Lastly, a limitation is that the framework focuses specifically on the planning and design phase of engagement strategies. It supports the development of structured, well-aligned strategies prior to implementation, but does not account for the challenges that may arise during execution—such as resource constraints, shifting stakeholder dynamics, or tool adaptability. As a result, the framework should be seen as a conceptual guide for strategy development rather than for practical implementation. This distinction limits its applicability in real-world settings and highlights the need for future research to examine how such strategies perform once operationalized. Future research is required to develop a framework for the implementation phase.

CRediT authorship contribution statement

K. Goes: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **B. de Jong:** Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **L.F. Schlindwein:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **M. Klösters:** Writing – original draft, Methodology, Investigation, Conceptualization. **J. Kraaijeveld:** Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **S.J. Kluiving:** Writing – review & editing, Supervision, Conceptualization. **E.J.L. Chappin:** Writing – review & editing, Supervision, Formal analysis, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Reading table

See Table A.1.

Table A.1
Reading Table.

Question	Explanation
General information	
Paper used	Authors and year
If you use multiple columns for this paper, number the columns here	Some overview or review papers might contain multiple tools or interventions or strategies, and you might need multiple columns in the table for one paper. If so, then number the columns in this row (1,2,3 etc).
Link to paper	Paste here the link to the paper
Read by	Put your name here
Date	Date on which you have filled in this table
Is the paper relevant for our overview (yes/no/not sure)?	Answer yes, no, or when in doubt you can say not sure. The paper is relevant if it describes a concrete strategy/tool/intervention that is focused on or uses engagement
Why not, or why not sure?	Short explanationation of why the paper is not relevant, or why you are in doubt
Topic	Also called a field, sector or domain. Fill in a code here: 1 = energy, 2 - thermal (transition), 3 = flooding, 4 = forestry, 5 = urban planning, 6 = other sustainable topics, 7 = health, 8 = safety, 9 = nuclear power, 10 = miscellaneous
Article type	Please indicate here if it concerns a specific type of paper: conference paper or review
Introduction	
Is the goal of the research paper described? (yes/no)	Answer yes or no.
What is the goal of the research paper (research question)?	Only answer this question if the authors have explicitly described a goal, and/or a research question. Don't interpret this yourself.
Are there hypotheses? (yes/no)	Answer yes or no.
What are the hypotheses?	Put the hypotheses from the paper over here
Is there a general target group specified for the tool/strategy? (yes/no)	Does the paper mention a general target group for whom the tool or strategy is designed or suitable? Note: this can differ from the participants that took part in the study. (For example: the target group is school children, but the participants were a specific group of students from a specific group).
What (general) target group is specified?	What is the general target group that the authors say the tool or strategy is suitable for or is designed for?
Is the target group localized? (yes/no)	Answer yes or no. Is the target group a local community for example (then yes). Or is it a scalable persona (then no)
Tool/strategy	
What tool/intervention/strategy related to engagement is examined or described in the paper?	Put here the name of the strategy or tool that is discussed in the paper, or, if there is no name, a one sentence description
Short description of the tool/strategy	Shortly describe what the tool looked like, and how it was implemented (or is supposed to be implemented)
What is the aim of the tool/strategy?	Describe the aim or goal of the tool/strategy as it is described in the paper
Is the theoretical framework/causal mechanism described? (yes/no)	Do the authors describe a causal mechanism? Do they explain why/how they think the tool should work?
Please explain your answer/comment on this	Please explain your answer. What is missing here? (For example, do the authors only describe the relevance of the research and then propose a solution, but the steps in between are missing?)
Method	
Was the engagement strategy or tool tested in this article? (yes/no)	Answer yes or no.
Does the study have a qualitative, quantitative, or mixed methods approach?	Answer qualitative, quantitative, or mixed
Which analysis method is used? (please choose a category)	Note: This question only applies for quantitative research. Categories: Descriptive statistics (simply describes the results, no analyses), Associating statistics (looks at associations, correlations, or for example anova's to check for differences between groups), Inferential statistics (measurement of effects, for example quasi-experimental or RCT)
What was the number of participants? (N)	Put here the number of participants
Which participants/target group participated?	Which target group/participants were included in the study? Note that this may also be a specific subset of the aforementioned target group
What methods are used in this study?	For example surveys, experiments, case studies etc
What are the dependent and independent variables (if applicable)	Put here the dependent and independent variables that are mentioned in the paper, if applicable
Were participitory needs of the citizens determined? (yes/no)	Answer yes or no (for an explanation on participatory needs see next question)
How were participatory needs determined?	Participatory needs are the needs of the citizens regarding participation. What do they want to get out of the participation? For example, do they just want to be informed, or do they want to gain control or competence? Is this mentioned in the paper?
What were the participitory needs?	Question speaks for itself.
Are there barriers for participation? (yes/no)	Answer yes/no
What are barriers for participation?	Write here the barriers that are described by the authors, if applicable
Is there a follow-up planned after engagement? (e.g., reflection or evaluation)	Answer yes/no. After the citizens have participated, is there also a follow up? For example a reflection on or an evaluation of the participation? This is often missing in strategies.

(*continued on next page*)

Table A.1 (*continued*)

Question	Explanation
Results/Main findings	
What are the results of the paper? (If applicable, describe if hypotheses were confirmed or rejected)	Describe in one or a few sentences what the main findings of the study were. If there were hypotheses, then briefly mention if they were confirmed or rejected.
Is the effect of the strategy/tool on engagement measured? (yes/no)	Answer yes or no. We are looking at studies that use an engagement tool or strategy to increase engagement (or a study in which engagement is used to solve a certain problem, or part of it). But do the researchers also measure (or describe) if their tool or strategy actually increased participation?
What is the effect of the strategy/tool on engagement?	If yes, what was the effect of the tool or strategy on engagement?
Conclusion/Discussion	
What is the threshold of success of the engagement tool or strategy?	When do the authors see the tool or strategy as successful?
Was the strategy or tool effective/succesful? (yes/no)	Answer yes or no. Succesful can mean that the goals set by the authors were achieved, but can also be indicated by a statistically significant effect for example
Describe why the strategy/tool was effective/succcesful	For example, were the goals set by the authors achieved, and how?
Generalization or potential for upscaling?	Do the authors mention generalization or potential for upschaling? What do they say about it?
Limitations of the study, mentioned by the authors	Do they authors mention limitations of the **study** (Note: this is different from limitations of the tool or strategy itself)? What are they?
Limitations of the tool or strategy, mentioned by the authors	Do the authors mention limitations specific to the tool or strategy? What are they?
Additional limitations, not mentioned by the authors (own interpretation)	Do you see any limitations yourself that were not mentioned by the authors? Then you can put those over here.
Additional relevant information	
Are underlying assumptions described? (yes/no)	Answer yes or no.
What underlying assumptions are described?	Do the authors explicitly mention assumptions, requirements or pre-requisites regarding the use of their tool? So for example: the existence of strong social cohesion, the willingness to change, the capacity to change
What underlying assumptions do we miss in the paper?	Do you see any assumptions that have not been explicitly mentioned by the authors? So for example: the existence of strong social cohesion, the willingness to change, the capacity to change
At what step(s) of Arnstein's ladder does the study fit (roughly)?	See additional document with explanation of ladder of Arnstein
Please explain your answer	Please explain why you have chosen this step of the ladder. If you would like to select a range of steps, then please also mention this here, and at the previous question, only state the lowest level.
Additional comments	Do you have any important additional comments that do not fit under the other questions, then you can write them here.
Potential snowballing references	Do you see references to potential other important research? Then put them here (but don't spend too much time on this). Or do the authors mention that they want to do follow up research on this same topic? Then you can note this here, so that we can search for their follow up work later on (or check if it is already included in our search list).
Adaptations needed before we can use/test it ourselves?	Please fill in a code here, 1 = no adaptations needed, 2 = few adaptations needed, 3 = needs quite a few adjustments, 4 = needs a lot of adjustments
Please explain your answer	Please explain what kind of adaptations you think would be needed for us to be able to use this intervention in the A4E project

Appendix B. Constant comparison table

See Table B.1.

Table B.1
Constant comparison coding.

Categories	Code	Subcode	References
Goal paper	Present/describe/suggest a strategy	Description of new tool or application	[28,40,42–61]
		Evaluation of a tool(s) for a certain goal (or explore potential use)	[35,62–77]
		Describing the role of a tool	[22,78–83]
		Integrating participation	[56,84–87]
	Determine an effect	Engagement as an instrument for behavior change	[36,37,63,88–91]
		Determine an effect on engagement	[39]
		Compare a tool or strategy in different localized target groups	[92]
		Determine factors that influenced participation in a tool or strategy	[39,79,85,93–95]
	Gather opinions/attitudes/beliefs/values/needs on a (local) problem	Determine attitudes	[40,92,96–102]
		Change of preferences	[35,92]
		Shape opinions	[83]
	Get overviews of existing strategies or insights		[103–109]

(*continued on next page*)

Table B.1 (*continued*)

Categories	Code	Subcode	References
Aim of the strategy	Co-creation and interaction		[28,35,40,42,51,61,62,65,69,70, 78–80,84,87,93,94,100,104,107, 109]
		Interaction between stakeholders	[45,57,67,68,70,74,96,107,109]
		Provide information/teach	[47,49,52,53,71,73,76,90]
		Citizen science	[39,45]
	Revealed behavior as a measure for effectivity		[36,37,43,50,54,89,99,110]
	Reducing energy consumption		[54,55,63,77,85,88,91,95]
	Activation	Promote sustainable living	[56,64]
		Reach new groups	[42,57,105]
		Create awareness	[46,47,52,66,68,75,78,86,89,90]
		Unspecified	[81]
		Increase energy citizenship	[22,108]
		Help/make it easier for citizens to influence decisions	[44,48,52,103,104]
	Needs assessment, gathering opinions	Assessment and elicitation	[35,58,60,68,92,96,98,101,102, 107]
		Changing perceptions	[83]
	Increase wellbeing or health or quality of life and develop skills		[97]
	Diversity	Energy Literacy	[48]
		Make information accessible to everyone	[107]
		Energy poverty	[105]
	Assessing different solutions		[81,107]
		Develop criteria	[72]
	Looking at barriers and opportunities		[57]
	Legitimacy	To increase acceptance (of RES or other power project)	[28,40,71,82]
		Build trust in a process	[83,94]
Theoretical framework	Authors provide a description of theory on which the engagement method is based		[28,35,37,39,40,42,46–48,51–53, 57,60,61,64,69–75,79,80,82,84– 88,90–94,97,98,101,102,104,107]
	Behavioral theories		[43,50,77]
	Social representation theory		[22]
	Motivational theories		[81]
	Citizen Science		[45]
	Energy cultures framework		[95]
	Arnstein		[55]
	Operant conditioning theory		[110]
	Virtuous cycle framework		[96]
	Gamification		[28,58,59,86,88,107,110]
	Memorandums of Understanding		[83]
	Smart Cities		[86]
Causal mechanism	Reducing social friction		[62,107]
	Not mentioned (or not explicit)		[35,39,42,44,48,49,52–55,60,61, 64–70,75,76,87,89,90,93–95,98, 99,101,102,105,108,111]
	Design principles		[74,79]
	Overcoming barriers		[57]
	Behavioral stimulus	Building certificates/public displays	[63]
		Behavior change	[43,77,91,110]
		Self determination	[81]
		Energy intervention framework	[50]
	Social mechanisms	Social contracts	[103]
		Through (commonly shared) values	[83,92,100]
		Through informality	[46,107]
	Increase of “wellbeing”		[80,97]
	Trust in the process		[83]
	Through increase of acceptance		[45,78,82,104,106]
	Through increased knowledge		[92]
	Tangibility		[28]
Target Audience	Specific consumer group		[43]
	Employees		[55]
	People/communities affected		[57]
	Age groups		[59,60,76,79,86]
	Difficult to reach groups		[42,57,105]

(*continued on next page*)

Table B.1 (*continued*)

Categories	Code	Subcode	References
Methods	Untested		[48,52–54,56,66,69,72,77,86,99, 102,110]
	Mixed methods	Questionnaires (pre and post) and focus groups	[42]
		Many methods	[91,92,105]
		Case study and associative statistics	[71,84,93,96,98]
		Case study and descriptive statistics	[28,67,68,75,76,80,90,91,100, 105]
		Interviews/focus groups and descriptive statistics	[61,74,83]
	Qualitative	document analysis	[45,65,108]
		document analysis and interviews	[62,82,95,104]
		Literature and case studies	[22,44,56,78,87,103]
		Ethnographic	[64]
		Focus groups/workshops and interviews	[43,55,57,78,81]
		Surveys and focus groups	[96]
		Focus groups/workshops	[43,51,60,79,94]
		Interviews	[40,97,106]
		Interviews and observations	[46,102]
		Observations	[59,70]
	Quantitative	Pre-post test	[37,89]
		Inferential	[39]
		Simulation model	[36]
		Customer surveys	[50,63]
		ANOVA	[88]
		Associative	[35,58,73,101,107]
		Descriptives	[47,56,63,85]

Data availability

Data will be made available on request. For requesting data, please write to the corresponding author.

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