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3D VISUALIZATION AND ELECTRONIC MODELS AS ACCELERATORS OF AFFORDABLE HOUSING APPROVALS IN THE UNITED STATES

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ABSTRACT

The shortage of affordable housing in the United States has become a federal priority, with the White House in FY2025 calling for reforms to reduce costs, accelerate approvals, and expand supply. Traditional housing development processes are slowed by lengthy permit reviews, costly design revisions, and community resistance often rooted in the difficulty of interpreting technical plans. This article argues that 3D visualization and electronic models—encompassing Building Information Modeling (BIM), 3D city models, and immersive environments—are practical tools to align with federal housing goals by streamlining approvals, lowering "soft costs," and enhancing public participation. Academic evidence demonstrates that realistic visualizations improve comprehension, trust, and dialogue in planning, while BIM-based permitting systems can automate compliance checks and cut review times. By converting abstract proposals into testable, transparent digital information, these tools reduce uncertainty, mitigate opposition, and enable more efficient multi-agency coordination. In the context of FY2025 presidential housing priorities, integrating 3D visualization and electronic modeling into permitting systems and participatory processes can significantly accelerate the delivery of affordable homes, ensuring that federal housing goals are met with greater legitimacy, equity, and efficiency.

Keywords: Affordable Housing. 3D Visualization. Building Information Modeling (BIM). Digital Permitting. Urban Planning. Public Participation. Housing Policy. United States. White House FY2025. Cost Reduction.

INTRODUCTION

The United States faces a structural shortage of affordable homes that has compounded over more than a decade of underbuilding, rising construction costs, and local regulatory frictions. In Fiscal Year 2025, the White House elevated housing affordability and supply expansion to a presidential priority, calling for cutting red tape, easing zoning bottlenecks, and speeding delivery while lowering “soft costs” in the development pipeline (White House, 2025a; White House, 2025b). Against that policy backdrop, 3D visualization and electronic modeling—encompassing Building Information Modeling (BIM), 3D city models, and immersive media—offer practical instruments to compress approval timelines, de-risk community engagement, and reduce design–review iteration costs for affordable projects without compromising public oversight.

Development approvals frequently stall around two points of friction: the interpretability of proposals by non-experts and the transaction costs of multi-agency coordination. Photorealistic and data-rich 3D models translate complex plan sets into legible spatial narratives that lay audiences and decision-makers can interrogate, improving comprehension of massing, shading, setbacks, and context impacts in ways that 2D drawings often cannot (Biljecki et al., 2015). Decades of research in environmental and landscape planning show that realistic 3D visualizations increase public understanding and can bolster confidence in decisions when used transparently, particularly for projects with visible neighborhood effects (Sheppard, 2005; Kwartler, 2005). In the housing context, that legibility can defuse opposition grounded in uncertainty by enabling early, scenario-based dialogue about scale, parking, and streetscape quality. Immersive consultation—via web-based 3D viewers or virtual reality walk-throughs—has been demonstrated as a feasible modality for public participation, even under constraints like the pandemic, by letting residents experience proposed environments before they are built and provide targeted feedback (Krajewska & Oprzędkiewicz, 2021). These tools do not eliminate disagreement, but they reduce the “translation penalty” that often elongates hearings, produces late-stage redesigns, and inflates soft costs.

Beyond community engagement, digitizing the building-permit pathway itself unlocks procedural gains. Systematic reviews of BIM-based permitting identify recurring benefits: machine-readable submissions, automated rule checking against code clauses, version-controlled collaboration, and traceable review comments, all of which reduce rework loops and clarify accountability among applicants and authorities (Ullah, Witt, & Lill, 2022). A complementary state-of-the-art survey documents live pilots where 3D/BIM submissions integrate with permitting back ends, demonstrating that digital transformation is technically mature when jurisdictions adopt common schemas and governance frameworks (Barmpis,

Stojanovic, Burova, & Parsanezhad, 2023). For affordable housing sponsors—who operate on thin margins and compressed timelines—those efficiencies translate into tangible savings: fewer paper resubmittals, shorter inter-disciplinary clarification cycles, and earlier certainty on entitlement conditions. When combined with 3D city models held by municipalities, reviewers can test envelope compliance, visualize fire apparatus access, or simulate overshadowing and wind comfort, turning qualitative concerns into analyzable, defensible checks (Biljecki et al., 2015).

Federal signals in FY2025 create an enabling policy climate for these digital practices. The Administration's housing agenda frames supply expansion as a national imperative and pairs it with directives to streamline permitting and modernize delivery systems; the budget narrative and subsequent fact sheets emphasize lowering the non-construction costs that slow projects and contribute to rent pressure (White House, 2025a; White House, 2025b). Parallel HUD initiatives that support state and local reforms—such as programs funding zoning modernization and permitting process improvements—explicitly target regulatory frictions that 3D/BIM workflows address, including multi-department coordination and predictable, transparent reviews (HUD, 2024–2025). Local governments pursuing these grants can plausibly incorporate 3D visualization and electronic submission standards into their "cutting-red-tape" playbooks, complementing pro-housing land-use changes.

The mechanism by which 3D models lower costs is not technological novelty per se but the conversion of ambiguity into shared, testable information. In public meetings, side-by-side scenarios—by-right massing versus proposed variances, or different façade treatments within the same envelope—let stakeholders focus on trade-offs rather than abstractions. Research across planning and environmental visualization underscores that when participants can perceive spatial consequences directly—height, shadow paths, privacy lines—they produce more specific, constructive feedback earlier, reducing the probability of late reversals (Sheppard, 2005; Biljecki et al., 2015). In staff and inter-agency reviews, BIM-to-permit integrations allow automated flagging of clear-cut noncompliance (e.g., stair clearance, egress, accessibility dimensions) so human reviewers spend more time on judgment calls and less on manual checks (Ullah et al., 2022; Barmpis et al., 2023). For affordable housing developers navigating layered subsidies and milestone-driven financing, cycle-time reductions of even weeks can protect tax-credit schedules and interest carry.

Crucially, these benefits depend on standards and governance. Jurisdictions can avoid vendor lock-in and applicant burden by accepting open formats (e.g., IFC) and publishing digital submission guides that map local code clauses to model attributes. Cities that maintain base 3D city models—LOD2/LOD3 building geometries with semantics—can require

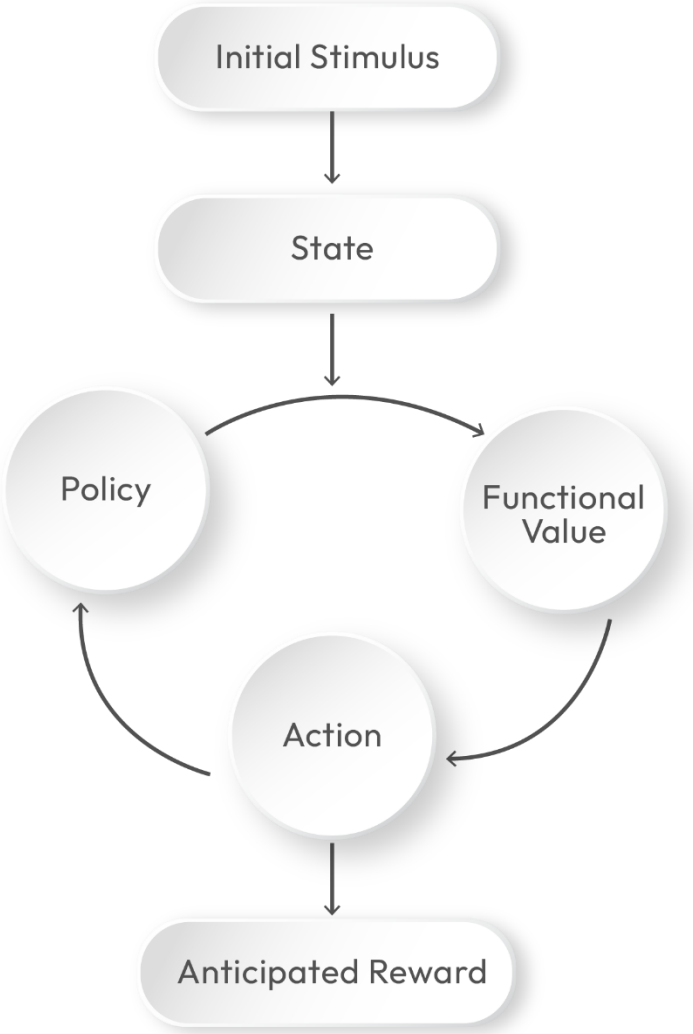
georeferenced submittals, enabling contextual analyses without bespoke data wrangling each time (Biljecki et al., 2015). To preserve equity in participation, agencies should pair immersive tools with accessible, low-bandwidth viewers and in-person kiosks so that residents without headsets or high-end hardware are not excluded. Transparency guidelines—including how render settings, daylighting assumptions, and camera lenses are chosen—mitigate the risk of “over-persuasive” visuals and align with ethical cautions from the visualization literature (Sheppard, 2005).

A pragmatic federal–local playbook emerges. At the federal level, keep tying competitive funds to measurable permitting reforms and digital capacity—model submission pilots, automated checks for standard code items, and open-data 3D basemaps for site plan review. At the state and metropolitan levels, offer shared services—regional BIM validation engines, template 3D policy guides, and training for small- and mid-size jurisdictions that cannot build bespoke systems. Locally, start with “no-regrets” steps: accept IFC-based submittals alongside PDFs; publish a 3D visualization protocol for hearings; and pilot VR or web-3D open houses for significant affordable projects, recording whether comment specificity increases and resubmittal counts fall. Evidence from permitting reviews and participatory planning suggests that these steps, if standardized and evaluated, can shorten decision cycles while improving deliberative quality, thereby advancing the FY2025 federal objective of faster, less costly delivery of affordable homes (White House, 2025a; Ullah et al., 2022; Barmpis et al., 2023).

The flowchart illustrates how the integration of 3D visualization and electronic models addresses the structural shortage of affordable housing in the United States. It begins with the problem of limited housing supply and slow approval processes, followed by the federal priority established in the FY2025 White House reforms. The chart then highlights barriers such as complex permitting, costly revisions, and community resistance. As a solution, it introduces the use of 3D visualization, Building Information Modeling (BIM), and immersive tools. These innovations generate benefits like faster approvals, reduced soft costs, improved public participation, and enhanced multi-agency coordination. Through open data standards, digital permitting systems, and inclusive consultation practices, the process ultimately leads to the accelerated and more legitimate delivery of affordable housing.

Figure 1

Flowchart of 3D Visualization and Electronic Models in Affordable Housing Approvals



Source: Created by author.

If housing affordability is a national priority, then the approval system must become a national asset rather than a liability. 3D visualization and electronic models are not silver bullets, but they are proven levers to convert contention into clarity and paperwork into data. With targeted governance and equity safeguards, they can compress timelines, lower soft costs, and enhance legitimacy—precisely the combination the United States needs to scale affordable housing at speed and with public trust.

REFERENCES

1. Barmpis, K., Stojanovic, V., Burova, A., & Parsanezhad, P. (2023). Digital Transformation of the Building Permit Process: State of the Art and Case Studies. Buildings, 13, 2554.
2. Biljecki, F., Stoter, J., Ledoux, H., Zlatanova, S., & Çöltekin, A. (2015). Applications of 3D City Models: State of the Art Review. ISPRS International Journal of Geo-Information, 4(4), 2842–2889.
3. Krajewska, A., & Oprzędkiewicz, J. (2021). Virtual Reality as a Tool for Public Consultations in Spatial Planning—Opportunities and Threats. Energies, 14(19), 6046.
4. Kwartler, M. (2005). Visualization in landscape planning: the VR model has been found not only to support public participation but to help build public confidence in planning decisions. In T. L. Bishop & E. Lange (Eds.), Visualization in Landscape and Environmental Planning: Technology and Applications (pp. 198–211).
5. Sheppard, S. R. J. (2005). Landscape visualisation and climate change: The potential for influencing perceptions and behaviour. Environmental Science & Policy, 8(6), 637–654.
6. Ullah, K., Witt, E., & Lill, I. (2022). The BIM-Based Building Permit Process: Factors Affecting Adoption. Buildings, 12(1), 45.
7. U.S. Department of Housing and Urban Development (HUD). (2024–2025). PRO Housing and related state–local action plan materials supporting permitting and zoning reform to reduce barriers to housing production.
8. White House. (2025a, January 14). Fact Sheet: Lowering Housing Costs for Working Families.
9. White House. (2024–2025). FY2025 Budget materials highlighting housing affordability and supply as a presidential priority.