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Digital Tools for Inclusive Planning in West Texas: Between Participation and the (Un)Sustainability of Datafication

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Abstract

Digital methods of citizen engagement are touted as an increasingly effective means for including public opinion and data in planning, especially as the American Southwest continues to experience accelerated urbanization and the compounding stresses of climate change. But as these tools proliferate across the American Southwest, they also pose questions of how sustainable these methods are from a material perspective. This article uses West Texas as a case study for critically examining the (un)sustainable implications of digital infrastructure. This study investigates the tensions between using digital methods for the public good and the ecological harms associated with the energy, water, and materials used to create digital infrastructures. By analyzing a set of regional policy and community data, we explore whether citizen-generated data can be useful to planning in this data-scarce region, as well as the digital waste and material pollution associated with participatory datafication. In doing so, this research distinguishes between the direct, comparatively marginal footprint of participatory digital tools themselves and the indirect, contextual impacts of the hyperscale data center economy within which those tools are embedded. This study has been framed around the following questions: How can digital methods of participation support a diverse citizenry in a regional planning context? How might digital waste and pollution be factored into our understanding of data for the purpose of supporting equitable outcomes in the regional context? This research argues that inclusion of citizen-generated data does enhance planning and decision-making, and that we must take care to consider not only what participatory data can tell us about our regional environment but also where they originate and what material costs they are associated with. This study contributes to ongoing conversations around the topic of digitalization and (un)sustainability by exploring the ways in which the benefits of digital infrastructure for a diverse citizenry in a regional context sit in tension with its environmental costs.

Keywords
artificial intelligence; citizen engagement; data centers; datafication; digital tools; Texas

1. Introduction

Urban growth, water stress, extreme temperatures, and uneven infrastructure in the Southwestern region of the US are all interrelated problems. Mobile experience sampling, human-as-sensor methods, wearables-enabled sensing, and interactive mapping are all touted as digital participatory ways to bring institutional planning data closer to people's lived experiences and highlight locally pertinent concerns that standard planning may not capture (Matsumoto & Bohorquez, 2023). As the use of digital technology for participatory planning continues to grow quickly, a pressing and often overlooked tension is also emerging—one that is central to current debates on the role of artificial intelligence (AI) and digitalization in urban planning (Tappert et al., 2024; Wang & Yorke-Smith, 2025). Participatory datafication methods intended to promote inclusive and sustainable practices for climate resilience in cities also have their own material and environmental impact. Data centers use roughly 2% of the world's electricity, a number that has historically doubled every 4 to 8 years (International Energy Agency [IEA], 2022). Cloud-based applications, digital data processing, and the general digital economy all produce substantial carbon emissions and require additional water resources (DeGeurin, 2023; Hogan, 2024; Li et al., 2023). Furthermore, the idea of the smart city and the underlying assumption of technology as a fix-all for wicked urban problems can lead to the acceptance of an unhealthy relationship with digital systems (Chiappini, 2020; Lovink, 2019).

In this article, this tension through the specific case of West Texas has been considered, where the material impacts of datafication meet the environmental issues that participatory sensing aims to address. In a semi-arid landscape of declining water supply, sparse settlement, and low-density patterns of urban growth, West Texas is a place where participatory planning processes are particularly important, yet top-down models struggle to account for contextual and spatial variation in planning outcomes (Grigg, 2022; Walsh, 2013). Local areas face multiple interconnected sustainability challenges, including limited transit access, unequal access to greenspace, a water-scarce environment, and a history of heat waves and flash floods that manifest differently for different communities, households, and people based on location, household composition, and socioeconomic status.

West Texas is currently a major site of data center development and associated data processing facilities. In Pecos County, the GW Ranch campus received approval to include 7.65 gigawatts (GW) of natural gas-fired power to support what its developers call the largest permitted data center campus in the US (Elliott, 2026). A 5,000-acre AI data center site in the West Texas Panhandle, 35 minutes from downtown Lubbock, is moving at full speed to receive 500 megawatts (MW) of behind-the-meter power to support 500 MW of processing capacity now and 1 GW capacity in the future. In Presidio County, an 80,000-acre campus site has been proposed near Marfa. In early 2026, Chevron and Microsoft signed an exclusivity agreement for a 2.5 GW gas-fired power plant hub in West Texas to be collocated with AI data infrastructures that can be scaled up to 5 GW (Saldana, 2026). These recent projects make the (un)sustainability of digitalization not just a question of global environmentalism, but an issue of local and regional significance (Chiappini & Ferrari, 2024).

An important analytical clarification frames the whole of this article. Two distinct digital infrastructures are at stake in our case: (a) the participatory digital tools used in planning—mobile mapping applications, cloud-based platforms, and the modest server capacity that hosts citizen-generated data—and (b) the hyperscale AI data center economy now expanding across West Texas, which primarily serves AI training and inference, cloud computing, cryptocurrency, and commercial data storage. This research does not claim that participatory planning applications are responsible for the resource consumption of gigawatt-scale data centers; their direct footprint is marginal by comparison. Rather, this study argues that participatory tools are embedded within, and dependent upon, a regional digital infrastructure whose water and energy demands increasingly compete with the very communities these tools are meant to serve. It is this embeddedness—not a direct causal chain from mapping app to aquifer depletion—that raises questions about the democratic legitimacy and material sustainability of participatory datafication. Section 3.4 operationalizes this distinction between direct and indirect impacts in our analysis.

In this article, the previous scholarship on participatory sensing, public engagement, digital visualization, and critical digital geography has been analyzed to describe a series of methods where digitally mediated methods that center the citizen can be used to highlight locally pertinent priorities and issues, while also raising concerns around digital waste, physical pollution, and the broader environmental impacts associated with participatory datafication in urban environments. The research outlines potential benefits for citizen engagement, methodological strategies, and concerns around environmental justice and inclusive decision-making for the West Texas context, while also raising some of the environmental contradictions of using participatory, data-driven tools in urban planning (Grigg, 2022; Walsh, 2013). This synthesis has been framed around two questions: (a) How can digitally mediated, participatory methods bring diverse perspectives into consideration in regional planning without also relying on unsustainable modes of thinking associated with techno-optimism and techno-utopianism? (b) What can we learn by simultaneously accounting for the environmental cost of digital systems and the knowledge of environmental planning produced by data?

Through participatory sensing and citizen-produced data, local inhabitants may gather, analyze, and disseminate observations of environmental danger, infrastructure, and public space, in addition to official data sources. This has been advocated as an avenue to bring greater equity to urban planning and to highlight specific, neighborhood-level information regarding climate change adaptation and resilience (Matsumoto & Bohorquez, 2023). Further, this kind of engagement involves reflective collaboration and knowledge co-production, in which residents and planners interpret together the data they are gathering to inform the policy, and governance processes they wish to develop (Bixler et al., 2022).

This article is single-authored and written in the first-person singular; the plural, where it appears, denotes the workshop group rather than a research team.

The following sections are divided as follows. Section 2 includes a discussion of prior literature on participatory sensing, digital planning tools, and the (un)sustainability of digitalization, as well as placing this work within the wider discourse on smart city solutionism and digital waste. The context, methods, and technologies used for this work are discussed in Section 3. The policy analysis, review of gray literature, and community workshop results are presented in Section 4. Planning implications for the occupation, equity, resilience, and sustainability of digital participation for West Texas and similar areas are considered in Section 5. The final section addresses issues relating to the research and suggests future avenues of study.

2. Literature Review

2.1. Participatory Sensing and Citizen Science in Urban Planning

The notion of participatory sensing first developed when personal mobile devices became increasingly common around the mid-2000s. This technology made it possible for average residents to gather, exchange, and analyze information about their surroundings. In the beginning, discussions about participatory sensing centered on the promise of gathering data from disparate places, especially with respect to air quality, noise, and traffic, to supplement traditional monitoring efforts. In recent years, the scope of what is defined as participatory sensing has widened beyond this, now including almost any instance of citizen-generated data, including formalized survey methods such as experience sampling as well as ad-hoc community reporting. Participatory sensing is related to the much larger body of research that has come to be known as citizen science. In citizen science, non-scientists engage as contributors to formal scientific studies. However, there are differences. Instead of involving residents in a planned research project, participatory sensing prioritizes and emphasizes experience as a primary source of evidence. In this framework, participants are not just data sources, but also human interpreters whose perceptions of comfort, safety, and accessibility contain planning-relevant knowledge. Despite the widespread popularity of participatory sensing among scholars, it has seen only limited uptake in formal planning processes (Bixler et al., 2022). Issues regarding the reliability and representativeness of data, as well as skepticism toward non-traditional sources of information, remain the most substantial obstacles, but others include the technical complexities involved in combining multiple distinct types of data (Meyer et al., 2018). Additionally, there have been concerns that participatory sensing practices could exacerbate issues of equity if the technology needed for participation is not accessible to all residents (Bixler et al., 2022).

2.2. Digital Tools for Inclusive Planning

Another branch of research investigates how digital technology, including geographic information systems (GIS), data dashboards, web-based mapping platforms, and mixed-reality tools, can create more equitable conditions for residents' participation in planning activities (Matsumoto & Bohorquez, 2023). Digital tools that enable input outside the traditional settings of face-to-face meetings, offer visualizations of planning scenarios, and translate technical language in planning materials into more easily digestible content have the potential to expand who can meaningfully engage. Studies of digital tools have identified features and capabilities that are highly applicable to our study (Mehan, 2023a, 2023b). Interactive visualizations allow residents to understand more abstract planning ideas and make spatial decisions. Mobile applications facilitate participation among individuals unable to attend evening hearings because of scheduling conflicts. Digital platforms for community mapping are designed to enable the public to add to, interpret, and interact with planning data. Yet, the literature also documents persistent challenges. Digital divides in terms of broadband access, device ownership, and digital literacy can limit who participates and whose data become part of the planning record; recent critical work on digital participatory budgeting distinguishes such first-level (access) divides from second level (skills and use) divides and warns of a "tokenism trap" in which digital participation confers legitimacy without redistributing influence (Gonçalves et al., 2026; Tappert et al., 2024). Tools, too, are shaped by design decisions, from the interface language, default map layers, and data categorization schemes, which embed assumptions that may not match local understandings (Mehan &

Mostafavi, 2024). Thus, scholars have advocated for co-design approaches that allow residents to design the tooling itself rather than only participate through standardized forms (Meyer et al., 2018).

2.3. The (Un)Sustainability of Digitalization and Digital Waste

More critically, recent scholarship has investigated environmental and material costs of digitalization. Data centers consume approximately 2% of total global energy, with this number expected to increase as AI services, cloud-based data storage, and digital archiving expand (IEA, 2022). The water use footprint of AI is also notable; researchers estimate that training a large language model such as GPT-3 can directly evaporate hundreds of thousands of liters of freshwater, with routine inference consuming considerable additional volumes for cooling and electricity production (DeGeurin, 2023; Hogan, 2024; Li et al., 2023). These costs are not evenly distributed but are instead concentrated in geographies that affect neighboring communities with air pollution, water stress, and land use (Chiappini & Ferrari, 2024).

The magnitude of these issues in Texas is now well documented. The Houston Advanced Research Center (HARC)'s January 2026 white paper, *Thirsty Data and the Lone Star State*, estimates that data centers consumed 25 billion gallons of water in Texas during 2025 if direct and indirect water uses are both considered (HARC, 2026). Depending on construction speed and type of cooling technologies, it is estimated that this consumption rate could increase to between 29 billion and 161 billion gallons per year by 2030. One GW of data center capacity, plus its co-located power generation, needs between 10 and 21 million gallons of water per day. The Electric Reliability Council of Texas predicts that data center power usage will go beyond 12,700 MW in 2026 and more than double in the following year (Electric Reliability Council of Texas, 2025). However, Texas law does not require that data center usage estimates or actual water usage be reported by data center operators, and so there is a gap in planning and accountability in areas facing water stress ("Texas' data center dilemma," 2025).

Critical digital geographers and media scholars have argued that smart city rhetoric, including smart cities, digital twins, and platform urbanism, and its associated tropes create false representations of digital solutions for complex urban problems without acknowledging the material and ecological costs of the infrastructures underpinning them (Babushkina & Votsis, 2022; Chiappini, 2020; Cristofari, 2023). On an everyday level, search engines, texting, social media, and logistical networks create so much data that Lovink (2019) calls it brain-junk, a kind of trash that pollutes both the ecosystem and the collective mind, resulting in disorder, exhaustion, and brain-fatigue. In a similar way, the apps that have been developed and the data these platforms collect exacerbate the issue (Dekeyser & Lynch, 2025; Vale et al., 2024), especially among those who do not know how to navigate the risks of co-dependency on digital media. Yet not much of that discussion has been brought into conversation with participatory sensing and citizen-centric planning. Tools that are promoted to facilitate democratic engagement, such as mobile apps, cloud-based mapping, and sensor networks, are themselves dependent on those digital infrastructures whose environmental footprint is now under scrutiny. It is important to be precise about this dependency: The direct energy, water, and e-waste footprint of participatory platforms is small relative to hyperscale AI workloads, but participatory tools share the same cloud infrastructure, the same grid, and—in regions like West Texas—the same aquifers as the data center economy at large. The critical question is therefore not whether a mapping app "consumes" a data center, but whether the democratic legitimacy of digital participation can be sustained when it is materially entangled with an infrastructure whose regional expansion competes with communities for scarce resources. To that end, this article explores the potential of (participatory) digital tools to enable democratic practice in the face of an (un)sustainable digitalization process, through a case study in West Texas.

2.4. Planning in Arid and Semi-Arid Regions

West Texas lies within the wider geography of arid and semi-arid regions that face unique challenges with respect to governance (Grigg, 2022; Walsh, 2013). Water governance and other forms of climate adaptation planning and land-use management occur in these contexts against ecological fragility and climatic uncertainty. Planning literature on the American Southwest has documented how dominant growth-oriented paradigms have neglected environmental constraints that eventually led to increased vulnerability (Grigg, 2022; Mehan, 2021; Walsh, 2013). Moreover, recent studies have argued for including local and experiential knowledge in climate adaptation planning, such as knowledge about local water resources in semi-arid regions (Bixler et al., 2022; Meyer et al., 2018). Indigenous peoples and long-time residents of a place typically are more attuned to their local conditions, whether that relates to water resources or microclimates, than is captured in formal spatial or quantitative data (Mehan, 2024, 2025c). Participatory approaches that focus on these forms of knowledge and local expertise have the capacity to improve the planning process, not only in terms of technical merit but also in terms of social legitimacy (Bixler et al., 2022; Mostafavi et al., 2025). However, there has been little discussion in the literature of the ways that digital participatory sensing methods can facilitate planning in places like the American Southwest, while also accounting for their own resource requirements. In West Texas, where the aquifers are depleting faster than they can be refilled, and public meetings have been held against proposals to build data centers nearby, there is urgency to consider the resource requirements (water, energy, e-waste) of these technologies in a place where those resources are increasingly scarce.

3. Methods

3.1. Case Study Context and Scope

Our study focused on diverse West Texas communities, spanning both large cities and smaller semi-urban towns set against the backdrop of open rangelands, irrigated crops, and scattered municipalities. For the purposes of sampling, "West Texas" was defined as the semi-arid western portion of the state encompassing the Permian Basin, the South Plains and Panhandle, and the Trans-Pecos, together with the municipalities and regional planning jurisdictions serving these areas. Despite their differences in scale and economic foundations, these communities face similar environmental stressors including long-term droughts, sweltering summer temperatures, flash floods, and lowering aquifers. Moreover, West Texas is currently at the forefront of a data center boom, with numerous new gigawatt-scale projects either approved or already under construction in the Permian Basin, the Panhandle, and along the Abilene–Sweetwater–Big Spring corridor. These data centers make West Texas an ideal location for studying the intersection of information technology and environmental resources. While there is much overlap between West Texas communities, there is also significant variation along lines of race, ethnicity, income, age, and home ownership. These disparities play an important role in how community residents experience environmental hazards and access to infrastructure, a nuance that planning documentation and statistics do not always capture (Mehan, 2025b). The study therefore aimed to understand the ways in which these disparities are reflected, or overlooked, in existing policy frameworks and gray literature, with a focus on the data center expansion and sustainability dimensions of the citizen-centric tools advocated for in public planning processes.

3.2. Policy Document and Gray Literature Corpus

This study is built on a qualitative approach centered on the analysis of policy documents and a review of gray literature. We did not collect primary data through questionnaires or surveys; instead, we synthesized policy documents, planning reports, technical reports, and other community-level documents to understand the role, deployment, and governance of citizen-centric sensing and digital tools in West Texas planning and the degree to which these sources address the environmental and material implications of digitalization. We analyzed a purposive sample of municipal, regional, and state-level planning agency documents with jurisdiction in West Texas. This included comprehensive plans, water management and climate plans, hazard mitigation plans, transportation plans and programs, capital improvement plans, and similar documents. We searched for documents based on the relevance of the planning topic (e.g., citizen engagement, environmental risk, or infrastructure access), the inclusion and extent of digital tools, and the inclusion or absence of sustainability dimensions of digital infrastructures. Specifically, we examined the degree to which the documents framed citizen participation, the primary data sources on which they relied, whether and in what ways these documents discussed participatory sensing and/or citizen-generated spatial data, and the extent to which they addressed environmental and material concerns of digital infrastructures.

This set of documents is by no means exhaustive. In parallel, we reviewed non-governmental organization (NGO), think tank, intergovernmental organization, and community organization gray literature (e.g., reports, white papers, working documents, technical briefs) relevant to West Texas and the American Southwest in the above domains. For example, in the review of international sources, we reviewed documents on citizen-centric sensing and digital tools by the OECD and the IEA (Grigg, 2022; Matsumoto & Bohorquez, 2023), while for US and Texas sources, we reviewed the white papers on water and climate by HARC. In particular, the HARC white paper *Thirsty Data and the Lone Star State* (2026), which contains the most comprehensive assessment of data center water consumption in the state of Texas to date, proved a particularly useful source for this research. We sought gray literature sources based on whether they were practice-oriented and relevant to our topics of interest: citizen participation in planning and the sustainability and implementation of digital tools in planning. Table 1 summarizes the composition of the corpus by document type and jurisdictional scope.

Table 1. Composition of the policy and gray literature corpus.

Document type	Jurisdictional scope
Comprehensive plans	Municipal
Water management and climate plans	Regional/State
Hazard mitigation plans	Municipal/Regional
Transportation plans and programs	Municipal/Regional
Capital improvement plans	Municipal
NGO, think tank, and community organization reports	Regional/State/National
Intergovernmental organization reports (OECD, IEA)	International

3.3. Pedagogical Framework and Workshops

To complement this document-based analysis, the study is grounded in a pedagogical framework developed through design-research studios and seminar-based inquiry. The framework was implemented through graduate-level design-research studios and seminar-based courses at Texas Tech University in the West Texas region, conducted over several semesters. Participants in the mapping and analysis activities were enrolled students and members of the research team, a substantial share of whom live in, and are long-term residents of, the West Texas communities examined; the workshop discussions therefore drew on situated, resident knowledge of the region as well as analytical training. Where we refer to "workshop participants" in Sections 4 and 5, we refer to these student and researcher participants. Participation was voluntary, all participants were informed about the aims and uses of the research, and workshop materials and transcripts were anonymized prior to analysis, in accordance with the research ethics procedures of the host institution.

This framework integrates critical spatial analysis, participatory mapping methodologies, and reflective engagement with digital tools as socio-technical systems. Within this pedagogical structure, students and researchers examined community-based environmental risks (e.g., flooding, heat exposure, and infrastructure gaps) alongside spatial assets such as mobility routes, public spaces, and sites of cultural significance. The digital tools at the center of the workshops were web-based collaborative mapping platforms used on personal smartphones and institution-provided tablets, through which participants annotated base maps with experiential observations (e.g., recurrent localized flooding, heat discomfort, gaps in pedestrian amenities; Mostafavi et al., 2025). These citizen-annotated layers were then compared with institutional datasets such as Federal Emergency Management Agency (FEMA) flood hazard maps and regional hazard mitigation plans, a comparison that speaks directly to how experiential flood knowledge relates to formal planning practice in West Texas (see Section 4.1). The framework also encouraged critical reflection on the environmental costs of digital participation, including water use, energy consumption, and e-waste, as well as the broader implications of data center expansion in West Texas (Mehan & Mostafavi, 2025). Digital mapping platforms and geospatial tools were employed as analytical instruments, enabling the synthesis of spatial, environmental, and infrastructural data within a research-led educational setting.

3.4. Coding and Analysis

Thematic coding was employed to analyze the policy and gray literature documents, with specific attention to frames, silences, and tensions in institutional representations of citizen knowledge, environmental risk, digital tool uptake, and sustainability of digital infrastructures (Bixler et al., 2022; Meyer et al., 2018). The analysis tracked how participatory sensing and citizen engagement were depicted in governance narratives, either as adjuncts to traditional data collection, as democratic obligations, or as institutional innovations, and investigated the degree to which existing policy contexts enable citizen-generated data to inform the planning and decision-making process in a manner that accounted for the material costs of the digital systems being promoted. Transcribed workshop conversations were then coded in a convergent design with the document coding. This allowed the team to identify similarities and divergences between institutional and community data. Through this process, we were able to pinpoint gaps in policy and practice when juxtaposed against the experiences of residents, as well as explore the trade-off between the democratic ideals inherent in digital tools and their environmental impacts in the West Texas context.

The coding protocol combined a set of pre-defined codes, derived deductively from the literature on participatory sensing, digital planning tools, and ICT sustainability (Sections 2.1–2.3), with emergent codes developed inductively during analysis (Table 2). In structuring the protocol, we drew on established approaches to plan content analysis and coding in the Texas planning context, including graduated scoring of policy language (e.g., distinguishing suggestive from mandatory provisions) and attention to inter-coder reliability (Raparthi, 2019), as well as indicator-based approaches that translate broad urban pressures into codable variables and operationalize potentially antagonistic relationships between development and sustainability objectives (Guzman et al., 2018). Consistent with the latter, our framework treats "promotion of participatory digital tools" and "data center resource consumption" as an antagonistic pair of indicators at the level of regional policy discourse—capturing tension and competition for resources—without implying a direct causal relationship between participatory tool use and hyperscale water consumption. An initial subset of documents was analyzed to calibrate code definitions, the remaining material was then coded independently, and divergent interpretations were resolved through discussion until consensus was reached.

Table 2. Coding framework: pre-defined and emergent codes.

Category	Pre-defined codes (deductive)	Emergent codes (inductive)
Citizen participation framing	Participation as adjunct to official data; participation as democratic obligation; participation as institutional innovation	Participation as legitimation device; participation fatigue
Data sources and evidence	Reliance on institutional/system-level data; references to citizen-generated or experiential data	Neighborhood-level variation missed by area-based measures
Environmental risk	Drought; extreme heat; flood hazard; aquifer depletion	Localized flooding absent from institutional hazard maps; differentiated heat exposure
Digital tool uptake	GIS/dashboards/web mapping; mobile applications; participatory sensing	Digital divides (broadband, devices, literacy); offline/analog alternatives
Sustainability of digital infrastructure	Energy consumption; water consumption; e-waste	Critical silence on material costs; data center expansion; water-use disclosure gap; competition with community water needs

3.5. Distinguishing Direct and Indirect Impacts

To avoid conflating two distinct digital infrastructures, the analysis explicitly separates: (a) direct impacts of participatory digital tools—the marginal energy and water use attributable to the servers hosting community mapping platforms, the embodied carbon and eventual e-waste of the tablets and devices used in workshops, and the storage footprint of citizen-generated data; and (b) indirect, contextual impacts of the regional data center economy—competition for groundwater and surface water, land-use change, air pollution from co-located gas-fired generation, and grid strain. Claims in Sections 4 and 5 are attributed to one of these two registers. This distinction sharpens rather than weakens the article's argument: Even where participatory tools have negligible direct footprints, their democratic legitimacy is complicated when they are embedded within an unsustainable regional digital infrastructure that competes with the same communities for scarce water and energy.

4. Results

4.1. Environmental Experience and Policy Blind Spots

The policy and gray literature review revealed that current planning and policy documents in West Texas mostly approach environmental risk, particularly drought, heat, and flood hazard, in terms of broad, area-based measures that fail to capture substantial neighborhood-level variation. The workshop data reflected this reality: Workshop participants identified locations where localized flooding has occurred repeatedly in the past but has been missed by the institutional hazard maps. Participants attributed these occurrences to issues such as poorly functioning drain infrastructure, recent alterations to land use patterns, or soil types that long-time residents would be aware of but would not show up on institutional hazard maps. The flood risk areas identified by the community were actionable data. If the community-identified flooding areas were included in the planning process—for example, as a citizen-generated layer reviewed during hazard mitigation plan updates or floodplain map revisions—they could have the potential to guide planning and hazard mitigation as well as investment in the region's infrastructure more effectively. Additionally, participants in lower-income neighborhoods reported feeling acutely uncomfortable with the heat in places with few trees and high amounts of impervious surfaces. This highlights how elements such as the quality of the housing, ability to have air conditioning, and time spent outside either working or commuting can affect individuals' perception of the outside temperature. This level of detail was largely absent from the policy and gray literature documents analyzed in this study.

4.2. Infrastructure Access, Mobility, and Digital Inequalities

The analysis of the documents indicated that planning around infrastructure in West Texas has focused more on the aggregate capacity of the system than the distributional impacts. The workshop mapping exercise helped to highlight these differences: Participants in more peripherally located neighborhoods reported longer commute times and longer wait times for water services as well as fewer open spaces within walking distance. Overlaying the participants' experiences with the base maps created composite depictions of infrastructure inequalities, and many participants described how they found that this was useful in communicating their issues to local decision-makers (Bixler et al., 2022). The patterns of mobility observed through the conversations highlighted how residents often spend time in locations with no or little pedestrian amenities, shade, or transit. Participants recounted how they navigate these issues using informal mechanisms, such as avoiding traveling at peak heat, relying on connections for a ride, or steering away from potentially unsafe areas; most of the mechanisms that residents employ to deal with their infrastructure gaps are not reflected in formal transportation and transit plans (Walsh, 2013). Importantly, workshop participants reported unequal access to broadband internet and mobile devices across communities, which brought up important questions about whose experiences and input are being captured when digital tools are used to collect citizen data or when residents are asked to access planning materials on online devices (Dekeyser & Lynch, 2025).

4.3. The Material Footprint of Digital Participation and Data Center Growth

One of the unique contributions of this research concerns the environmental and resource costs associated with the digital systems employed in participatory design, as well as the expanding data center network that is changing the West Texas landscape. Following the distinction introduced in Section 3.5, we report these as two registers: the direct (and comparatively marginal) footprint of the participatory tools themselves, and the indirect, contextual pressures of the regional data center economy within which those tools operate. Figure 1 summarizes the principal environmental impact pathways of data center operations, and Figure 2 details how these operations generate CO_2 emissions, consume water for cooling, produce electronic waste, and deplete shared groundwater resources. The gray literature showed that the policy papers in the West Texas area that advocate the use of digital systems to facilitate community involvement, such as data monitoring systems and smart-city strategies, make no mention of the energy, water, and waste consequences of the digital systems they encourage. This is an unexpected omission considering the amount of data center development going on in West Texas. A total of 7.65 GW of natural gas power generation capacity has been permitted for the GW Ranch campus in Pecos County, for example (Elliott, 2026). The 5,000-acre AI data center campus located in the West Texas Panhandle is currently expediting 500 MW, with the intention of increasing to 1 GW of total capacity; meanwhile, an 80,000-acre data center campus has been proposed in Presidio County close to Marfa. In the West Texas area, Chevron and Microsoft have signed an exclusivity pact for a 2.5 GW natural gas electricity hub that could grow to 5 GW to share natural gas power generation alongside AI data centers (Saldana, 2026). As of 2026, data center power usage in Texas is predicted by the Electric Reliability Council of Texas to exceed 12,700 MW of capacity, with the number expected to double the following year (Electric Reliability Council of Texas, 2025). Figure 3 maps the geography of these emerging data center and AI infrastructure projects across West Texas, highlighting their energy capacity and regional clustering.

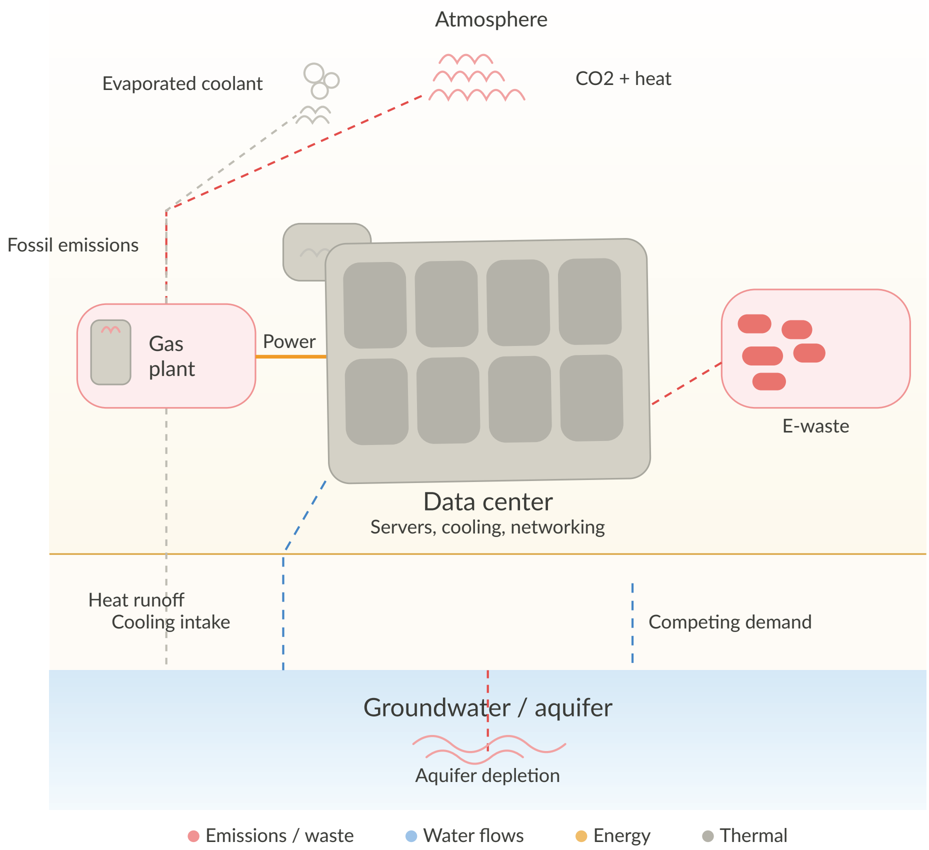

Figure 1. Environmental impacts of data center operations.

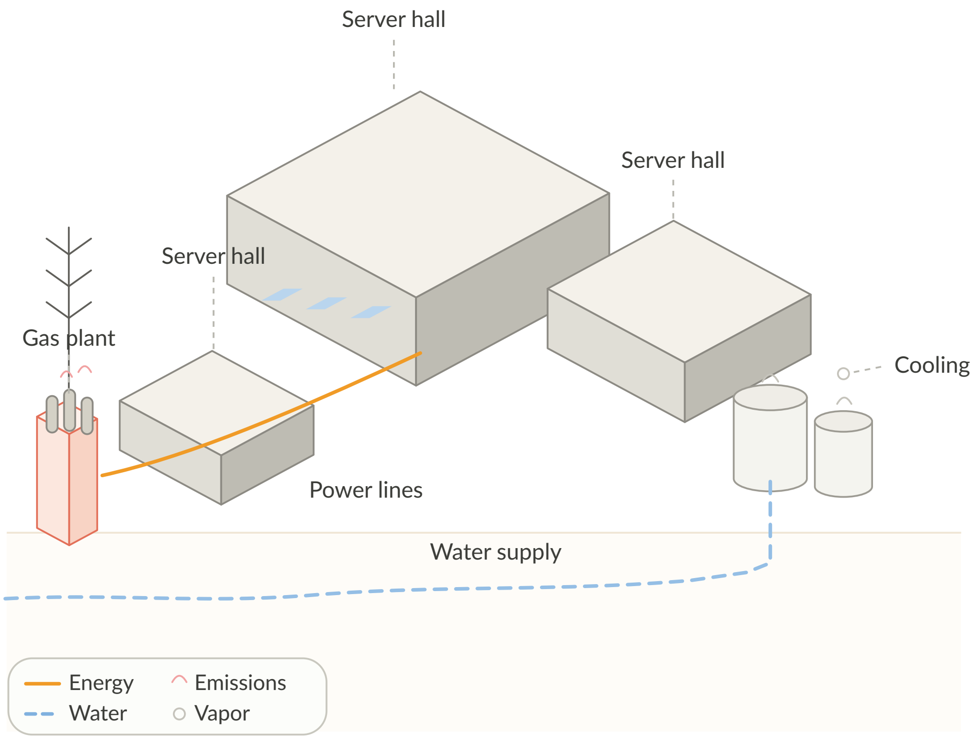

Figure 2. How data center operations generate CO_2 emissions, consume water for cooling, produce electronic waste, and deplete shared groundwater resources.

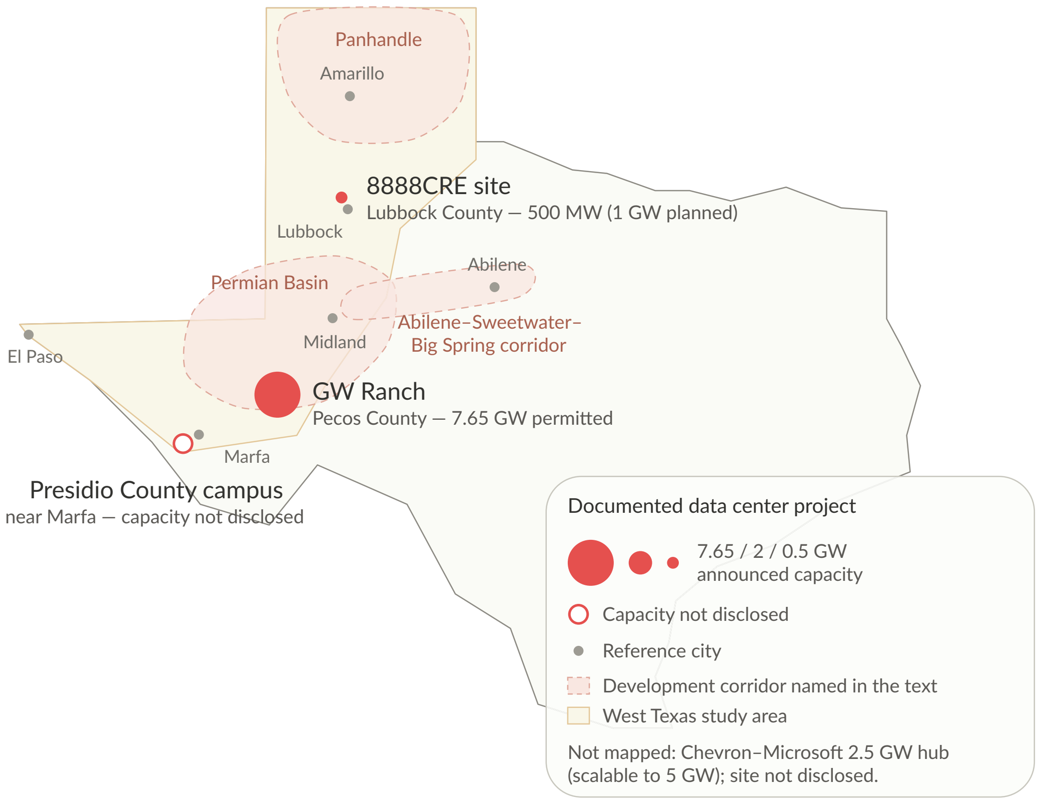

Figure 3. Geography of emerging data center and AI infrastructure projects across West Texas, highlighting energy capacity and regional clustering.

In West Texas, water use is of great consequence. In 2025, HARC reports that data centers in Texas consumed approximately 25 billion gallons of water, with consumption predicted to rise to as much as 161 billion gallons per year by 2030, potentially up to 2.7% of all water usage statewide, corresponding to as much as 1.3 million typical families (HARC, 2026). For each gigawatt of data center capacity, 10 million to 21 million gallons of water is required daily. In Amarillo, in the Panhandle, public meetings have been organized to speak out against data centers being constructed in the area and to teach others about the risks to the Ogallala Aquifer, which is the primary source of water in the region and is being utilized more quickly than it is being recharged. Figure 4 shows the location of AI data center projects on top of the Ogallala Aquifer, visualizing this direct spatial overlap between hyperscale infrastructure and the region's principal groundwater resource. However, in the state of Texas, data center operators are not required to disclose their estimated water usage or to provide data on their actual water use, nor is there a central data center location registry, which HARC claims puts finite water supplies at risk of colliding with one of the most resource-intensive industries on the planet ("Texas' data center dilemma," 2025).

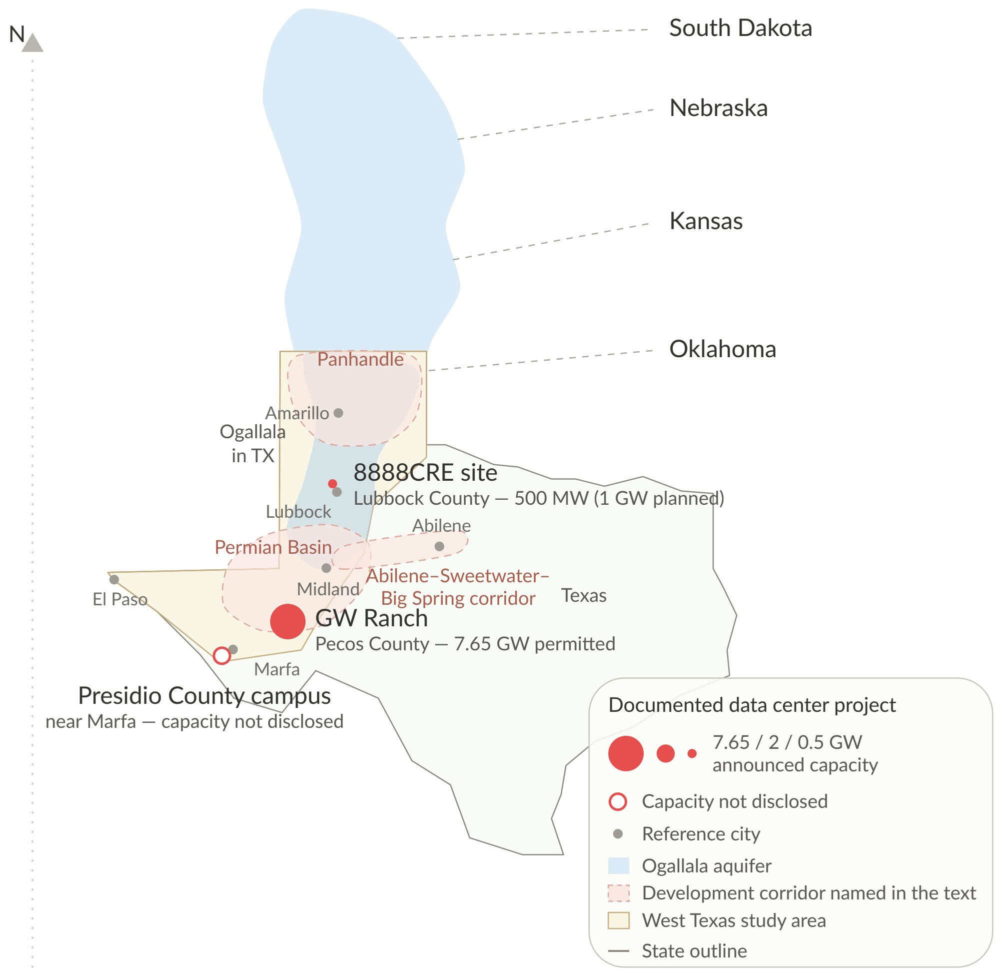

Figure 4. AI data centers on top of the Ogallala Aquifer in West Texas.

The pedagogical conversations sharpened this finding. Participants were struck by regional data centers' water and power demands amid recurring shortages, and by the smaller but non-zero footprint of the participatory mapping itself—the phones and tablets people used to access the platform, which have few local recycling options once they are obsolete (Chiappini, 2020; Lovink, 2019).

4.4. Community Needs and Capacity

The pedagogical framework employed in this study revealed several planning priorities that reflect a nuanced and relational understanding of West Texas communities. Rather than isolating singular issues, the analysis demonstrated how concerns related to infrastructure deficiencies, environmental risks, community life, and the increasing reliance on digital technologies and data centers are deeply interconnected in shaping everyday living conditions. Issues such as water availability and road quality were not treated as discrete problems but as part of broader socio-environmental systems. This holistic perspective challenges sector-specific planning models and points toward the need for cross-sectoral frameworks that integrate environmental, infrastructural, social, and digital dimensions (Bixler et al., 2022; Meyer et al., 2018).

Furthermore, the pedagogical approach grounded in design-research studios and critical mapping practices contributed to an enhanced sense of analytical agency among participants. By systematically documenting spatial conditions and environmental risks through research-driven mapping and reflective inquiry, localized experiences were reframed from taken-for-granted realities into matters of critical examination and policy relevance. This process foregrounded the role of knowledge production in shaping planning discourse (Mehan et al., 2023). As a result, the pedagogical framework fostered a more informed and critical understanding of the entanglements between digital infrastructure, environmental resource use, and community capacity.

Figure 5 synthesizes the discussion by tracing how three key insights—experiential knowledge, communicative mapping, and reflexive digital literacy—converge on a critical silence in planning documents regarding the material costs of digital infrastructure and identifies three pathways toward sustainable participatory planning practice.

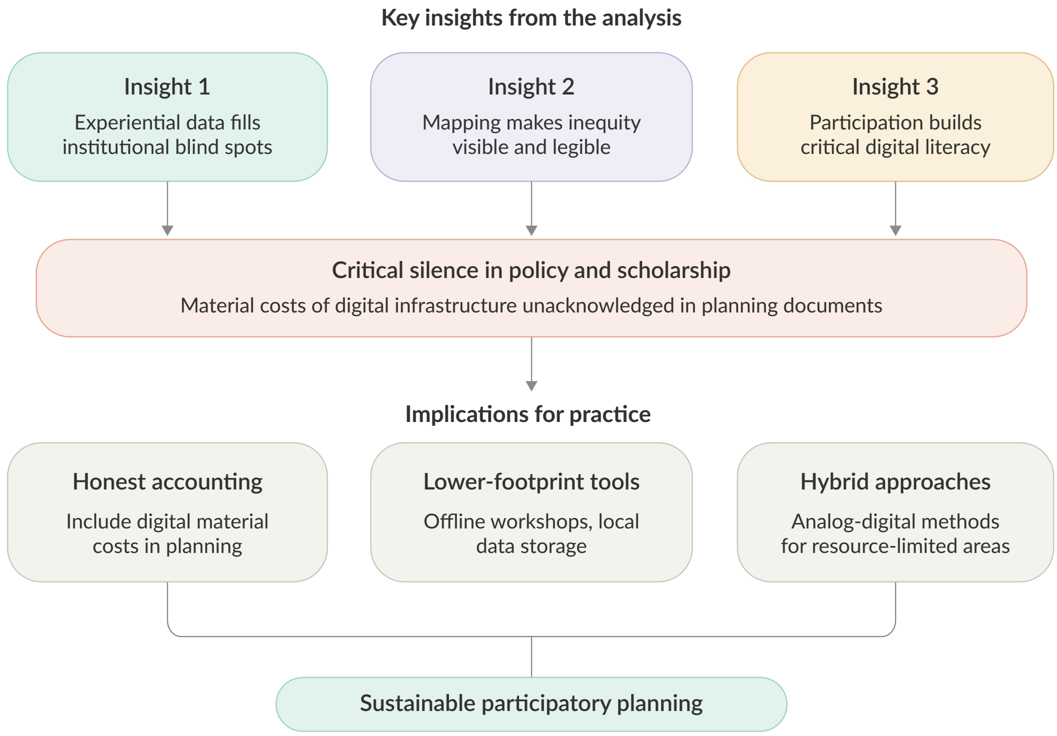

Figure 5. Convergence of experiential knowledge, communicative mapping, and reflexive digital literacy on the critical silence in planning documents regarding the material costs of digital infrastructure.

5. Discussion

Participatory sensing and digital technologies can improve planning outcomes, but only with careful attention to the sustainability of the digital infrastructure they rely upon. Three findings stand out.

First, the planning documents we reviewed recommend data and evidence but generalize about system-level sources, largely omitting experiential knowledge and the material costs of digital data collection. The citizen-produced flood risk maps are one example of knowledge absent from official West Texas hazard maps. Yet the cloud services, mobile apps, and sensor networks used to capture, store, and visualize such knowledge consume energy and water—costs that planning documents ignore (Chiappini & Ferrari, 2024; IEA, 2022). The direct footprint of participatory applications is marginal relative to hyperscale AI workloads (Section 3.5); the consequential omission is the absence of any accounting of the digital infrastructure economy at either scale. Where the Ogallala Aquifer is declining, gigawatt-scale projects are being approved, and HARC projects data center water use reaching 161 billion gallons annually by 2030, that silence matters.

Second, digital technologies communicate social relations. Interactive mapping collects data but also renders inequity legible to diverse audiences; Bixler et al. (2022) argue that maps make spatial patterns of inequality visible. Maps produced collaboratively in workshops consolidated scattered observations into a coherent picture (Mehan & Casey, 2025), which participants found useful for advocacy. Celebrating digital tools uncritically, however, risks reproducing smart-city logic, in which digital solutions to social problems appear inherently positive and their attendant costs go unexamined (Casey & Mehan, 2023; Chiappini, 2020; Cristofari, 2023)—including the tokenism trap, where digital engagement lends legitimacy without redistributing influence (Gonçalves et al., 2026). An honest account of participation must take material costs seriously.

Third, participation generates capacity. Participants reported a better understanding of local environmental conditions and greater confidence in addressing them, echoing arguments that such engagement serves as civic education (Bixler et al., 2022; Meyer et al., 2018). Facilitators prompted discussion of the energy and water costs of regional data center development, an issue rarely raised in participatory planning (Dekeyser & Lynch, 2025). Participants noted the paradox of a water-stressed region hosting resource-hungry infrastructure and reflected on disposing of the devices they used to participate—a concern resonant with recent work on digital excess (Lovink, 2019).

These findings carry a justice dimension. Read through environmental and climate justice, the case exhibits a distributional asymmetry: Benefits of the data center economy—tax base, construction employment, corporate revenue—accrue largely to actors outside the affected communities, while burdens of groundwater drawdown, air pollution from co-located gas-fired generation, and grid strain are borne locally, most acutely by lower-income residents already exposed to heat and flood risk. Read through data justice, the absence of mandatory water-use disclosure is a procedural injustice: Communities contribute their data and lived knowledge while being denied data about the infrastructures reshaping their water future. For planners, five implications follow: Attach water-use disclosure and metering to data center permitting and tax abatement agreements; incorporate citizen-generated risk layers into hazard mitigation and water plans through defined review procedures; budget for analog and offline formats so that broadband and device divides do not determine whose knowledge enters the record; offer bilingual materials and work through trusted community organizations to reach Spanish-speaking and undocumented residents; and weigh hosting and hardware footprints, including take-back arrangements, in platform procurement.

Limitations remain. The review drew primarily on English-language sources; few Spanish-language articles were identified, which in a region with many monolingual Spanish speakers may mean overlooking an important part of the population. Other divides, among undocumented residents for instance, could not be investigated (Mehan, 2025a). Workshop sampling was geographically constrained and the citizen-generated data temporally shallow, so the findings are analytically rather than statistically generalizable. Uptake of citizen-generated data also depends on political and bureaucratic will that a discrete project cannot secure (Grigg, 2022; Walsh, 2013). HARC identifies the disclosure gap as a particular obstacle to the transparent planning this study advocates. These constraints point to ongoing, institutionalized programs designed from the outset for both democratic inclusion and environmental sustainability (Mehan & Mostafavi, 2026), and to resource-efficient alternatives—offline workshops, analog mapping, local storage—that enable participation without intensifying the pressures participants seek to address (Matsumoto & Bohorquez, 2023).

6. Conclusion

This study has argued that digital participatory methods provide important means for incorporating citizen knowledge into planning processes in West Texas, though we must evaluate their democratic promise considering the sustainability of the digital infrastructures on which they rest. Results suggest that citizen-generated data illuminate environmental and infrastructural patterns missed by conventional planning data, visualize inequities in visually engaging ways, and bolster a sense of agency among participants with respect to shaping the direction of their communities. The policy analysis and workshop discussions further point to a critical silence in planning documents as well as participatory sensing literature about the energy and water demands and electronic waste created by the digital technologies we seek to deploy for democratizing planning. Crucially, this is not a claim that participatory tools themselves drive hyperscale resource consumption; it is a claim that participatory planning loses legitimacy when it remains silent about the material economy of the infrastructure it depends upon. West Texas offers both a challenging and instructive context in which to tackle this contradiction in light of local water scarcity, environmental degradation, low-density settlement patterns, and socio-demographic diversity in which the material costs of digital technologies become more tangible: in the competition for resources between data center cooling and irrigation water use, in the dearth of recycling infrastructure for electronic waste, and in the disparities in broadband availability that determine participation among the community and who is excluded. The scale and pace of data center deployment now underway in the region, with several projects totaling gigawatt capacity approved in the Permian Basin, the Panhandle, and along new emerging corridors, make these questions urgent. The study adds to the literature on digitalization and (un)sustainability by documenting both the democratic value and the sustainability challenges of digitally centered citizen participation for planning. We call for planning practices that combine participatory sensing with a clear accounting of the material costs of digital technology and development of more resource-efficient participatory technologies that can support democratic participation without reinforcing the very vulnerabilities they seek to ameliorate. Future research is needed on the long-term sustainability of institutional integration of citizen-generated data, on the relative (un)sustainability of different digital technologies for facilitating participation, and on the potential of analog-digital hybrid modes for participatory planning in resource-constrained contexts.

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Conflict of Interests

The author declares no conflict of interests.

LLMs Disclosure

The author used Grammarly solely for language editing, including grammar, phrasing, and readability.

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