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Accelerating sustainable technology adoption through public policy: Communication strategies, public perception, and development outcomes

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Abstract

The adoption of sustainable technology is contingent not only on the technical availability, but also on factors such as policy design, institutional capacity, public trust and communication. This PRISMA-guided critical scoping review synthesizes a range of materials, including peer-reviewed studies, official reports, policy documents and selected discourse material on sustainable technology adoption in development contexts. Sustainable technology is regarded as a distinct socio-technical category covering green, clean and digital technologies solely when they contribute to environmental, social or institutional sustainability. The review identifies policy design dimensions, communication mechanisms and contextual factors that shape adoption. Findings show that effective adoption requires coherent policy mixes, enabling infrastructure, capability-building, safeguards, participatory communication and misinformation management. The present study proposes an integrated policy communication framework for sustainable technology adoption and highlights the need to design adoption for legitimacy, equity and long-term public value.

Keywords: Public policy design; sustainable technology adoption; sustainability communication; PRISMA-guided review; public trust

1. Introduction

Technology adoption has emerged as a central test of public policy as governments increasingly rely on digital public services, clean energy systems, artificial intelligence, electric mobility, smart agriculture, data platforms and urban sustainability tools to achieve development goals. The issue at hand extends beyond the mere conception, acquisition or deployment of technology. The deeper challenge is to make technology usable, legitimate, affordable, safe and meaningful for citizens, firms, communities and public institutions. In the context of sustainability and development, this challenge is urgent since adoption is uneven across income groups, geographical regions, literacy levels, infrastructure conditions and trust environments [1-3].

The present paper employs the term sustainable technology in a bounded sense. The term "sustainable technology" is defined as a socio-technical system, infrastructure, platform, device or process whose design, deployment or use contributes to environmental protection, resource efficiency, social inclusion, institutional capability or sustainable development outcomes. It is broader than green technology, which mainly emphasizes environmental improvement, and broader than clean technology, which typically refers to emission or pollution reduction. It is important to note that the term digital technologies is only included in the context of sustainability or development functions, such as digital public infrastructure, climate information systems, AI-enabled public services, smart mobility, renewable energy integration or inclusive service delivery [4-9]. The paper therefore does not treat all technology as sustainable technology.

The mainstream policy narrative frequently presents technology as an accelerator of development. Digital public infrastructure has the potential to broaden access to identity, financial transaction. welfare provision, data exchange and public services [4,5]. Clean energy technologies can contribute to decarbonization and energy security through a range of means, including renewable power, grids, electric vehicles, batteries, heat pumps and efficiency systems [6,7]. Digital tools can also support SDG delivery through their applications in a range of sectors, including health, agriculture, climate adaptation, disaster response, education and governance [8,9]. Whilst this optimistic reading is valid, it is incomplete. ITU data demonstrate that billions remain offline, and adoption gaps are shaped by rural exclusion, affordability and capability constraints [1].

A more critical view reveals that adoption initiatives often encounter challenges when policy makers misconstrue technical availability for social acceptance. Diffusion and user acceptance theories demonstrate that adoption depends on a number of factors, including perceived advantage, usefulness, ease of use, compatibility, social influence, facilitating conditions and observability [10-12]. Research in the field of sustainability transitions has demonstrated that technologies are embedded within regimes of infrastructure, regulation, markets, social practice, industrial interests and cultural meaning [13,14]. Consequently, public policy must shape adoption ecosystems, as opposed to the current practice of merely subsidizing products or promoting awareness.

Communication is central to this policy challenge. In this review, public communication refers to non-partisan, public-interest

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communication by governments, public agencies, development institutions and authorized public actors with the aim of informing, listening to, engaging with and responding to citizens during the policy process. The operationalization of this concept is multifaceted, encompassing the provision of information, framing, risk communication, stakeholder engagement, trusted messengers and misinformation response [26-29]. This is of particular concern as sustainability technologies can become politically contested when citizens interpret them through fears of surveillance, loss of autonomy, inequality, coercion or elite control [31-36].

This present paper presents a PRISMA-guided critical scoping review of public policy design for sustainable technology adoption. Its novelty lies in its integration of four streams that are typically studied separately: technology adoption theory, sustainability transitions, policy design and public communication. The review utilizes peer-reviewed research and official policy documents as its primary evidence base, while media, fact-checking and discourse material are employed solely to understand public perception and legitimacy risks.

2. Literature Review

2.1. Sustainable technology adoption as a socio-technical process

Technology adoption research begins with the insight that innovations do not diffuse automatically. Rogers [10] posits that adoption depends on relative advantage, compatibility, complexity, trialability and observability. As demonstrated by Davis [11], perceived usefulness and ease of use shape user acceptance, while Venkatesh et al. [12] integrate social influence and facilitating conditions into a broader acceptance framework. These concepts are directly relevant to public policy because citizens may reject or avoid a technology even when it is officially available.

Sustainability transition studies has the potential to offer a more comprehensive perspective on this view. Geels [13] explains technological transitions through interactions among niches, regimes and landscapes, while Markard et al. [14] describe sustainability transitions as being characterized by long-term, multidimensional changes in socio-technical systems. This indicates that the adoption of sustainable technology is not solely a user decision; it is also influenced by various factors including grids, standards, finance, regulation, public institutions, supply chains, repair ecosystems, cultural significance and political contestation. The development of electric mobility, rooftop solar, AI-enabled public services and digital public infrastructure each require technical systems and social acceptance to develop together.

Previous reviews confirm this fragmentation. Systematic reviews on consumer electric vehicle adoption have identified various barriers, including price, charging infrastructure, range anxiety and consumer perception [15,16]. A review of digital technologies for SDGs and technological innovation in public administration demonstrates that AI, IoT, blockchain, cloud systems and platforms have the capacity to support sustainable public value. However, they also require governance, ethics, institutional capability and accountability [8,9]. A recent review on policy design for sustainability transitions observes that transition scholarship and policy design scholarship remain insufficiently integrated [17]. Whilst these reviews are valuable, they tend to focus on either technology adoption, sectoral sustainability or public-sector innovation. Examinations of policy design and public communication as adoption mechanisms are infrequent.

2.2. Policy design, policy mixes and adoption governance

The term "policy design" refers to the knowledge-based process through which policy goals and policy means are deliberately connected to influence social, institutional and market behaviour [18]. As posited by Howlett et al. [19] contemporary policy design has evolved from the utilization of single tools to toolkits, portfolios and policy combinations. This is important for sustainable technology adoption, given that isolated instruments rarely solve systemic adoption barriers. The provision of subsidies may increase demand; however, adoption may not result in successful adoption if infrastructure, standards, consumer protection, skills and grievance mechanisms are lacking.

In this review, policy design is characterized through eight dimensions: problem framing, instrument design, infrastructure design, capability design, safeguard design, participation design, communication design and evaluation design. This typology draws on scholarship relating to policy design and policy mix, which emphasizes the selection of substantive and procedural tools, instrument combinations, coherence, consistency, credibility and comprehensiveness [20-22]. The concept is further developed through the lens of mission-oriented and transformative innovation policy, wherein the state shapes markets around public goals and guides innovation towards sustainability, inclusion and system transformation [22-24].

The concept of responsible innovation introduces an ethical dimension. Stilgoe et al. [26] argue that anticipation, inclusion, reflexivity and responsiveness are central to the process of responsible innovation. In the context of adoption policy, these principles require governments to interrogate the following questions: who stands to benefits, who may be adversely affected, who participates in design process and how systems can be corrected post-implementation. This is of particular importance for digital public infrastructure, AI systems, biometric identity, smart city technologies and clean energy systems where the adoption of such technologies can create both public value and new forms of exclusion or surveillance risk [4,5,37-39].

Table 1. Conceptual boundary of sustainable technology utilized in the review

Concept	Core meaning	Treatment in this review
Green technology	Technology primarily designed to minimize environmental harm or enhance ecological performance.	Included when associated with adoption, policy design or development outcomes.
Clean technology	Technology that reduces emissions, pollution or resource waste, such as renewables, EVs and efficiency systems.	Included as an important sub-category of sustainable technology.
Digital technology	Platforms, AI, data systems, DPI, IoT, cloud, blockchain and digital public services.	Included only when connected to sustainability, inclusion, public value or development.
Sustainable technology	A broader socio-technical category linking environmental, social, institutional and developmental outcomes.	Main concept of the paper; not synonymous with all technology.

Table 2. Policy design dimensions for sustainable technology adoption

Dimension	Definition	Indicative adoption indicators
Problem framing	How the policy defines the adoption challenge and sustainability objective.	Clarity of problem, target users, sustainability outcome.
Instrument design	Selection and combination of regulatory, financial, organizational and information tools.	Subsidies, mandates, standards, procurement, information tools.
Infrastructure design	Physical and digital systems that make adoption possible.	Grid readiness, charging networks, connectivity, DPI rails.
Capability design	Skills and institutional capacity required for effective utilization	Digital literacy, technical training, frontline support.
Safeguard design	Protections against exclusion, privacy harms, safety risks and abuse.	Data protection, accessibility, grievance redress, auditability.
Participation design	Mechanisms for citizen, user and stakeholder involvement.	Consultation, co-design, feedback, local demonstration.
Communication design	Public-interest communication across the policy cycle.	Framing, risk communication, trusted messengers, pre-bunking.
Evaluation design	Monitoring of uptake quality, equity, trust and unintended consequences.	Adoption quality, complaints, exclusion patterns, trust indicators.

2.3. Public communication, trust and contested meaning

The field of communication scholarship has been instrumental in challenging the assumption that public resistance is only an information deficit. The OECD defines public communication as a government function that delivers information, listens and responds to citizens in the common good, distinct from partisan political communication [26]. Research in the domain of climate and science communication has demonstrated that individuals interpret technology through the lenses of values, identity, emotions, trusted networks and lived experience [27-29]. The theory of framing demonstrates that the manner in which a policy is presented influences citizens' evaluation of responsibility, benefit, risk and legitimacy [30].

In this review, public communication is operationalized through five mechanisms. Firstly, information provision explains what the technology does and how it can be utilized. Secondly, the concept of framing serves to establish a correlation between technology and public value, autonomy, fairness or risk. Thirdly, risk communication explains uncertainty, safeguards and trade-offs. Fourthly, dialogic communication facilitates the processes of listening, consultation and feedback. Fifthly, the misinformation response strategy includes pre-bunking, fact-checking and correction. Research into misinformation has demonstrated that corrections are more effective when they explain why false claims are wrong and provide an alternative causal account [31]. Research into inoculation techniques further suggests citizens should be warned about misleading techniques before exposure to reduce vulnerability to misinformation [32].

The 15-minute city debate illustrates why communication is not merely a promotional function. The concept under discussion is an urban planning approach focused on access to essential services in close proximity to the residential areas. However, some public narratives have presented it as a tool of restriction, surveillance or forced localism. It has been demonstrated that such claims frequently result in the distortion of the planning concept, but the backlash also reveals deeper legitimacy concerns about autonomy, car dependence, post-pandemic distrust and government overreach [34-36]. The communication problem is therefore not only about factual correction; it is also about the design of trust, participation and transparent safeguards.

3. Research Gap

Previous review studies have examined electric vehicle adoption, digital technologies for SDGs, technological innovation in public administration, policy mixes for sustainability transitions, and communication responses to climate misinformation [8,9,15-17,27,31-34]. However, these bodies of work remain separated by discipline and sector. The field of adoption studies frequently prioritize user acceptance and market barriers, while transition studies emphasize socio-technical change. Policy design studies focus on instruments and policy mixes; and communication studies examine framing, trust or misinformation. The existing literature is lacking in the development of an integrated scoping review that defines sustainable technology clearly, maps policy design dimensions, treat public communication as an adoption mechanism and compare academic, policy and discourse sources without mixing verified evidence with unsupported claims. This present paper aims to address that gap by developing a policy communication framework for sustainable technology adoption across clean, green and sustainability-oriented digital technologies.

4. Objectives

Objective 1: To synthesize how policy design dimensions shape the adoption of sustainable technologies in sustainability and development contexts.

Objective 2: To analyze how public communication, trust, misinformation and contextual variation influence the legitimacy and quality of sustainable technology adoption.

5. Materials and Methods

5.1. Review design and search period

The present study employs a PRISMA-guided critical scoping review because the topic is interdisciplinary, conceptually broad and includes both formal evidence and public discourse. The review was conducted in accordance with the PRISMA 2020 and PRISMA-ScR, with adaptations made to align with a critical policy review rather than a statistical meta-analysis [40-43]. The review did not estimate pooled effect sizes. Instead, it mapped concepts, source types, policy instruments, communication mechanisms, sectors, geographical contexts and knowledge gaps. The initial search encompassed the years 2000 to 2026 to include foundational adoption, policy design and transition theory. Sources from 2020 to 2026 were prioritized for current evidence on digital public infrastructure, clean energy investment, AI, misinformation and public-sector digital transformation. The updated revision search was conducted between 13 June 2026 and 17 June 2026.

5.2. Search strategy, source types and eligibility

A comprehensive search strategy was conducted across scholarly databases and publisher platforms including Google Scholar-facing records, ScienceDirect, Taylor & Francis, PubMed and MDPI. A comprehensive search was conducted of policy and official sources in the OECD iLibrary, UN, UNDP, World Bank, IEA, ITU, IRENA and

G20 repositories. Credible media and fact-checking sources, including Reuters and Associated Press, were used solely in instances where they documented public claims concerning sustainability technologies. Blogs, YouTube videos, public posts and forum discussions were screened as discourse materials to identify public anxieties and narratives, yet they were not treated as evidence of factual claims.

Academic sources were included when they addressed technology adoption, sustainable technology, sustainability transitions, policy design, public communication, misinformation, trust, public-sector technology or development outcomes. Official and policy documents were included when they provided current evidence on digital infrastructure, clean energy, digital government, safeguards or sustainable development. Non-academic sources were included solely where they provided documentation of public claims, policy controversy or discourse patterns that were relevant to adoption legitimacy. The exclusion of sources was based on the following criteria: pure technical nature without policy relevance, promotional content without analytical value, inaccessible, duplicated, outdated without historical value, or based on unsupported claims presented as fact.

Table 3. Search strategy and eligibility logic

Search domain	Illustrative Boolean string	Purpose
Policy design and adoption	"public policy" OR "policy design" OR "innovation policy" AND "technology adoption"	To identify policy instruments, design dimensions and adoption mechanisms.
Sustainability and development	"sustainable development" OR sustainability OR SDGs AND technology	To locate sustainability-oriented technology and development evidence.
Digital public infrastructure	"digital public infrastructure" AND safeguards AND inclusion	To capture DPI, governance, trust and inclusion reports.
Clean/green technology	"clean technology" OR "green technology" OR "electric vehicle adoption" AND policy	To capture clean energy and EV adoption sources.
Communication and misinformation	"public communication" OR trust OR framing OR misinformation AND sustainability technology	To capture communication mechanisms and legitimacy debates.
Contested discourse	"15-minute city" AND conspiracy OR misinformation	To screen public-perception narratives without treating unsupported claims as fact.

Table 4. Inclusion and exclusion criteria by source type

Source type	Inclusion criteria	Exclusion criteria
Peer-reviewed articles/books	Relevant to adoption, transitions, policy design, communication, trust, misinformation or sustainability governance.	Purely technical studies without policy or adoption relevance; duplicated records.
Official and policy documents	Current institutional evidence on DPI, clean energy, digital government, SDGs, safeguards or public communication.	Promotional releases without substantive policy or evidence content.
Grey literature	Analytical reports with identifiable institutional authorship and relevance to implementation or governance.	Unverifiable claims, unclear authorship, weak analytical contribution.
Media and fact checks	Utilized to document public claims and verified controversies around sustainable technology.	Opinion-only content not useful for discourse analysis.
Blogs, videos and forums	Utilized only for narrative scanning and public-perception coding.	Never utilized as factual proof; unsupported conspiracy claims excluded from evidence synthesis.

5.3. Screening, coding and rigor

The screening process was comprised of four stages: identification, duplicate and relevance screening, eligibility assessment and inclusion. Titles, abstracts, summaries and source descriptions were first screened for relevance. Subsequently, the full texts or complete reports were subjected to an evaluation process for conceptual fit, policy relevance, source credibility and contribution to the review questions. Source credibility was evaluated through authorship, publication venue, institutional authority, methodological transparency, citation traceability, recency and consistency with stronger evidence. Peer-reviewed and official sources were assigned the highest evidentiary weight. Media and fact-checking sources were used as contextual evidence. The utilization of public discourse material was exclusively employed for the coding of anxiety, framing and legitimacy risks.

Content analysis was conducted in two cycles. First-cycle coding captured source type, year, geography, sector, technology category, policy instrument, communication mechanism and evidence role. Second-cycle coding grouped sources into the following themes: ecosystem adoption, policy mix coherence, infrastructure and capability, safeguards, public trust, misinformation, equity, geography and adoption quality. To reduce bias, factual claims from non-academic sources were only accepted if they were supported by academic, official or verified fact-checking material. Interpretive claims were separated from verified evidence, and conflicting or context-specific findings were retained rather than forced into a single universal conclusion.

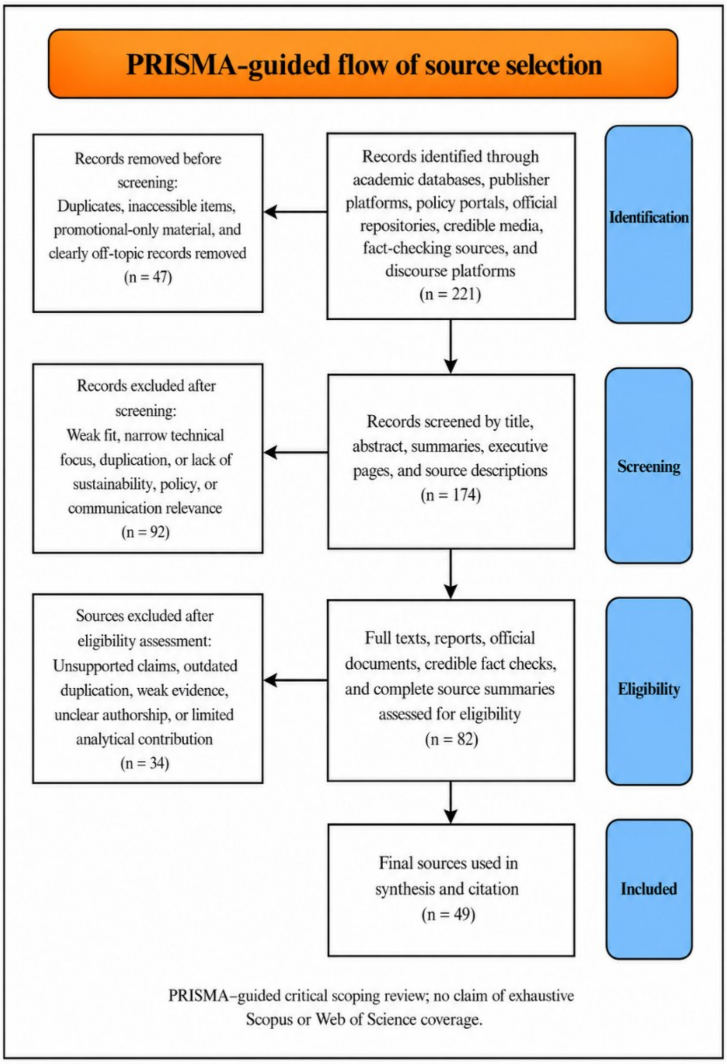

Fig. 1. PRISMA-guided flow diagram for source identification, screening, eligibility assessment and inclusion

Table 5. PRISMA-style review summary

PRISMA stage	Review action	Records / sources
Identification	Records identified through academic databases, publisher platforms, policy portals, official repositories, credible media, fact-checking sources and discourse platforms.	221
Removal before screening	Duplicates, inaccessible items, promotional-only material and clearly off-topic records removed.	47
Screening	Titles, abstracts, summaries, executive pages and source descriptions screened for direct relevance.	174
Screening exclusion	Records excluded for weak fit, narrow technical focus, duplication or lack of sustainability, policy or communication relevance.	92
Eligibility	Full texts, reports, official documents, credible fact checks and complete source summaries assessed.	82
Eligibility exclusion	Sources excluded for unsupported claims, outdated duplication, weak evidence, unclear authorship or limited analytical contribution.	34
Included	Final sources used in synthesis and citation.	49

Table 6. Source classification and evidentiary treatment

Source class	Number	Evidentiary treatment
Peer-reviewed journal articles and academic books	31	Main evidence base for theory, adoption, transitions, policy design, communication and misinformation.
Official reports and primary policy documents	13	Main evidence base for current policy, digital government, DPI, energy investment and safeguards.
Grey literature and institutional commentary	3	Supplementary evidence for implementation issues and policy practice.
Credible media and fact-checking sources	2	Contextual evidence for public claims and contested narratives.
Blogs, videos, forums and conspiracy narratives	Screened, not utilized as factual proof	Utilized solely for discourse scanning; unsupported claims excluded from evidence synthesis.

Table 7. Geographical and contextual distribution of reviewed evidence

Dominant context	Number of sources	Main technologies / sectors	Main review contribution
Global or multilateral	18	DPI, SDGs, digital government, clean energy	Sets global policy, infrastructure and safeguard context.
OECD / high-income settings	11	EVs, digital government, public communication, misinformation	Shows trust, communication and consumer adoption issues.
Developing economy / G20 / LMIC relevance	6	DPI, digital inclusion, public services, energy access	Highlights affordability, capacity, infrastructure and equity constraints.
European and urban planning contexts	5	15-minute city, smart mobility, urban sustainability	Shows public backlash, proximity-policy limits and autonomy concerns.
Cross-context theoretical sources	9	Adoption theory, policy design, transition theory, communication theory	Provides analytical framework across regions and sectors.

6. Results and Discussion

6.1. Evidence profile and scope of findings

The evidence base demonstrates that the adoption of sustainable technology is not concentrated in one technology or region. The final synthesis incorporated a total of 49 sources, with peer-reviewed articles and academic books constituting the primary conceptual framework and official documents providing current policy evidence. The strongest empirical and policy evidence appeared in the following areas: digital public infrastructure, digital government, electric mobility, clean energy, urban sustainability and public communication. The geographic evidence was mixed: global and multilateral sources were dominant, followed by OECD and high-income contexts, while developing economy and LMIC evidence appeared mainly through digital inclusion, DPI and energy access sources. This distribution indicates that the conclusion of the paper should be interpreted as a cross-context policy synthesis rather than a claim of uniform adoption behavior across all countries.

The evidence further demonstrates that findings vary according to source type. Adoption theory and transition theory explain the mechanisms of acceptance and system change [10-14]. Policy design studies explain the significance of bundles of instruments over isolated tools [18-22]. Official reports reveal current governance concerns in DPI, clean energy and digital government [1-7,37-39]. Communication scholarship explains the factors that influence legitimacy in the context of framing, trust, risk communication and misinformation [26-34]. Media and fact-checking sources demonstrate how sustainability policies can become the subject of distorted narratives, particularly in the context of 15-minute city debate [34-36].

Table 8. Evidence-mapping matrix for major findings

Finding / theme	Support	Sectors	Context	Evidence
Ecosystem adoption	19	DPI; digital services; EVs; clean energy	Global/OECD/LMIC	Academic + official
Policy mixes and demand creation	15	Clean energy; EVs; digital government	Global/OECD/G20	Academic + policy
Communication legitimacy	14	Digital services; urban sustainability; EVs	OECD/global/urban	Theory + policy
Misinformation and trust deficits	8	15-minute city; EVs; digital ID; AI	Urban/OECD/global	Academic + fact-check
Equity and adoption quality	13	DPI; digital inclusion; clean energy	Global/LMIC	Official + academic
Context and capacity variation	11	Digital government; energy; urban policy	Global/OECD/LMIC	Evidence map

6.2. Sustainable technology adoption is an ecosystem problem

The initial major finding is that the process of adoption is accelerated when sustainable technology is regarded as an ecosystem as opposed to being viewed as a single device, platform or scheme. Across the reviewed sources, adoption depended on the interaction of infrastructure, affordability, capability, regulation, trust, safeguards and local relevance. This finding was most robust in the field of peer-reviewed adoption theory, transition studies and official digital infrastructure reports [4,5,10-14]. This same logic is also observable in clean energy and EV adoption, where various factors, including charging access, grid readiness, cost, consumer confidence, standards, repair ecosystems and public information influence the adoption rate [6,7,15,16].

This ecosystem view challenges supply-led policy assumptions. While governments may launch portals, applications, dashboards or subsidy programs, these instruments do not automatically produce meaningful adoption. It is important to note that while a citizen may have access to a digital service, they may still be dependent on intermediaries due to the factors such as low literacy, weak connectivity or fear of making errors. A household may support rooftop solar but avoid adoption in view of high upfront cost, uncertain maintenance and weak installer trust. A commuter may support electric mobility in principle but reject the adoption of EV due to concerns regarding range anxiety, charging uncertainty or misperceptions [15,16,49]. It is therefore important to note that the quality of adoption can differ from nominal uptake. The model encompasses sustained use, user confidence, equity, grievance resolution, behavioural capability and perceived legitimacy [48].

The concept of sustainable technology must therefore remain constrained. Clean and green technologies are included because they directly target environmental and resource outcomes. Digital public infrastructure, AI and data platforms are included only when they are linked to sustainable development, public value, inclusion, climate adaptation or governance capability. Without this boundary, the concept risks becoming excessively broad, thereby diminishing its analytical value. The review therefore treats sustainable technology as a socio-technical category defined by its contribution to sustainability outcomes, rather than by novelty or digital character alone.

6.3. Policy design explains why adoption succeeds or fails

The second finding is that the design of policy is of consequences because sustainable technology adoption requires the existence of coherent combinations of goals, instruments and implementation arrangements. The present theme was supported mainly by policy design, policy mix and mission-oriented innovation literature [18-25]. The evidence under review indicates that adoption is more robust when policy design integrates a clear public mission with instruments that reduce user cost, infrastructure barriers and institutional uncertainty. This supports the policy mix argument that consistency, coherence, credibility and comprehensiveness are important factors in transitions [21].

The employment of a policy design lens serves to clarify the reasons for the failure of some adoption strategies. Instrument design without problem framing can result in the emergence of techno-solutionism. Incentives without infrastructure can create demand that systems cannot serve. The provision of incentives in the absence of infrastructure can produce unused or poorly understood systems. Communication without safeguards can result in its perception as promotional or manipulative. Safeguards without communication may remain invisible to users. In each case, the failure of adoption f is not caused by the technology alone. It is also caused by weak alignment among policy design dimensions.

Mission-oriented policy adds the role of demand creation. Clean energy and digital public infrastructure show that the state can shape markets and adoption pathways by setting direction, funding early deployment, coordinating actors and creating public procurement demand [22-24,44-47]. However, it is imperative to emphasize that demand creation must be connected to public value and accountability. DPI has the capacity to enhance service delivery; nevertheless, without privacy, interoperability, grievance redress and institutional oversight, there is a risk of exacerbating exclusion or surveillance concerns [4,5,37-39]. Consequently, public policy must accelerate adoption through rights-based and capability-sensitive design, in addition to scale and speed.

6.4. Geography and institutional context condition adoption

The third finding is that adoption is context-dependent. Evidence from global reports and OECD documents indicates that digital and clean technologies are expanding rapidly. However, institutional capacity, infrastructure, trust and income conditions differ sharply across different contexts [1-7]. In high-income settings, there is often an emphasis on consumer confidence, regulatory credibility, misinformation and transition politics. In the context of developing and LMIC, the emphasis is frequently placed on affordability, connectivity, institutional capacity, literacy, infrastructure access and exclusion risks. This does not mean that misinformation is absent in developing contexts or that affordability is absent in rich countries. It suggests that adoption barriers combine differently across policy environments.

Digital public infrastructure illustrates this variation. Within global and G20 policy narratives, DPI is presented as a foundational public architecture for identity, payments, data exchange and inclusive service delivery [4,5,47]. In development contexts, its potential is linked to scale, welfare access and SDG acceleration [8,46]. However, the same systems raise concerns regarding data protection, accountability, public-private governance and exclusion when safeguards are found weak [37-39]. Consequently, the transfer of adoption models across countries requires caution. A system that works in a high-capacity institutional setting may fail in a low-capacity context if offline alternatives, grievance systems and user support are absent.

Urban sustainability policies exhibit a similar pattern. The 15-minute city debate has become a prominent feature of public discourse in European and North American public discourse. However, its adoption relevance is broader as it demonstrates how sustainability concepts can be transformed into symbols of coercion when communication is weak or politicized [34-36]. The lesson is not that urban proximity policies should be abandoned. The lesson is that context-sensitive design must address local mobility patterns, equity effects, car dependence, public consultation and autonomy concerns.

6.5. Communication is an adoption mechanism, not only information provision

The fourth finding is that communication affects adoption through several mechanisms, rather than merely through awareness. The communication sources reviewed demonstrate that people interpret sustainability technologies through frames of benefit, cost, autonomy, risk, identity, fairness and trust [26-30]. It is evident that public communication is imbued with a design function. The objective of this initiative is to facilitate citizens' understanding of the problem, interpretation of the technology, assessment of trade-offs, identification of protections and evaluation of the credibility of institutions. This finding strengthens the communication contribution of the paper beyond simple information provision.

The framing of technological phenomena is of significance, given the capacity for different interpretations of the same technology. Digital identity may be framed by governments as inclusion and efficiency, but by citizens as surveillance or dependence. Electric vehicles may be framed as climate action measure; however, they are perceived by some consumers as being expensive, inconvenient or politically symbolic. Urban proximity planning may be framed as access and livability, yet by opponents as restriction or control [34-36,49]. Public communication must therefore explain not only what the technology does, but also what it does not do, what protections exist and how users can contest errors.

Risk communication is equally important. Sustainability technologies are frequently accompanied by uncertainty, including data risks, battery performance, grid capacity, infrastructure readiness, algorithmic accountability and cost distribution. A communication strategy that exclusively emphasizes benefits may compromise its credibility. It is important that public communication is underpinned by empirical evidence, with an obligation t acknowledge risks, explain safeguards and provide channels for correction. The importance of dialogic communication in this context is twofold. Firstly, citizens are more likely to adopt new systems if they have opportunity to ask questions, report problems and see that feedback changes implementation. Trusted messengers, local demonstrations and peer experience support diffusion because they make the benefits observable and socially credible [10,26-29].

Misinformation response should be designed prior to controversy peaks. Research on the correction and inoculation of misinformation has demonstrated that false claims can continue to influence reasoning and that pre-bunking can reduce susceptibility to misleading claims [31,32].When applied to the domain of sustainable technology adoption, this means that governments should anticipate common misunderstandings surrounding EVs, digital identity, AI, smart cities and climate policies. However, misinformation management should not become propaganda; it must be transparent, evidence-based, non-partisan and open to legitimate criticism.

6.6. Public anxiety and conspiracy discourse reveal legitimacy deficits

The fifth finding is that public anxieties and conspiracy narratives should be analytically separated from verified evidence. The review did not treat conspiracy claims as factual proof. Conversely. such narratives were interpreted as discourse signals that reveal public fears about surveillance, autonomy, inequality, elite control or loss of local agency. This distinction is significant because unsupported claims should not influence factual conclusions, but they can still affect adoption outcomes through distrust and mobilization.

This assertion is clearly demonstrated by the 15-minute city debate. Fact-checking sources documented false claims regarding the impacts of such policies. These claims include the assertion that the policies would lock residents into districts. However, scholarly work indicates that backlash was linked to broader acceptability and trust problems [34-36]. The existence of misinformation does not prove authoritarian intent. It indicates that policy communication failed to pre-empt or answer anxieties regarding mobility, freedom and governance. Similarly, EV adoption debates contain legitimate concerns about charging infrastructure, battery performance, cost implications and supply chains, but they also contain exaggerated claims that have the potential to reduce adoption interest or polarize the discourse [15,16,49].

This finding has a theoretical implication. The process of adoption is not only a rational evaluation of the usefulness or price of an object; it is also a legitimacy process. Technologies become acceptable when users believe that institutions are competent, honest, responsive and fair. These provisions become contested when citizens interpret them as imposed, opaque or unequal. Public communication and safeguards therefore function in a symbiotic manner. Communication makes safeguards visible, and safeguards make communication credible.

6.7. Equity, power and adoption quality

The sixth finding is that technology adoption has the capacity to reproduce inequality when equity is not designed into policy. ITU data demonstrate that large populations remain offline, and official reports repeatedly point to digital divides, rural exclusion and capability barriers [1-3]. If public services become digital by default in such settings, people with the greatest need may face the greatest barriers. The adoption of clean energy can also become unequal when early benefits go to wealthier households while poorer households face higher energy burdens or remain dependent on older infrastructure.

Equity is characterized by distributive, procedural and communicative dimensions. Distributive equity concerns with the question of who should pay, who should benefit and who should be excluded. Procedural equity concerns with who should participate in design and whose local knowledge is recognized. Communicative equity concerns whether information is accessible in language, format, channel and trust level. Responsible innovation and DPI safeguard frameworks support this broader understanding as they emphasize inclusion, safety, accountability, responsiveness and human agency [25,37-39].

The concept of power is also of relevance in this context. Sustainable technology adoption frequently involves large firms, platform providers, energy companies, data intermediaries and international organizations. These actors can provide resources and expertise, but they may also influence standards, procurement, data governance and performance metrics. A policy that accelerates adoption while reducing accountability is not conducive to sustainable development success. Consequently, the quality of adoption should be measured through sustained use, user capability, trust, fairness, grievance handling, accessibility and long-term public value, not solely through uptake statistics.

6.8. Integrated policy communication framework

The synthesis indicates the existence of an integrated policy communication framework for sustainable technology adoption. The framework under discussion comprises six interconnected functions: direction, infrastructure, capability, incentives, safeguards and communication. Direction defines the sustainability mission. The technical feasibility of adoption is facilitated by infrastructure. Capability enables users and institutions to utilize the technology. The utilization of incentives has been demonstrated to be an effective strategy to reduce cost and uncertainty. Safeguards are designed to protect rights, safety, equity and accountability and communication are designed to build public meaning, trust, feedback and misinformation resilience.

The framework also explains interaction effects. Incentives without infrastructure have the potential to produce frustration. Infrastructure without capability may create underuse. Safeguards without communication may fail to reassure citizens. The absence of safeguards in communication may appear promotional. Direction without participation may be perceived as an imposition. Evaluation without equity indicators may hide exclusion. Consequently, effective adoption policy requires integrated design as opposed to isolated actions.

Theoretical implications follow from this framework. Firstly, adoption theory should be extended beyond individual acceptance to include policy design, institutional legitimacy and public communication. Secondly, sustainability transition theory would benefit from a greater focus on communication as a mechanism of legitimacy, rather than solely as public engagement. Thirdly, policy design scholarship should treat communication, safeguards and feedback as core design dimensions. Fourthly, misinformation studies should be connected to adoption policy as misinformation affects both belief and technology diffusion and institutional trust.

The practical implications are direct. Policymakers should define sustainable technology narrowly and link adoption to public value. Development agencies should assess infrastructure, capability and equity prior to promote digital or clean technology scale. Public communication teams should be involved from problem framing to evaluation, not only at launch. Urban planners, energy agencies and digital government bodies should utilize pre-bunking, trusted messengers, transparent risk communication and citizen feedback channels. Researchers should report adoption through both uptake rates, and evidence on trust, exclusion, complaints, safeguards and long-term use.

7. Findings

The review posits that sustainable technology adoption is determined by the interaction of policy design, institutional trust, infrastructure, user capability, safeguards, communication and context. The strongest evidence indicates that adoption succeeds when technology is embedded in an ecosystem of affordability, standards, capability-building, participation, accountability and local relevance. Policy design is of consequence, for a coherent policy mix is superior to a combination of isolated instruments. The significance of public communication in the context of adoption is shaped by framing, risk perception, the role of trusted messengers, misinformation and visible safeguards. The evidence also demonstrates geographical variation: high-income and OECD contexts frequently emphasizing trust, consumer confidence and misinformation, while developing and LMIC contexts more often emphasize access, affordability, digital divides and institutional capacity. The study supports an integrated policy communication framework in which adoption speed is balanced with considerations of adoption quality, equity and legitimacy.

8. Conclusion

Public policy has the potential to accelerate sustainable technology adoption, but only when adoption is treated as a socio-technical, institutional and communicative process. It is imperative to note that sustainable technology is not synonymous with all technology, nor is it limited to green or clean technology. The term encompasses green, clean and sustainability-oriented digital systems, provided that they contribute to environmental, social, institutional or development outcomes. The review indicates that public policy must move beyond isolated subsidies, infrastructure programs or awareness campaigns. It must integrate direction, instruments, infrastructure, capability, safeguards, participation, communication and evaluation. The central lesson is that sustainable technology adoption is contingent not only on technological performance, but also on the presence of trust, effective governance and shared public understanding. Policies that scale rapidly but ignore legitimacy, equity and communication may generate backlash or exclusion. Policies that are designed to foster adoption ecosystems can support more durable, inclusive and publicly defensible sustainability transitions.

9. Implications of the Study

The present study contributes theoretically by connecting technology adoption theory, sustainability transitions, policy design, public communication and misinformation research into a single review framework. It contributes methodologically by demonstrating how PRISMA-guided critical scoping reviews can include non-traditional discourse sources without treating them as factual evidence. Practically, the study posits that policymakers should design sustainable technology adoption through coherent policy mixes, context-sensitive implementation, public safeguards and two-way communication. Development agencies and public institutions should assess who can access, use, contest and benefit from sustainable technologies before scaling them. Communication practitioners should employ framing, risk communication, trusted messengers, pre-bunking and feedback loops as policy tools, in addition to their promotional techniques.

10. Limitations and Future Research Directions

This study has some limitations. It employs a comprehensive PRISMA-guided scoping review design and does not conduct statistical meta-analysis. The evidence is drawn from a variety of source types and geographical contexts; therefore, the findings should be interpreted as conceptual and thematic rather than universal. Non-academic sources were employed solely as a means of to facilitate understanding of public perception, not as factual evidence. It is recommended that future research may empirically test the proposed policy design framework across specific countries, sectors, and technologies to examine how policy design, communication, trust, and institutional capacity influence sustainable technology adoption.

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