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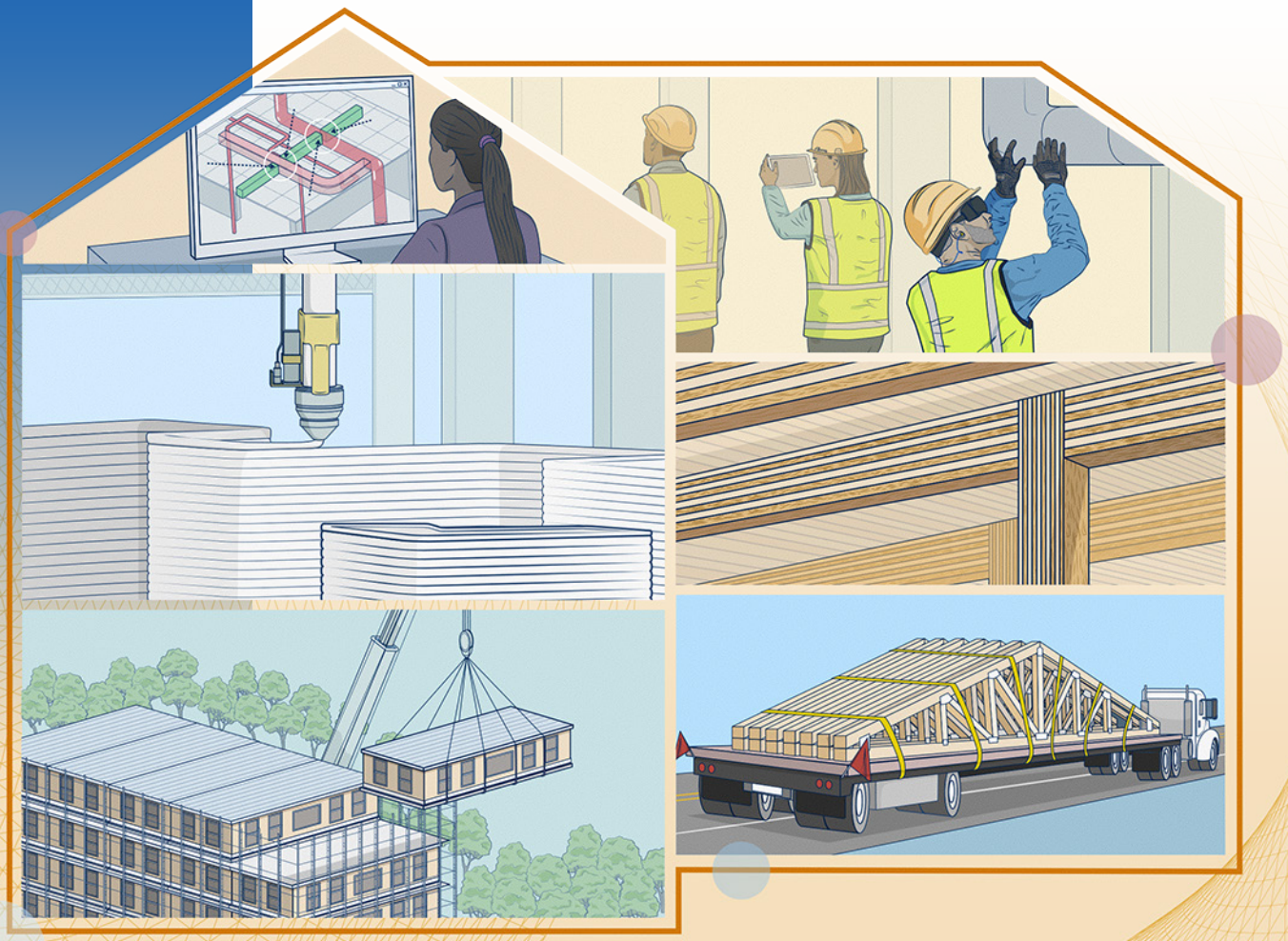
Report to Congressional Committees

November 2026

TECHNOLOGY ASSESSMENT

Housing Construction Innovations

Technologies and Policy Options to Help Increase Supply and Affordability



GAO-27-108037

The cover image is a stylized representation of a house illustrating several innovative housing construction technologies. Clockwise from top left: engineer using computer aided design software, construction workers checking building information on a tablet computer, mass timber structural elements, roof trusses in transit to a construction site, a modular multifamily housing development, and 3D concrete printing.

Cover source: GAO. | GAO-27-108037

TECHNOLOGY ASSESSMENT

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Highlights of GAO-27-108037, a report to congressional committees

November 2026

Why GAO did this study

Housing affordability is a top concern for many Americans, as high housing costs can lead to adverse economic and social effects. Owners and renters have seen housing costs increase faster than other consumer prices and income, straining household budgets.

While housing construction is a near-trillion-dollar industry, limited inventory contributes to housing unaffordability, as potential homebuyers and renters compete to purchase or rent housing. GAO reviewed technologies that could help improve production and reduce costs of housing.

This report examines (1) current and emerging technologies that could help increase supply and affordability of housing, (2) benefits and challenges associated with these technologies in comparison to traditional construction methods, and (3) policy options that could support various policy goals related to these technologies.

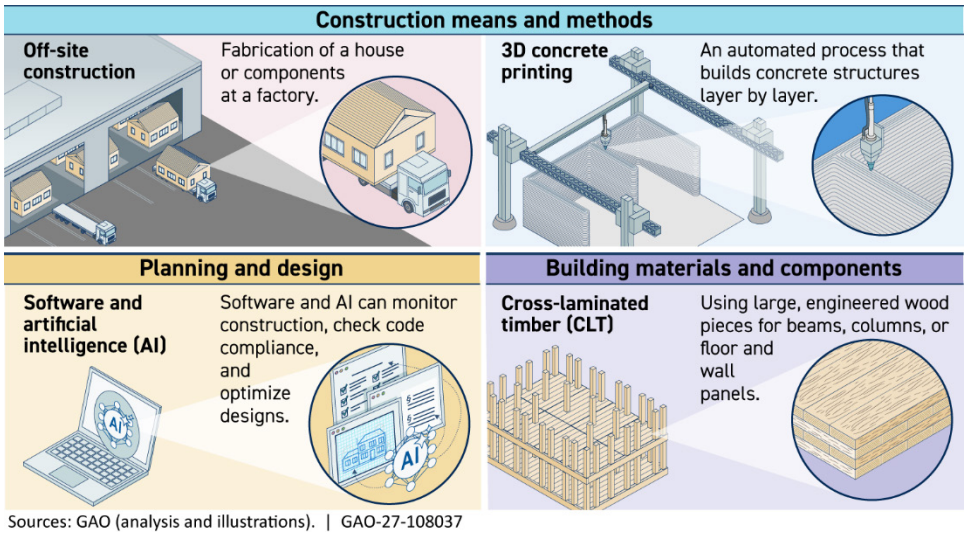
To conduct this technology assessment, GAO reviewed relevant literature and agency documents; interviewed officials and representatives from government, industry, academia, nonprofits, and trade associations; conducted site visits; attended conferences; and convened a 2-day meeting of 17 experts. GAO is identifying policy options in this report (see next page).

View GAO-27-108037. For more information, contact Karen L. Howard, PhD, at HowardK@gao.gov.

What GAO found

Numerous housing construction technologies could help improve production, reduce costs, and potentially increase supply and affordability. Some technologies are mature but not widely adopted, and others are new or emerging. These technologies can be grouped into three categories: planning and design, construction means and methods, and building materials and components. Examples are shown in the figure below.

Examples of housing construction technologies



Sources: GAO (analysis and illustrations). | GAO-27-108037

Benefits of housing construction technologies such as these may include:

- **Faster construction and enhanced efficiency**. For example, building a house or some of its components off-site in an efficient, controlled environment can reduce the overall project time.
- **Reduced costs**. For example, automated technologies that cut lumber to precise dimensions can reduce costs by minimizing waste.
- **Improved decision-making and regulatory oversight**. For example, software tools that use land and regulatory data can help planners understand how local policy decisions can inform housing construction outcomes.

Challenges limiting broader adoption and use of construction technologies include:

- **Regulatory challenges**. More than 20,000 jurisdictions administer residential building codes, requiring significant time, labor, and money to comply.
- **Workforce and education gaps**. Training on new technologies requires staff, time, and money that builders may not have.
- **Financial challenges**. New technologies can have high up-front costs that are more than traditional construction methods for both builders and consumers.

Based on GAO's review, GAO identified five policy subgoals and associated policy options related to the broad goal of increasing housing supply and improving affordability. These policy options are a set of alternative actions that policymakers, such as legislative bodies, government agencies, standards-setting organizations, industry, and other groups, could consider taking.

Policy subgoals and policy options to help increase housing supply and improve affordability using construction technologies

Subgoal: Streamline regulatory processes

Policy options:

- Establish state or regional building code authority with interstate reciprocity for off-site-constructed housing (report p. 24)
- Develop regulatory pathways for new technologies (report p. 25)
- Standardize oversize load permitting for interstate transportation of housing modules or components (report p. 25)
- Support zoning and development conditions that enable innovative housing construction (report p. 26)
- Implement and scale preapproved housing design libraries (report p. 27)

Subgoal: Reduce financial barriers

Policy options:

- Provide financial incentives for housing suppliers to use innovative methods (report p. 28)
- Provide financial incentives and products to support consumers (report p. 29)

Subgoal: Increase housing production capacity through education and training

Policy options:

- Expand vocational and technical education pathways for innovative construction (report p. 31)
- Engage labor unions as partners in expanding the off-site construction workforce (report p. 32)
- Train and certify building inspectors and code officials in innovative construction methods (report p. 33)

Subgoal: Increase public acceptance of innovative housing options

Policy option:

- Support public education campaigns on housing construction technologies (report p. 34)

Subgoal: Optimize government resources and leadership

Policy options:

- Increase government support for technology adoption (report p. 35)
- Build a national housing construction data infrastructure (report p. 36)
- Prioritize federal research and development activities to better support housing construction technologies (report p. 37)

Source: GAO. | GAO-27-108037

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Abbreviations

AI	artificial intelligence
BIM	building information modeling
CAD	computer-aided design
FHA	Federal Housing Administration
HUD	Department of Housing and Urban Development
R&D	research and development

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November 10, 2026

The Honorable Tim Scott
Chairman
The Honorable Elizabeth Warren
Ranking Member
Committee on Banking, Housing, and Urban Affairs
United States Senate

The Honorable French Hill
Chairman
The Honorable Maxine Waters
Ranking Member
Committee on Financial Services
House of Representatives

The Honorable Brian Babin
Chairman
The Honorable Zoe Lofgren
Ranking Member
Committee on Science, Space, and Technology
House of Representatives

High housing costs are one of the top economic issues facing American households. They can cause financial strain for many Americans across income levels, as disproportionate spending on housing leaves fewer resources for other expenses such as food, health care, and transportation. Unaffordable housing can also affect long-term retirement security, limit the ability to save, restrict economic mobility, and increase inequality, among other societal effects. Both homeowners and renters have seen housing costs increase faster than other consumer prices and income, which significantly stresses household budgets. For example, the Joint Center for Housing Studies of Harvard University found that from 2019 through 2024, median single-family home prices in the U.S. rose by approximately 50 percent, exceeding the rise in median income.[1] The center also reported that in 2023 the number of cost-burdened homeowner

[1]During this period, the median housing price-to-income ratio increased from 4.1 to 5.0, showing that housing prices increased at a greater rate than income. Joint Center for Housing Studies of Harvard University, *The State of the Nation's Housing 2025* (Cambridge, Mass: Jun. 24, 2025) and *Housing Perspectives: Home Prices Surge to Five Times Median Income, Nearing Historic Highs* (Cambridge, Mass: Oct. 6, 2025).

households was 20.3 million (representing 24 percent of all homeowner households), and cost-burdened renter households equaled 22.6 million (about 50 percent of all renter households).[2]

While residential construction is a near-trillion-dollar industry, limited inventory continues to contribute to housing unaffordability, as potential homebuyers and renters (consumers) compete to purchase or rent housing.[3] While several types of housing products—such as single-family homes or apartment units—exist to help meet demand, production is highly regulated, capital intensive, and sensitive to local labor and material availability.[4] These factors have contributed to housing production lagging behind the pace that is needed to improve affordability. A 2024 analysis from the Office of the Comptroller of the Currency found that approximately 80 percent of metropolitan areas in the U.S. had housing production rates in 2023 below their historical averages.[5] This analysis also found that the single-family home production rate remained below historical average levels for the 15 years prior (2008–2023).

We prepared this report at the initiative of the Comptroller General to describe how construction technologies could increase the production of housing at the scale and price points needed to help improve affordability. Specifically, this report examines (1) current and emerging technologies that can help to improve production or reduce the costs of housing to increase supply and affordability; (2) potential benefits and challenges to adopting these technologies and how they compare to traditional construction methods; and (3) policy options that could support various policy goals.

To address all objectives, we identified and reviewed relevant literature and agency documents, and interviewed experts and stakeholders to determine how technologies may help improve production and reduce costs, and to identify policy options that could help realize identified policy goals. We conducted multiple site visits to locations in six states where housing construction innovations were in use or under development. In addition, we convened a 2-day expert meeting focused on policy options to help address identified challenges and achieve

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[2]Joint Center for Housing Studies of Harvard University, *The State of the Nation's Housing 2025*. The report defines cost-burdened households as those who spend more than 30 percent of their income on housing and utilities.

[3]Estimating the extent to which there is a housing shortage is complex, as the interaction between supply and demand can be affected by a variety of interrelated factors, including housing prices, location, demographic trends, and preferences. Further, housing shortages are not evenly distributed, and estimates do not provide information on the magnitude or type of shortages or surpluses in specific geographic areas. Studies using different methodologies that estimate housing supply range from reporting a surplus to a deficit of millions of units. For example, Kirk McClure and Alex Schwartz, "Where Is the Housing Shortage?" *Housing Policy Debate*, vol. 35, no. 1 (2025). https://doi.org/10.1080/10511482.2024.2334011, and Moody's Corporation, "Bringing the Housing Shortage Into Sharper Focus" (Jul. 2025).

[4]For purposes of this report, housing units are defined as any long-term residence including single-family housing or multifamily housing such as apartments, townhomes, and condominiums. Single-family housing refers to a property with one to four families that reside on the premises. Multifamily housing such as apartment and condominium buildings refers to a structure that contains five or more families.

[5]The analysis refers to production rates as the ratio of total housing completions (single-family and multifamily) to resident populations. See Office of the Comptroller of the Currency, *The Geographic Mismatch Between Housing Construction and Shortages* (Washington D.C.: Oct. 10, 2024).

policy goals. See appendix I for the full objectives, scope, and methodology for this report and appendix II for the expert meeting participants.

We conducted our work from January 2025 through November 2026 in accordance with all sections of GAO's Quality Assurance Framework that are relevant to technology assessments. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to meet our stated objectives and to discuss any limitations to our work. We believe that the information and data obtained, and the analyses conducted, provide a reasonable basis for any findings and conclusions in this product.

1 Background

1.1 Housing costs and affordability

Availability of affordable housing has been a long-standing goal for policymakers. For example, in the Housing Act of 1949, Congress set a national goal of "a decent home and a suitable living environment for every American family."[6] More recently, the 21st Century ROAD to Housing Act was enacted in July 2026, aiming to increase housing supply through revisions to several federal housing programs, including streamlining environmental reviews, updating manufactured housing requirements, and expanding financing of affordable housing.[7]

Despite these goals, U.S. housing supply and production rates have not kept pace with population and household growth.[8] As a result of undersupply and other factors, housing costs have risen faster than income growth, which can contribute to reduced affordability. Low- and median-income households are particularly sensitive to housing cost increases, which have occurred across the U.S., including 88 of the 100 largest metro areas.[9] For example, according to the National Association of Realtors, the share of first-time buyers in the market fell to 21 percent in 2025, a sharp decrease from approximately a 40 percent share in 2007, as these households are priced out of the housing market.

1.2 Housing types and construction methods

The U.S. housing supply is made up of a mix of various housing types ranging from single-family homes to multifamily apartment buildings. More than 90 percent of single-family housing in the U.S. is built with wood-frame construction. Low-rise multifamily buildings are also often wood-frame construction. Multifamily buildings above a certain height typically incorporate steel and concrete materials in their structures.

Housing construction methods range from building on-site using traditional construction methods at a house's permanent location to fabricating significant components or the entire house off-site. Components that are built off-site can then be delivered and assembled at a residential property location.[10]

[6]42 U.S.C. § 1441. The Cranston-Gonzalez National Affordable Housing Act, enacted in 1990, reaffirmed this goal and aimed to help first-time homebuying families save for the down payment of a home and retain affordable housing for low-income families, among other purposes. 42 U.S.C. §§ 12701–12703. In March 2026, the President issued an executive order setting out a policy "to reduce regulatory barriers to building homes and to steward taxpayer dollars in a manner that promotes housing affordability." Exec. Order No. 14394, *Removing Regulatory Barriers to Affordable Home Construction*, 91 Fed. Reg. 13207 (Mar. 13, 2026).

[7]Pub. L. No. 119-101, 140 Stat 846.

[8]It is too soon to measure effects of the July 2026 legislation.

[9]Joint Center for Housing Studies of Harvard University, *The State of the Nation's Housing 2025*.

[10]For purposes of this report, on-site construction refers to housing constructed primarily at the building site under applicable state and local building codes. Modular construction refers to buildings or components constructed in whole or in part away from the final building site that generally remain subject to applicable state and local building codes. Components, or subassemblies, are elements designed for use in or as part of a building and may be part of the structural, electrical, mechanical, plumbing, or fire protection systems.

Manufactured housing is a special type of housing that is assembled in a factory to conform to federal standards set by the Department of Housing and Urban Development (HUD).[11] Among other things, these standards specify that a manufactured house be of certain dimensions and meet certain fire safety and energy efficiency standards. Unlike other housing types, manufactured housing has primarily been titled as personal property, which can result in less favorable treatment with respect to financing and taxation.

1.3 Housing construction process and regulatory controls

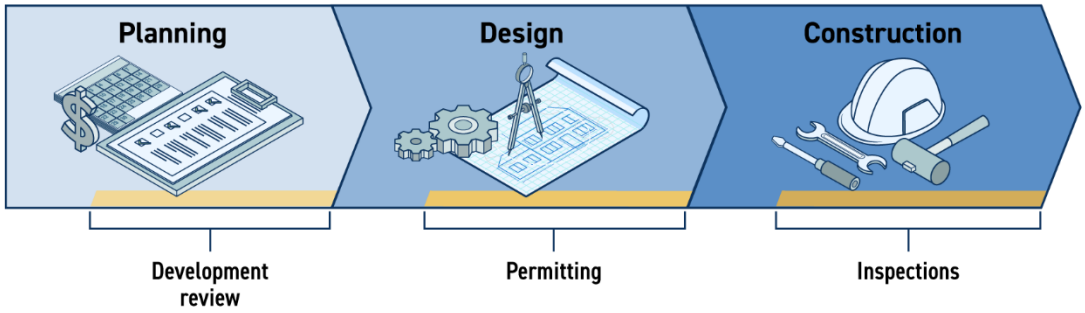
The housing construction industry is widely distributed with an estimated 400,000 or more homebuilding companies across the U.S.[12] Approximately 100 of the largest companies in the sector account for about half of new single-family housing sales. Homebuilding companies are responsible for executing a highly regulated construction process. Different levels of government are responsible for regulatory oversight of the process, including the enforcement of building standards developed by code-setting bodies.

Construction process. For housing developers, the housing construction process consists of three major phases—planning, design, and construction (see fig. 1). In the planning phase, a developer conceptualizes project ideas and conducts needs assessments of possible sites, structures, and eventual occupants. Financing and land are usually obtained during this phase, and initial site plans are submitted to local regulatory agencies for development review. During the design phase, the developer defines a project with architects and engineers by creating plans and specifications. In addition, permit applications are submitted by the developer for site work and construction. Financing work may continue during this phase. In the construction phase, the design is executed by a construction contractor (or manufacturer) using labor, materials, and equipment to turn the design into a completed house. Inspections are a key part of this phase to help ensure construction entities comply with quality and safety standards. Insurers also play a role by providing coverage for contractors during the construction phase as well as for homeowners during occupancy.

[11]Manufactured housing is built to the Manufactured Home Construction and Safety Standards, also known as the HUD Code. 24 C.F.R. Part 3280. These standards took effect in 1976 and are updated periodically by HUD based on analysis of recommendations from the Manufactured Housing Consensus Committee (a federal advisory committee). 42 U.S.C. § 5403(a).

[12]Better Business Bureau, *Home Builders Outlook: Home Builders Industry Trend Forecast* (2022).

Figure 1: Housing construction process and selected regulatory steps



Source: GAO (analysis and illustrations). | GAO-27-108037

Regulatory agencies. Housing construction is largely regulated through local zoning ordinances and state and local building codes. Zoning ordinances established by local authorities set rules such as allowable building types and densities in each zone or geographical area. Local government planning and zoning staff typically review development proposals to determine whether they are allowable under zoning ordinances.

In addition, state and local regulatory agencies set requirements for the building codes to which construction must conform, which local authorities can modify further.[13] For example, state and local codes may require more or less stringent standards than the most recent edition of the model codes. In states that do not set statewide standards, local agencies establish building code standards. In either case, these agencies are responsible for inspecting construction to ensure that the housing meets code requirements.

Standards development organizations and testing entities. Residential building codes are usually based on model codes developed by standards development organizations, also known as code bodies, such as the International Code Council. The International Code Council publishes the International Residential Code, which covers single-family homes, and the International Building Code, which covers multistory residential buildings. These codes are updated every 3 years and detail minimum requirements for residential housing components. Requirements include those related to structural components; thermal insulation; and heating and cooling, plumbing, and electrical systems. These requirements are intended to provide a reasonable level of safety for occupants as well as for emergency responders.

Testing and certification entities support code development by testing the performance of products used in housing construction. Products that pass these tests receive certification to show that they meet safety and regulatory requirements.

[13]The International Code Council develops residential building codes, which have been adopted by most states and municipalities.

2 Housing Construction Technologies

We examined several housing construction technologies that could improve production and reduce costs, which may help increase housing supply and affordability. We grouped these technologies into three categories based on when and how they are used during the construction process: planning and design, construction means and methods, and building materials and components. Some are mature but not widely adopted, and others are new or emerging. Multiple, interrelated benefits could be derived from use of these technologies; however, these benefits might accrue unevenly among stakeholders.

2.1 Planning and design

Planning and design technologies are used to perform or support activities prior to construction, such as designing the structure that will be built and obtaining land, financing, and regulatory approvals. The primary innovations in this category relate to software, artificial intelligence (AI), virtual reality, and blockchain.

Software. Notable software tools include building information modeling (BIM) and digital twins, both of which are advancements in computer-aided design (CAD), a software platform that allows architects and engineers to create 2D and 3D drawings of a building.[14]

BIM software can integrate multiple CAD drawings into 3D models and allows project teams to understand how multiple building systems, such as the electrical, plumbing, and structural systems, will interact with each other in a realistic model. Digital twins are an expansion of BIM technology and act as a virtual replica of a building.[15] They provide builders with a 3D digital model of a construction site in real time, continuously updated using on-site data obtained through sensors.

AI. AI broadly refers to machine-based systems that are capable of making predictions, recommendations, or decisions given a set of human-defined objectives. AI has many possible uses for the housing construction industry, and new AI tools continue to be developed (see table 1).

[14]CAD was developed in the late 1950s and early 1960s. It is standard for designers to use CAD tools to create building drawings. BIM started as a concept in the 1990s and began to be adopted in the early 2000s. Although it is used by some commercial builders, according to one technology company we spoke with, BIM is still not widely used in the housing construction industry as many homebuilders do not have the technology or staff trained in it.

[15]For additional information on digital twins, see GAO, *Science & Tech Spotlight: Digital Twins—Virtual Models of People and Objects,* GAO-23-106453 (Washington, D.C.: Feb. 14, 2023).

Table 1: Current and potential uses of innovative software and artificial intelligence (AI) technologies by different stakeholders in the planning and design phase

Technology	Uses for architects, engineers, and builders	Uses for regulatory officials[a]
Software tools, such as building information modeling (BIM)	• Clash detection[b] • Component design • Inventory management • Collaboration between trades • Improving energy efficiency • Crowdsourcing investments • Creating a digital marketplace for prefabricated components	• Market forecasting to understand effects of policies • Electronic permitting and plan reviews • Permit tracking • Digitizing building code and zoning regulations • Virtual inspections
AI	• Land parcel identification • Optimizing site design • Design generation adhering to multiple code and zoning laws • Prechecking code compliance • Waste reduction through design optimization	• Digitizing building code and zoning regulations and records • Plan review for code compliance • Inspections • Analyzing the effectiveness of building code requirements • Monitoring regulatory sentiment

Source: GAO analysis of agency information and literature. | GAO-27-108037

[a]These potential uses of software and AI for regulatory officials were noted by the experts we interviewed.

[b]Clash detection is the process of identifying where the planned location of different components (e.g., plumbing and mechanical components) interfere with each other.

Builders can use software and AI tools to support planning and design activities. For example, by identifying conflicts in the design phase, clash detection can help a project avoid lengthy and costly rework during construction. In addition, digital twins can provide information to builders on progress, flag timeline deviations, and prevent costly rework by comparing physical builds directly to design plans. Further, housing developers can use software tools to determine whether a new project is feasible and inform decisions on where they could consider development.

These tools can also help support regulatory functions. For example, software simulation tools that draw on parcel-level land use and regulatory data can help users understand how policy actions, such as increasing allowable density, could affect housing construction. Use of such software tools, including to inform where to develop housing in proximity to economic centers, could provide information on and potentially shorten commuting distances and decrease traffic congestion, improving the quality of life for people in a community. Further, software tools could help officials manage activities such as project reviews and permitting actions more efficiently, according to experts we interviewed.

Virtual reality. Virtual reality immerses users in a 3D computer-generated simulation of a

building model that can be used for clash detection or with a digital twin.[16] When a designer or builder can visualize a building's design in this way, they can identify where components might clash with each other or find other design changes that need to be made before construction starts.

Blockchain. Blockchain operates as a distributed database that keeps a secure record of all updates and actions.[17] It can help state and local agencies keep a time-stamped record of updates to building codes and zoning ordinances and help builders keep a list of supply transactions. By using blockchain, these records are less susceptible to security threats. Additionally, people seeking information about building codes can identify which edition of the building code was active at a given point in time.

2.2 Construction means and methods

Housing is traditionally constructed with most of the work conducted on site. Technologies related to construction means and methods can present different approaches to building housing that may help speed the construction process and reduce costs. These include approaches to off-site construction and other emerging technologies.

Off-site construction. Off-site construction is the fabrication of a housing unit or significant components in a factory. Off-site construction technologies range from having the entire housing unit built in a factory to having only smaller sections, sometimes referred to as subassemblies, built in a factory and the rest of the housing unit built on-site. Because off-site construction occurs in a controlled environment where production is not susceptible to weather delays, projects could be delivered with greater certainty compared to projects that are fully built on-site. Off-site construction can also result in safer and more efficient production because a controlled environment can allow for standardization, streamlining, and fewer fabrication errors. The predictability of off-site construction could allow for the establishment of contractual arrangements for housing units at set prices, reducing project risk for the housing developers.

[16]For more information on virtual reality, see GAO, *Science & Tech Spotlight: Extended Reality Technologies,* GAO-22-105541 (Washington, D.C.: Jan. 26, 2022).

[17]For more details on how blockchain works, see GAO, *Blockchain: Emerging Technology Offers Benefits for Some Applications but Faces Challenges,* GAO-22-104625 (Washington, D.C.: Mar. 23, 2022).

One type of off-site construction is manufactured housing (see text box), which, according to HUD, accounts for approximately 10 percent of total single-family new construction activities in the U.S. Similar to manufactured housing, modular housing is built off-site. Whereas manufactured housing is built to meet requirements of the federal Manufactured Home Construction and Safety Standards (HUD Code), modular housing is built to state and local codes.[18] Modular housing units can be constructed and configured for both single family and multifamily housing developments. Figure 2 shows the construction of a multifamily building using modular housing units. Modular construction in 2025 represented about 5 percent of new construction activities.[19]

Manufactured housing

Historically, manufactured housing has been built on a steel chassis, enabling units to be transported to a site, where most remain as originally placed.



However, recently enacted legislation directs a change in the federal Manufactured Home Construction and Safety Standards (HUD Code), to allow placement of manufactured houses on permanent foundations without a chassis (see Housing Supply Expansion Act within the 21st Century ROAD to Housing Act, § 301(a)–(b), Pub. L. No. 119-101, 140 Stat. 846, 888 (2026) (codified at 42 U.S.C. §§ 5402(6), 5403(a)(7))).



Elimination of the chassis allows for greater design flexibility and enhanced architectural features, including two-story configurations for multifamily housing structures.

Source: GAO analysis (text) and Clayton Homes (photos). | GAO-27-108037

[18]24 C.F.R. Part 3280. The HUD Code was adopted pursuant to the National Manufactured Housing Construction and Safety Standards Act of 1974, 42 U.S.C. §§ 5401–5426.

[19]The Modular Building Institute, *2026 United States Permanent Modular Construction Industry Report* (Charlottesville, Va: 2026).

Figure 2: **Modular multifamily housing development**



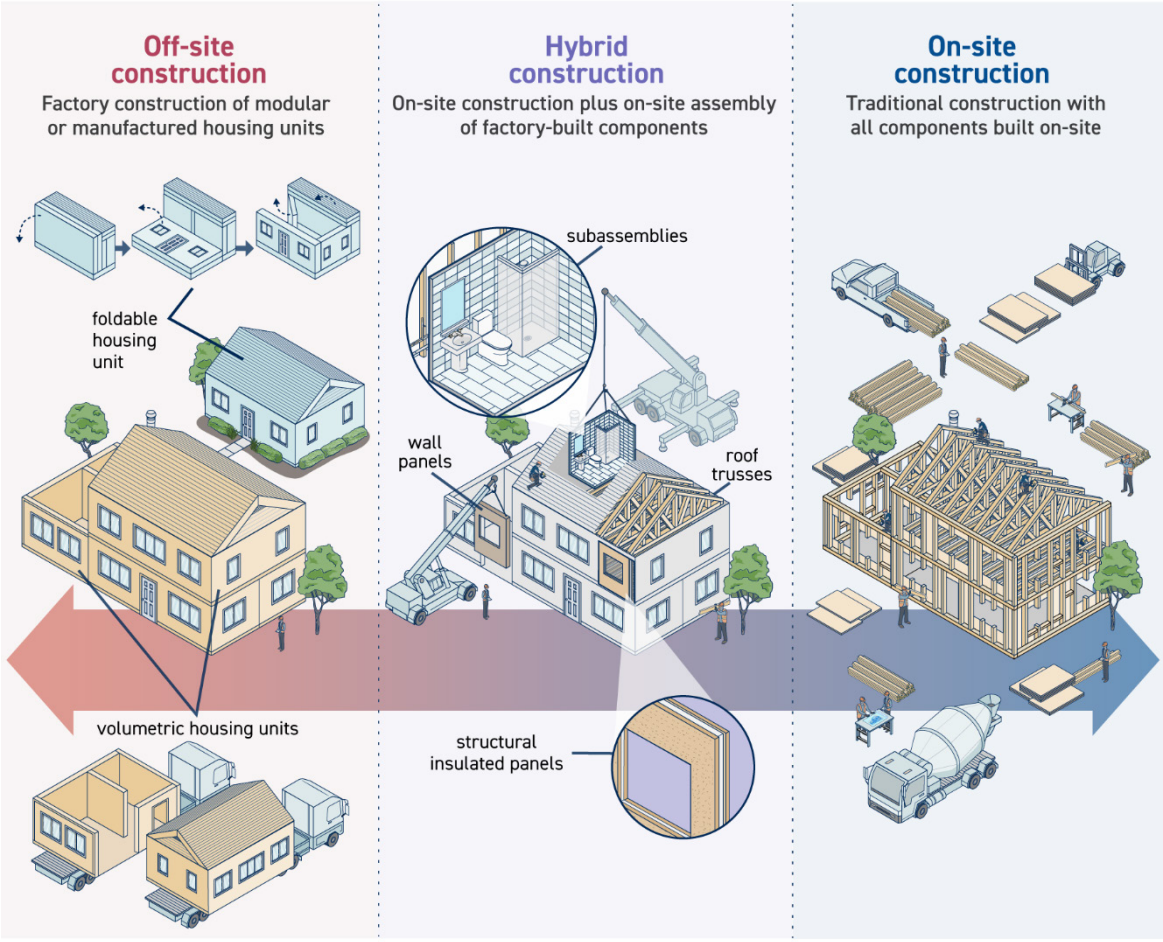
Source: Nibbi Brothers General Contractors. | GAO-27-108037

Modular housing units can be built and shipped using different methods. *Volumetric assembly* involves building and transporting a complete 3D room-sized module. *Foldable units* are folded smaller for transportation and then restored to their full, final shape when delivered to a site. *Flat-pack units* have wall, floor, and roof units that are stacked together during transportation and then constructed into a house at a project site.

Examples of subassemblies that can be built off-site include complete bathroom or kitchen pods that can be craned into place at a project site. Other components that can be built in a factory and transported to the project site include roof trusses, wall panels, and floor systems. For example, structural insulated panels are a type of subassembly that consists of an insulation core, typically foam, sandwiched between two wall facings made from wood products. These panels can be fabricated with integrated wiring and piping to facilitate the operation of heating and cooling, electrical, and plumbing systems once the panels are assembled. Structural insulated panels can improve building performance by providing both structural strength and insulation for improved energy efficiency.

Other parts of a house that can be built off-site are prefabricated foundations, modular electrical panel systems, and plumbing units. Standardized electrical and plumbing units assembled in the factory require less work and time to install on site, potentially resulting in lower project costs. Figure 3 illustrates the spectrum of off-site to on-site construction.

Figure 3: **Spectrum of off-site to on-site housing construction methods**



Source: GAO (analysis and illustrations). | GAO-27-108037

While off-site construction has been practiced in the U.S. since the early 1900s and more prominently after World War II, current innovative practices involve automation. For example, some factories are almost entirely automated, using robotics for most assembly steps. This can include automated cutting and material handling systems to manage, move, and cut lumber to precise dimensions, thereby minimizing waste. Lastly, companies are developing software tools to optimize the use of space in off-site construction factories. Automation, waste reduction, and optimization of factory space could lead to increased efficiency and lower production costs.

Other construction means and methods technologies. In addition to off-site construction, other housing construction means and methods technologies include 3D concrete printing, on-site robotics, mobile micro-factories, and augmented reality for construction workers.

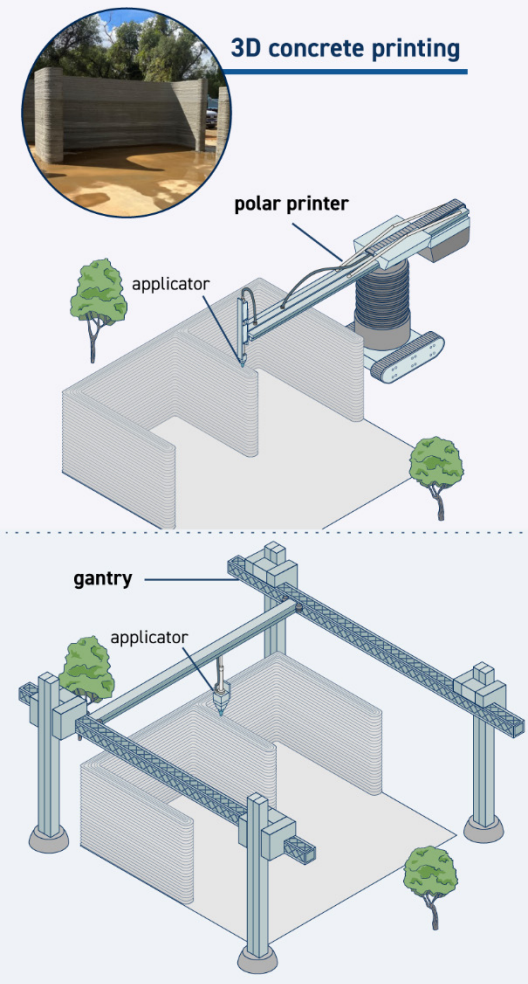
3D concrete printing, an example of additive manufacturing, is an automated process that builds concrete structures layer by layer (see fig. 4). A large printer with a moveable nozzle places concrete in layers as the nozzle moves. There are multiple styles of concrete printers, but the most widely used is a gantry printer, in which an applicator nozzle is mounted to a horizontal frame so it can move over the entirety of a house footprint. 3D-concrete-printed houses, if properly designed and reinforced, could be more resilient to many natural hazards, such as extreme winds, floods, and wildfire, compared to traditional light-frame wood constructed houses, because of the strength and durability of concrete.

Some innovative housing construction technologies represent advancements in both construction means and methods and building materials. Examples of these technologies include steel-frame and mass timber modular houses, which combine off-site construction with new materials. Modular housing is typically built using light-frame wood construction, which is the most common material used in housing construction, but some companies are designing modules that can be built in a factory with steel frames or mass timber.

Other innovations that are both a new construction method and building material are mixtures for additive manufacturing. Researchers are investigating how 3D printing might be done with local materials, wood byproducts, plastic, or new concrete mixtures.

Source: GAO. | GAO-27-108037

Figure 4: Examples of 3D concrete printers



Source: GAO (photo and illustrations). | GAO-27-108037

Concrete printing is not the only use of robotics for on-site construction. On-site robots can be used to print (using ink) the layout of a house or to tie rebar, for example. Such technologies can help tradespeople work more efficiently and avoid rework.

Other innovative construction methods include the use of mobile micro-factories that can bring elements of off-site construction closer to a housing construction site. These factories include robotic machines that can assemble wall panels. Once a project is completed, the mobile micro-factory can be relocated to the next project.

In addition, virtual and augmented reality can help facilitate construction. These technologies can be used to train construction workers and help them visualize the steps for a construction project.

2.3 Building materials and components

Building materials and components are the physical elements used to build housing. The innovative material most discussed by experts we interviewed is mass timber, while other advancements may improve materials such as concrete and insulation.

Mass timber. Mass timber is a type of engineered wood product formed into components such as columns, beams, and floor and wall panels used in building construction.[20] Mass timber is a structural system that can be used in combination with or in lieu of steel or concrete structural elements. Types of mass timber include cross-laminated timber and mass plywood. Cross-laminated timber consists of multiple layers of solid, sawn lumber glued together perpendicular to each other. Mass plywood consists of multiple layers of plywood glued together. Cross-laminated timber can be used to make wood panels as large as 12 feet wide and 60 feet long, and mass plywood panels can be up to 12 feet wide and 48 feet long.

Mass timber can be used for buildings up to 18 stories tall but is most effectively used for mid-rise buildings that are 8 to 12 stories tall.[21] In this range, mass timber is more advantageous than other building materials: light-frame wood construction is typically limited to 5 or 6 stories; steel and concrete are heavier, and projects using these materials can have longer construction schedules. Use of mass timber is growing in the U.S. The first modern mass timber building in the U.S. was completed in 2016, and as of 2026 more than 2,800 mass timber buildings have been constructed or are in progress. Figure 5 shows an apartment building in Oakland, California, which includes 16 stories of mass timber.

Mass timber is considered a high-quality product with aesthetic and sustainable benefits. Mass timber can provide fire resistance because the outer layer of a mass timber component will initially char during a

[20]Engineered wood is made by bonding different pieces of wood, wood fiber, or wood veneers into a single component. Adhesives, heat, and pressure are used to bond the wood pieces together. Engineered wood can be lighter, stronger, straighter, and more dimensionally stable than solid sawn lumber. Additionally, smaller diameter logs that cannot be used as sawn lumber can be used to make engineered wood, allowing for more efficient use of wood materials.

[21]For more information on allowable building type and height for mass timber, see International Code Council, *2021 International Building Code* (Washington, D.C.: October 2020).

fire, which temporarily protects the inner layer from damage. Additionally, with proper design, mass timber buildings offer characteristics that provide resilience in earthquakes, because wood is a lightweight and flexible material that can resist ground motions without suffering catastrophic structural damage. Researchers continue to develop engineered wood products by researching ways to strengthen wood, use different wood species, and improve veneers and adhesives.

Figure 5: Mass timber apartment building in Oakland, CA



Source: oWOW with photo by FLOR Projects. | GAO-27-108037

Other building material technologies. Additional building material technologies include advancements in cement materials and insulation. Cement alternatives or additives (e.g., hemp, fly ash, and geopolymers) can help to reduce the carbon content of concrete, which contributes approximately 8 percent of global carbon emissions, and enable the self-repair of cracks. In addition, new types of insulation, such as hempcrete and wood fiber insulation, can offer suitable thermal properties and cost-effective alternatives to traditional insulation.

2.4 Benefits may be interrelated and can accrue unevenly to stakeholders

The use of innovative technologies, including those described in this chapter, could lead to benefits such as lower costs, shorter construction schedules, and improved quality and performance. These benefits may be interrelated. For example, technologies that enhance production efficiency, such as the automated assembly of housing components, can lead to both time and cost reductions in construction work. However, benefits of technology use may accrue differently to stakeholders—builders, consumers, regulatory entities, the public, and others. Each construction project faces a unique set of circumstances as determined by the physical environment, market conditions, regulatory framework, consumer preferences, and other factors. As a result, a given technology may not be the best solution in all cases, and the intended benefits of a technology may be realized unevenly. For example, a builder could capture cost benefits from efficiency gains but choose not to reduce the purchase price of the homes it sells.

Some benefits can also take time to realize. While they may not result in lower initial construction costs, technologies that help produce more energy-efficient and resilient homes could accrue benefits to owners and occupants. For example, some technologies could reduce recurring energy and insurance costs over the long term.

3 Challenges to Using Housing Construction Technologies

Based on our interviews with experts and the reports we reviewed, we identified several challenges that limit the use of housing construction technologies, some of which we reported on decades ago.[22] Present-day challenges include a fragmented regulatory landscape, a risk-averse industry slow to adopt newer innovations, workforce gaps, financial barriers, consumer perceptions, and other issues unique to individual technologies.

Regulatory challenges for new technologies. Across the U.S., more than 20,000 jurisdictions administer residential building codes and related requirements, and each jurisdiction may operate differently.[23] This fragmented regulatory landscape for housing construction poses challenges. For on-site and modular construction, most jurisdictions rely on nationally recognized model codes, although states and local jurisdictions may adopt different editions, make amendments, and maintain different administrative and permitting requirements. These differences can require builders operating across multiple jurisdictions to expend significant time, labor, and resources to identify and comply with applicable requirements.

A challenge faced by builders is that some local ordinances, such as zoning ordinances, can forbid the use of certain housing construction technologies, including off-site construction. Additionally, according to experts we interviewed, regulatory officials responsible for permitting and inspections can disallow the use of newer technologies or innovative construction approaches if they are unfamiliar with them or do not feel confident that available data adequately demonstrate safety and performance.

Further, because building codes are updated on multiyear cycles, there could be instances where newer technologies are included in the latest model building codes but not yet reflected in current local building codes. As a result, regulatory officials who rely on these building codes could be slow to approve the use of these technologies, according to experts we interviewed. While there are pathways allowing builders to use technologies that are not codified in building codes, these pathways can be time consuming and costly, and they do not always guarantee that local officials will provide approval.[24]

Risk-averse construction industry. The housing construction industry has a limited willingness to take on risk and is reluctant to invest in innovations, preferring to build using trusted practices and technologies to limit liability exposure. Therefore, technologies that are unproven or unfamiliar often

[22]GAO, *Greater Use of Innovative Building Materials and Construction Techniques Could Reduce Housing Costs*, CED-82-35 (Washington, D.C.: Feb. 18, 1982).

[23]Federal Emergency Management Agency, *Building Codes Adoption Playbook for Authorities Having Jurisdiction, FEMA P-2196* (Washington, D.C.: June 2025).

[24]The alternative materials, design, and methods part of the building codes allow building officials to approve a technology that is shown to be at least equivalent to what the code prescribes. Evaluation reports issued by accredited evaluation services are the most common way to document that equivalence. Demonstrating equivalence may require additional technical documentation, testing, or review, which adds time and cost.

experience limited market adoption. Risk aversion throughout the industry has led to a culture of limited innovation with few first adopters, making it difficult for new technologies to succeed.

Furthermore, because the housing construction industry is so widely distributed, with many builders constructing only a few houses a year, it can be difficult for new technologies to achieve scale in the market.[25] Contributing to the challenge of gaining a considerable market share is that builders could want to have multiple suppliers for materials and components to reduce supply chain risk, limiting demand for technologies from a single company. Having multiple suppliers reduces a builder's risk from a supplier going out of business or raising their prices.

Workforce shortages and education and training needs. The housing construction industry faces several challenges with its workforce. In particular, experts reported that there is a shortage of skilled construction workers. Many workers left the industry following the 2008 financial crisis, and as the workforce gets older, many others are retiring. According to experts we interviewed, those in the housing construction industry also struggle to recruit younger workers, in part because of the physical toll of the work. These factors have contributed to a shrinking housing construction workforce and to predicted workforce shortages in the future.[26] This results in construction delays and increased costs as builders compete for a smaller pool of workers.

Furthermore, education and training have not kept pace with the development of new technologies, meaning builders, subcontractors, and laborers can be unaware of newer technologies or of how to use them most effectively. Exacerbating this challenge, builders and technology companies may bear the costs for education and training on how to use housing construction innovations. These companies might have limited budgets and employee time to facilitate training, which can inhibit the use of new technologies. In addition, new technologies can require digital tools or computer software that builders might not have. This contributes to less uptake of new technologies.

Education and training challenges are not limited to builders. Architects and engineers may choose not to use new technologies in their designs because they are not trained in how to design with them. If lenders and insurers are unfamiliar with new technologies, they may be hesitant to provide coverage for housing constructed with these technologies.

Financial challenges. Experts we interviewed identified several financial challenges limiting new housing construction technologies, including high start-up costs, limited availability of funding (often requiring multiple funding sources) for new technologies, and prohibitive financing

[25]The median number of houses builders started constructing in 2024 was six. National Association of Home Builders, *Who Are NAHB's Builder Members?* (Washington, D.C.: Aug. 2025).

[26]The Home Builders Institute highlights research efforts by the University of Denver and the National Association of Home Builders on estimates of skilled labor shortages for single-family homebuilding resulting in lost production of thousands of newly built homes. See Home Builders Institute, *Construction Labor Market Report* (Washington, D.C.: 2025).

structures. One challenge is that new technologies can have high initial capital costs for those developing the technology, such as needing to acquire a factory to support production. These start-up costs can deter companies from investing in new technologies. Past industry failures also contribute to hesitancy to invest in innovations.

Not only can private sector stakeholders be hesitant to invest in housing construction technologies, according to experts we interviewed, government investment in housing construction innovations, such as federal research and development (R&D) funding for companies seeking to build using new technologies, is also limited. Notably, companies can experience a funding gap (sometimes called the "innovation valley of death") between receiving initial seed money for R&D and having a mature product with a stable market share, and innovators can struggle to survive financially in this gap.

Even if a company can successfully develop and market a housing construction innovation, it might not be used by housing developers and builders for various financial reasons. Financing structures can make it difficult to use new technologies. Lenders may raise interest rates because they are uncertain about new technologies, which can make obtaining loans for acquiring and using these technologies cost-prohibitive for housing developers and builders. For example, banks may be reluctant to lend to companies that develop or build with construction innovations that have a limited record of success, and off-site construction companies may have to seek funding from lenders who charge higher fees and rates.

Additionally, financial constraints and lack of incentives could affect housing developers and builders who are interested in constructing middle-income (including workforce) housing.[27] For example, builders of low-income housing may benefit from various tax credits and grants, and builders of luxury housing can sell or rent their housing units at more profitable margins. Whereas, builders of middle-income housing may neither be able to obtain subsidies nor benefit from price premiums. This challenge for builders of middle-income housing could limit their interest in using new, unproven technologies.

In addition, because of their unfamiliarity with new technologies, builders who contract with housing developers may increase what they charge for a project to cover potential contingencies related to using new technologies. These increased costs are in addition to the higher costs associated with new technologies that are often more expensive than existing technologies until they are used at sufficient scale to bring costs down. As a result, a project using new housing construction technologies can have higher costs for the builder and consumer. Even if a technology reduces housing construction costs for the builder, experts said that these savings may not be passed on

[27]Workforce housing refers to housing that is affordable and available for a population distinct from either low-income or upper-income households. Typically, these households earn between 60 and 120 percent of area median income. This housing can be targeted to people who work as teachers, firefighters, health care workers, or similar middle-income professions.

to consumers through lower mortgage or rent payments.

Consumer perceptions. An important element to the adoption and use of housing construction technologies is for consumers to be both knowledgeable of and interested in having the new technologies used to construct their housing. However, many consumers are unaware of innovative technologies, so they do not request that builders use the technologies or seek housing built with such technologies.

Even when consumers are aware of a new technology, they might have a negative perception of it either because it is a different material than most houses, there is an existing stigma around a similar technology, or for a variety of other reasons. For example, concrete is not a commonly used or desired material for single-family housing in the U.S., which could limit the growth of 3D concrete printing even though it can offer benefits. Such perceptions of housing construction technologies can create market resistance even when the technologies promise quality improvements.

These perceptions can also result in restrictive zoning if enough people protest the use of a specific housing construction technology in their neighborhood or community. For instance, negative perceptions of manufactured housing have resulted in zoning barriers restricting the use of this technology.

Lastly, certain housing construction technologies or approaches, such as off-site construction, are most efficient when they are used to build housing units with standardized designs. However, consumer preferences can favor unique, custom houses. This preference can limit demand for certain technologies or decrease the efficiency of constructing housing using new technologies.

Challenges related to specific technologies. While many of the challenges described above can apply to multiple housing construction technologies, there are some technology-specific challenges limiting their greater adoption and use. These unique challenges relate primarily to off-site construction, manufactured housing, 3D concrete printing, and mass timber. Examples of these challenges are included in table 2 below.

Table 2: Challenges in adopting and using specific housing construction technologies

Technology	Challenges
Off-site construction	• More difficult to obtain construction financing compared to traditional on-site construction[a] • Variation in building codes across multiple jurisdictions makes achieving lower costs through increased production difficult • Intermittent demand limits the ability of factories to have continuous operations • Incompatibility with traditional inspection processes • Trade labor unions can oppose off-site construction that uses a different labor pool and perceive a risk of job loss for union workers • Automation and robots can present challenges when working with wood and other materials • Transportation of housing modules to sites requires additional logistics and permits • Installation can require additional equipment, such as cranes
Manufactured housing	• Competing regulatory authority at the federal level increases code requirements and causes confusion[b] • Limited financing options for consumers purchasing a manufactured house as personal property[c] • Lingering stigma related to the historical perception that manufactured housing was unsafe prior to the effective date of the federal Manufactured Home Construction and Safety Standards (HUD Code) in 1976
3D concrete printing	• Consumers might not want concrete houses, creating a niche market • Doubts about scalability • Unknown performance in seismic activity as methods to include structural reinforcement are still being developed • Builders have not yet solved how to efficiently integrate mechanical, electrical, and plumbing systems into printed concrete walls • Concerns about concrete having the strength, flow, and setting characteristics necessary for printing applications
Mass timber	• Technology and cost are currently better suited for larger-scale multifamily projects than for single-family housing construction • Industry must compete with more established European and Canadian producers that can provide material at lower cost • Projects are subject to price fluctuations for timber, which may vary widely or be unpredictable

Source: GAO analysis of agency information and literature. | GAO-27-108037

[a]The 21st Century ROAD to Housing Act directed the Department of Housing and Urban Development (HUD) to conduct a review of Federal Housing Administration (FHA) construction financing programs to identify barriers to the use of modular home methods, as well as a study on the cost effectiveness of off-site constructed housing, including manufactured and modular housing. Modular Housing Production Act and Property Improvement and Manufactured Housing Loan Modernization Act, Pub. L. No. 119-101, §§ 302, 303(b), 140 Stat. 849, 891–892, 893–894 (2026).

[b]The 21st Century ROAD to Housing Act addressed the issue of competing regulatory authority over energy efficiency standards by establishing HUD as the sole federal agency with the authority to set energy efficiency standards for manufactured housing. Pub. L. No. 119-101, § 301(d)(2), 140 Stat. 849, 890 (2026). Prior to the act's enactment, the Department of Energy also regulated energy efficiency of manufactured housing. More broadly, the act includes provisions aimed at identifying opportunities for HUD and the Departments of Agriculture and Veterans Affairs to

coordinate and streamline laws and regulations related to their housing programs. HUD–USDA–VA Interagency Coordination Act and Streamlining Rural Housing Act, §§ 801–802, 140 Stat. at 958–959.

[c]The 21st Century ROAD to Housing Act increased the limits of FHA-insured manufactured housing loans. In addition, it authorized FHA to establish a 4-year pilot program to increase access to mortgages of $100,000 or less, which could be used to finance manufactured housing. Pub. L. No. 119-101, §§ 105, 303(a), 140 Stat. 849, 852–853, 892–893 (2026).

4 Housing Construction Technology Policy Goals and Policy Options

We framed our work around a broad policy goal of increased housing supply and improved affordability. Within this broad goal, over the course of our work we further identified five potential policy subgoals (see table 3). Through our interviews, literature review, and expert meeting, we identified 14 policy options that represent a menu of alternatives policymakers could consider to help achieve specific policy subgoals. For the purposes of our work, policymakers include legislative bodies, government agencies, standards-setting organizations, industry, and other groups.

Table 3: Policy subgoals and policy options to help increase housing supply and improve affordability using construction technologies

Subgoal: Streamline regulatory processes
Policy options: • Establish state or regional building code authority with interstate reciprocity for off-site-constructed housing • Develop regulatory pathways for new technologies • Standardize oversize load permitting for interstate transportation of housing modules or components • Support zoning and development conditions that enable innovative housing construction • Implement and scale preapproved housing design libraries
Subgoal: Reduce financial barriers
Policy options: • Provide financial incentives for housing suppliers to use innovative methods • Provide financial incentives and products to support consumers
Subgoal: Increase housing production capacity through education and training
Policy options: • Expand vocational and technical education pathways for innovative construction • Engage labor unions as partners in expanding the off-site construction workforce • Train and certify building inspectors and code officials in innovative construction methods
Subgoal: Increase public acceptance of innovative housing options
Policy option: • Support public education campaigns on housing construction technologies
Subgoal: Optimize government resources and leadership
Policy options: • Increase government support for technology adoption • Build a national housing construction data infrastructure • Prioritize federal research and development activities to better support housing construction technologies

Source: GAO analysis of agency and expert information. | GAO-27-108037

For each policy option we provide examples of ways various stakeholders could implement the policy option, opportunities the options may present, and factors to consider. We intend for the policy goal, subgoals, options, and example implementation approaches to provide policymakers with a broad base of information for decision-making, but this is not an exhaustive list. In addition, these are not presented in any order of priority or importance.

Policy subgoal: Streamline regulatory processes

We examined five policy options that could help support the subgoal of streamlining regulatory processes for greater adoption and use of housing construction technologies (see table 4).

Table 4: Policy options to support streamlining regulatory processes

Policy option: Establish state or regional building code authority with interstate reciprocity for off-site-constructed housing	
Policymakers could shift primary building code adoption, interpretation, and enforcement for off-site construction from local jurisdictions to the state or regional level. This could help address the challenges associated with a fragmented regulatory landscape of multiple jurisdictions that maintain variations of residential building codes and requirements.	
Example implementation approaches Government policymakers could create a formal certification system in which an off-site-constructed product approved as meeting design criteria in one jurisdiction also meets reciprocal jurisdictions' design criteria. For example: • Participating states could agree to use a common edition of the model building codes, for example those applicable to modular construction, and organize reciprocity agreements around shared climate and hazard zones. • The federal government could support states in developing and piloting frameworks for interstate certification systems.[a]	**Opportunities** The consolidation of building code authority for off-site constructed housing products at the state or regional level could eliminate conflicts among local codes and reduce risk and uncertainty. This could allow modular houses that have been inspected and permitted by one jurisdiction to be approved in a participating jurisdiction. State or regional programs and reciprocity agreements could facilitate plan review and inspection of work performed in an off-site construction facility while preserving the authority of the local jurisdiction over applicable site-specific requirements, installation, foundations, utility connections, and other work performed at the building site. **Considerations** Actions to shift building code enforcement authority to the state or regional level could be challenging. States could incur costs to build their capacities for enforcement and inspection, such as training inspectors on variations in wind and seismic hazards that may exist across a region.

While authorities should be cognizant of and account for local hazards and climate conditions, the adoption of a large number of additional amendments accounting for local conditions could defeat the purpose of interstate reciprocity.

Policy option: Develop regulatory pathways for new technologies

This would establish inspection and evaluation criteria and approval frameworks for innovative materials and construction methods. This could help address the challenge of building codes being slow to integrate new technologies.

Example implementation approaches

Policymakers could develop regulatory pathways that allow for more widespread use of a greater range of innovative materials and construction methods. For example:

- Policymakers could establish criteria for emerging technologies such as 3D-printed concrete and panelized systems that are difficult to evaluate under existing building codes.
- State and local governments could develop a housing system certification that provides a repeatable means to permit components used to construct single or multifamily housing units as opposed to the prevailing model in which housing is permitted as a one-off, site-specific project.
- Federal policymakers could develop a housing construction certification program to evaluate housing construction innovations against defined performance criteria (e.g., structural, fire, energy, acoustic, and durability factors).

Opportunities

These approaches could allow for more rapid adoption of innovative materials, such as printed concrete and mass timber, to enable greater choice for stakeholders in delivering projects best suited to local conditions. They could also address a potential regulatory gap in instances where processes exist to certify use of fully volumetric housing units but not components such as panels and bathroom pods, which are partially volumetric assemblies installed on-site.

Permitting and inspecting housing built with certified systems could reduce permitting and inspection timeframes and design costs.

Considerations

Developing regulatory pathways for certain innovative materials and construction methods could favor some materials and methods over others. In addition, regulatory fragmentation could occur if different jurisdictions create incompatible frameworks or do not allow reciprocity.

Establishing inspection, evaluation, and approval frameworks for innovative materials and construction methods could cause jurisdictions to incur costs to, for example, administer new practices such as in-factory inspections.

Developing criteria and frameworks for regulating the use of innovative materials and construction methods could be technically complex and require precise technical definitions that do not yet exist.

Policy option: Standardize oversize load permitting for interstate transportation of housing modules or components

This would involve establishing a federal standard for transportation of off-site-constructed housing modules or components across state lines. This could help address challenges presented by the complex patchwork of conflicting state permits, route restrictions, and highway patrol escort requirements.

Example implementation approaches

Federal and state policymakers could streamline regulations affecting the transportation of oversized housing modules or components across state lines. For example:

- Federal and state policymakers could develop a uniform oversize load standard.
- Federal policymakers could establish a single federal portal to standardize applications for interstate off-site-constructed housing transport permits, with automatic forwarding to state transportation departments for addressing route-specific conditions and bridge and tunnel constraints.

Opportunities

Streamlining permits could replace the need for shippers to navigate the patchwork of differing state requirements and restrictions associated with transporting oversize loads, leading to lower costs and fewer delays.

Moreover, eliminating barriers to cost-effective transportation could expand the effective area served by factories that produce housing modules and components, potentially enabling broader market access and lower costs through economies of scale.

Considerations

Physical constraints such as bridge and tunnel clearance and mountainous terrain could cause some jurisdictions to seek exemptions from a national standard.

In addition, jurisdictions could lose revenue from fees associated with permit applications, motor carrier inspections, and highway patrol escorts and may resist having a national standard.

Policy option: Support zoning and development conditions that enable innovative housing construction

Policymakers could support by-right development conditions and consistent approval requirements to allow all housing types to be permitted in any zone where housing constructed on-site is allowed, without additional design requirements, setbacks, or aesthetic standards.[b] This could address the challenge posed by discriminatory zoning practices that limit or prohibit smaller, more affordable units, such as manufactured or modular housing constructed off-site.[c]

Example implementation approaches

Policymakers could preempt local zoning practices that reduce or eliminate limits on housing types. For example:

- State governments could establish zoning regulations to allow for the placement of manufactured housing at any location in the state that is zoned for single-family housing.
- Federal government policymakers could require nondiscriminatory zoning practices as a condition to receive funds derived from federal housing grant programs.[d]

Opportunities

Minimizing zoning restrictions could address functional limits of regulations that allow for different housing types but impose requirements that are not likely to be met by certain types.

In addition, adopting zoning that provides automatic approval for housing construction that complies with requirements could reduce litigation risk compared to selective zoning practices, which require government approval that is subject to legal challenges.

Considerations

State actions to take charge of local zoning authority may curtail communities' ability to tailor decisions to local needs and could generate friction between state and local officials.

	Furthermore, by-right zoning ordinances do not guarantee that housing is built, as financing and construction gaps would also need to be addressed. Distinguishing between necessary performance and safety standards and discriminatory design requirements requires careful legal drafting and weighing of interests. Adopting zoning practices to accelerate construction of housing could have unintended environmental or other consequences (e.g., accelerating urban development may bring about increased congestion and encroachment on vulnerable areas, such as where urban development meets wildlands).
Policy option: Implement and scale preapproved housing design libraries	
This would develop state and local libraries of preapproved housing plans. This could help address the regulatory challenges associated with long and varied design review processes across different jurisdictions.	
Example implementation approaches Policymakers could develop preapproved housing design libraries that lead to expedited design approvals and construction starts. For example: • State governments could structure programs that promote use of preapproved designs in coordination with local governments, with limits on customization. • Policymakers could organize preapproved designs by regions having similar climate conditions and exposure to natural hazards so that stakeholders know the designs are appropriate for that environment.[e]	**Opportunities** Use of preapproved designs could significantly reduce permitting timelines by minimizing the amount of design review needed. Providing free or low-cost access to preapproved designs could lead to greater use of the designs. In addition, providing financial incentives such as reduced mortgage rates or expedited financing to use preapproved designs could lead to greater use of the plans. Preapproved designs that incorporate innovative materials, components, and systems could increase adoption and use of innovations. Preapproved designs that account for common climate and hazard conditions could be developed for regional use. **Considerations** Consumer preference for customization could reduce use of preapproved housing designs. Expedited permitting may not translate into faster project delivery if production capacity is not sufficient. Preapproved designs still require educated inspectors and appraisers; permitting speed alone does not solve all adoption barriers. Preapproved designs may be difficult to construct and could become outdated when building codes are updated.

Source: GAO analysis of agency and expert information. | GAO-27-108037

[a]The 21st Century ROAD to Housing Act authorized the Department of Housing and Urban Development (HUD) to award a grant to study the design and feasibility of a standardized uniform commercial code for modular homes to evaluate (i) the utility of a standardized coding system for serializing and securing modules, streamlining design and construction, and improving innovation, and (ii) a means to coordinate a standardized code with financing incentives. Pub. L. No. 119-101, § 302(c), 140 Stat. 849, 892 (2026).

[b]"By-right" or "as-of-right" development is where local ordinances allow city or county planning officials to approve certain housing projects without a discretionary review process by the city council or elected officials. The planning officials need only conduct an administrative review to determine whether projects comply with existing general plan and zoning rules and meet quality and safety standards.

[c]For the purposes of our report, discriminatory zoning practices include local ordinances that act as a targeted ban to prevent the use of certain construction methods. For example, a municipality or county may restrict or add requirements that make the use of off-site housing construction impossible or unfeasible economically.

[d]The 21st Century ROAD to Housing Act directed HUD to establish a 5-year competitive grant program to help states, cities, counties, regional planning agencies, or consortia of regional planning agencies with planning and implementation activities associated with affordable housing. The act also directed HUD to establish a competitive grant program sunsetting in 2033, called an "innovation fund," for localities that have successfully increased their local housing supply. Among the initiatives that meet criteria for eligible purposes include increasing by-right uses (including duplex and multifamily buildings) in areas of opportunity, streamlining regulatory requirements, and other initiatives that reduce barriers to increasing housing supply and affordability. Pub. L. No. 119-101, §§ 207–208, 140 Stat. 849, 873–878 (2026) (codified at 42 U.S.C. §§ 19504–19505).

[e]The 21st Century ROAD to Housing Act authorized HUD to award grants to local governments and tribes to select prereviewed designs of mixed-income housing (including, among others, accessory dwelling units, duplexes, and townhouses) to streamline and expedite approval pathways for affordable housing construction, with 10 percent of total funding set aside for rural areas. This is also related to the above policy option related to interstate reciprocity for off-site-constructed housing, as one of the considerations for awarding grants is that localities coordinate with state, local, and regional transportation planning authorities. HUD is to encourage localities to share publicly information about the benefits of the designs they selected and to disseminate best practices. Accelerating Home Building Act, Pub. L. No. 119-101, § 209, 140 Stat. 849, 878–879 (2026) (codified at 42 U.S.C. § 19506).

Policy subgoal: Reduce financial barriers

We examined two policy options in support of the subgoal of reducing financial barriers related to using housing construction technologies (see table 5).

Table 5: Policy options to reduce financial barriers

Policy option: Provide financial incentives for housing suppliers to use innovative methods
Policymakers could provide financial incentives for stakeholders involved with building housing using innovative construction methods. This could help address multiple financial challenges of using new technologies, including high start-up costs, limited availability of funding, and difficult financing structures.

Example implementation approaches

Policymakers could select from practices and financial instruments to promote access to capital and reduce risks associated with housing construction. For example:

- Federal and state governments could provide loan guarantees or loan loss reserves to help build factory capacity for off-site constructed housing or support financing of on-site constructed housing that uses innovative materials or construction methods.
- States could prioritize innovative construction by amending their Qualified Allocation Plans for the Low-Income Housing Tax Credit to give points for housing developers using innovative construction methods.[a]
- Federal and state governments could provide tax credits that reduce taxes to housing developers, builders, and manufacturers who adopt technologies to support the delivery of innovative housing construction projects.[b]
- Policymakers could offer depreciation benefits for factory equipment and innovation investments.
- States could dedicate funding to support off-site construction through a competitive process.

Opportunities

Use of loan guarantees or loan loss reserves could attract relatively larger amounts of private capital compared to the direct costs to governments.

Use of tax credits, which lower project costs, could help to offset higher initial costs of adopting technologies to support the delivery of innovative housing construction projects.

Tax credits can also allow private entities the ability to finance innovative housing construction projects at below-market interest rates.

Direct government funding in support of off-site construction innovations may better achieve scale and could create a pipeline of projects that encourages the most promising to be selected and built.

Considerations

Governments bear the risk of defaults on guaranteed loans, which could discourage their use or take away funds from other programs in the event of defaults.

Tax credits represent a cost to governments that forgo tax revenue, which could be used to fund other programs.

Variation in tax obligations among housing developers, builders, manufacturers, and others could mean that some entities benefit more than others from tax credit programs.

Government interventions such as subsidies intended to support housing construction technologies may not address affordability or greater use of such technologies if the program is not structured carefully.

Policy option: Provide financial incentives and products to support consumers

This would involve providing incentives and products to better support consumers who choose housing built with innovative construction approaches. This could help address the challenge of negative consumer perceptions or consumer hesitancy to use new technologies.

Example implementation approaches

Policymakers could select from a range of practices and financial products for consumers to promote access to capital and reduce risks associated with housing purchases. For example:

- Governments could provide subsidies to those who rent or purchase housing built using innovative materials or construction methods.
- Congress could direct federal housing finance agencies to implement reforms to ensure that purchasers of manufactured housing can obtain mortgage products, which could recognize them as real property, and use terms and conditions similar to housing built using traditional construction methods and materials.[c]
- State insurance regulators could support the use of existing insurance products and standards that have been demonstrated to reduce damage during storm events, accomplished through grants to homeowners or mandates for insurers to provide discounts for using these products and standards.
- State insurance regulators could require insurance companies to update their actuarial models to reflect actual loss experience from housing built using innovative materials or construction methods and offer lower premiums if supported by this analysis.

Opportunities

Reforming mortgage products to offer similar terms and conditions for all types of housing at like cost could expand the homebuyer market.

Efforts to ensure that insurance costs are in line with the risk of loss for housing built using innovative materials or construction methods could eliminate a key barrier to the adoption of innovative technologies.

Considerations

Government subsidies for housing using innovative materials or construction methods could limit available funds for other housing programs. In addition, subsidies may not improve affordability if the program is not structured carefully.

Absent the ability to title manufactured housing as real property together with the land on which it is placed, consumers may need to obtain chattel loans with higher interest rates than traditional mortgage loans. Chattel loans are a type of financing for personal property in which the loan is secured by the manufactured housing itself—a depreciating asset—rather than the housing together with the underlying land, which could appreciate.[d]

Source: GAO analysis of agency and expert information. | GAO-27-108037

[a]The Low-Income Housing Tax Credit (LIHTC) is the largest source of federal assistance for the construction and rehabilitation of low-income rental housing. I.R.C. § 42. Each state receives an annual allocation of LIHTCs, and each state's housing finance agency administers the state's LIHTC program by, among other things, developing a Qualified Allocation Plan governing how it awards the credits to housing developers, who may then sell the credits to investors to help fund the project. These state agencies can use the Qualified Allocation Plan's selection criteria to influence the type of projects housing developers propose and build.

[b]The 21st Century ROAD to Housing Act directed the Department of Housing and Urban Development (HUD) to conduct a review of Federal Housing Administration (FHA) construction financing programs to identify barriers to the use of modular home methods. In addition, it directed HUD to initiate rulemaking to examine an alternative draw schedule for construction financing loans provided to modular and manufactured housing developers. Pub. L. No. 119-101, § 302, 140 Stat. 849, 891–892 (2026).

[c]The 21st Century ROAD to Housing Act took steps to address this by increasing loan limits of FHA-insured manufactured housing loans and authorizing a pilot program to increase access to mortgages of $100,000 or less. Pub. L. No. 119-101, §§ 105, 303(a), 140 Stat. 849, 852–853, 892–893 (2026).

[d]The government-sponsored entities Fannie Mae and Freddie Mac have established programs to facilitate the use of traditional mortgage products for certain types of manufactured housing that are also titled with the land as real property. *See* 12 C.F.R. Part 1282, Subpart C. The act's removal of the requirement for manufactured housing to have a permanent chassis may also facilitate titling a manufactured home as real property because without the chassis and wheels it can be permanently attached to a foundation. Pub. L. No. 119-101, § 301, 140 Stat. 849, 888–891 (2026). Other land ownership arrangements for manufactured housing, analogous to a condominium ownership arrangement, may also expand financing options, depending on the ownership arrangement of a particular community, along with applicable state laws and local zoning rules.

Policy subgoal: Increase housing production capacity through education and training

We examined three policy options in support of the subgoal of increasing housing production capacity through education and training (see table 6).

Table 6: Policy options to increase housing production capacity through education and training

Policy option: Expand vocational and technical education pathways for innovative construction	
Policymakers could increase education and training efforts on housing construction innovations, along with developing curricula aligned with science, technology, engineering, and mathematics for high schools, community colleges, vocational schools, and apprenticeship programs focused on the digitization and automation of construction practices. This could help address the challenge of limited skilled labor and education gaps around new housing construction technologies.	
Example implementation approaches	**Opportunities**
Policymakers could establish education and training programs to develop a workforce with the technical design, construction, and assembly skills needed to deliver the range of innovative housing products discussed in this report. For example:	Targeted education and training programs could address the persistent labor shortages that have affected housing production. Such programs could also offer additional benefits. For example, education and training programs could be developed within existing school programs and infrastructures, reducing the start-up costs and time needed to establish them. Education and training programs could target underrepresented groups in the technical fields that support housing production to create a more diverse workforce. Professional education and training programs could be administered through existing professional organizations and could offer continuing education credits.

• Governments, nonprofit organizations, and industry stakeholders could collaborate in developing technical training curricula for high schools and post-secondary institutions paired with programs intended to place graduates in housing production jobs. • Federal policymakers could structure education grant programs in a manner that provides incentives to state and local governments to develop relevant curricula. • Governments and industry stakeholders could collaborate in developing technical resources and best practices for housing developers, architects, engineers, and builders to enhance housing construction technology adoption. • Policymakers could collaborate with industry stakeholders to establish new credentialing for factory workers based on product-line work rather than a specific job role.	**Considerations** Newly trained workers could be attracted to jobs in other industry sectors that offer greater pay and benefits. Designing and implementing new curricula would likely be resource intensive, including both time and costs needed for infrastructure investments and instructor training. Establishing training programs does not provide an immediate solution to current labor shortages.

Policy option: Engage labor unions as partners in expanding the off-site construction workforce

This would involve increased engagement with labor unions to address the challenge of labor unions' potential opposition to off-site construction that could decrease job opportunities for union workers.

Example implementation approaches Policymakers could take steps to address the potentially shifting workforce dynamics of housing production and its effects on labor needs. For example: • Government, union, and industry officials could convene work groups to collaborate on housing labor issues and the roles of labor unions in supporting housing production.	**Opportunities** Dialogue among stakeholders could help to illustrate labor unions' concerns about how emerging housing products and production methods could affect demand for union workers and provide the opportunity to address these concerns. Such dialogue could also yield more tangible workforce benefits. For example, engaging labor unions could allow off-site manufacturers to gain access to trained worker pipelines. Furthermore, new occupational classifications could allow unions to expand their memberships.

• Government, union, and industry officials could develop new occupational classifications for work associated with off-site construction.	**Considerations** Work associated with some production methods, such as off-site construction, is more similar to manufacturing than traditional construction. Without clarifying how off-site construction tasks involving multiple trades relate to existing trade jurisdictions, conflicts could arise that increase costs and undermine the workforce benefits of off-site construction. Understanding and addressing unions' specific concerns (e.g., automation, job loss) would be important to converting potential opposition into partnership.
Policy option: Train and certify building inspectors and code officials in innovative construction methods	
This would involve developing education and certification programs for building officials and inspectors on innovative and emerging building methods. This could help address the challenge of inspectors and regulatory housing officials not being familiar with new construction technologies.	
Example implementation approaches Policymakers could develop pathways to certify inspectors and code officials who can regulate housing production across the range of product types. For example: • Code bodies could work with industry and state officials to develop specialty training and certification pathways for on-site, modular, panelized and other construction regulated under state and local building codes. • Code bodies could develop inspector training modules for non-volumetric prefabricated systems. • The federal government could create grant programs for inspector training in low-income and rural communities.[a]	**Opportunities** Certification and training programs could address a key bottleneck where inspectors or code officials who are unfamiliar with a housing product or production method might take a comparatively longer time to complete their reviews. Certification and training programs could allow inspectors and code officials to keep pace with the development of new products and production methods and build institutional capacity to regulate a range of housing products. **Considerations** Local governments that are under-resourced could face difficulties training existing inspectors and code officials to regulate new product types and may be limited in their ability to hire new inspectors. Local jurisdictions could resist accepting housing products that are certified outside of their jurisdiction because of perceived infringements on their authority and liability concerns. More broadly, some jurisdictions may resist any external certification requirements on similar grounds.

Source: GAO analysis of agency and expert information. | GAO-27-108037

[a]Grant programs could follow the model of the 21st Century ROAD to Housing Act, which directed a federal financial institution examination council to make grants to agencies that certify and license state appraisers or to post-secondary institutions for education and training activities to address appraiser industry workforce needs. Appraisal Industry Improvement Act, Pub. L. No. 119-101, § 403(d), 140 Stat. 849, 901 (2026) (codified at 12 U.S.C. § 3338(b)(7)).

Policy subgoal: Increase public acceptance of innovative housing options

We examined one policy option in support of the subgoal of increasing public acceptance of innovative housing options (see table 7).

Table 7: Policy option to increase public acceptance of innovative housing options

Policy option: Support public education campaigns on housing construction technologies	
This would involve supporting public awareness campaigns to improve perceptions of new housing construction innovations. This could address challenges associated with a lack of consumer or regulatory official awareness or negative perceptions of new technologies.	
Example implementation approaches Government and industry policymakers could promote information sharing to raise awareness of innovative construction materials and housing products. • Manufacturers of housing units or components built off-site could host tours of their production facilities to educate housing developers, architects, lenders, code officials, and others involved in housing production decisions on key benefits of off-site construction. • Government and industry representatives could organize public showcases, such as the Department of Housing and Urban Development Innovative Housing Showcase, and distribute information pertaining to innovative materials and housing products. • Government officials and industry representatives could conduct market research to better understand consumer perceptions of housing construction innovations on safety, quality and value.	**Opportunities** Educating key housing production decision-makers about off-site construction and other innovative housing construction methods could lead to better understanding of and willingness to adopt these methods. Educating consumers about innovative housing products could lead to increased demand for these products. Increasing consumer and local official (e.g., planning department and code officials) awareness of housing construction innovations could help change perceptions about quality and reduce regulatory resistance. **Considerations** Public education campaigns could be ineffective without parallel actions to address any financial or regulatory barriers that affect the adoption of innovative housing products. Campaigns are most effective when such barriers have already been reduced, so that interest generated by outreach can translate into actual housing delivered in a timely manner. Public education campaigns could also be ineffective unless they account for what construction technologies have been successfully demonstrated, what remains uncertain, and when a technology or construction approach may or may not be appropriate.

Source: GAO analysis of agency and expert information. | GAO-27-108037

Policy subgoal: Optimize government resources and leadership

We examined three policy options in support of the subgoal of optimizing government resources and leadership (see table 8).

Table 8: Policy options to optimize government resources and leadership

Policy option: Increase government support for technology adoption	
This would involve governments supporting new housing construction technologies by purchasing them or requesting their use in government contracts. This would help address the challenge newer technologies face with sustaining demand and reaching a stable market share.	
Example implementation approaches Governments could support the development and adoption of innovative housing materials and delivery methods directly through the housing they operate and indirectly through the administration of other programs. For example: • For housing they operate, governments could include performance requirements in contract solicitations, such as requirements that could allow for a range of offers from companies offering innovative solutions that can be delivered quicker. • Governments could help to aggregate demand by, for example, timing investments, tax credit offerings, and housing development grant allocations to align with industry off-site production capacity. • Governments could identify and consider using existing publicly owned land for construction projects using innovative construction methods. • State governments could consider establishing a state bulk purchasing cooperative for mass timber and other off-site-compatible building materials.	**Opportunities** The purchasing power of governments could effect change to spur housing construction innovation adoption and use. Federal agencies could incentivize housing production using innovative approaches in their programs and funding opportunities. Bulk raw material procurement could substantially reduce materials costs for independent off-site housing factories that currently buy at retail prices. Government actions to promote technologies such as off-site construction could improve production predictability and lower costs. **Considerations** Government purchasing could benefit some producers and not others and lead to criticism about unequal treatment. Direct government procurement can create sectors that are structurally dependent on government as their primary customer; procurement strategies should be designed to build toward commercial market viability, not sustained dependence on government demand. Demand aggregation that is not tied to cost reduction may prop up inefficient producers rather than drive the sector toward cost competitiveness.

Policy option: Build a national housing construction data infrastructure

This would involve federal data collection on housing construction measures and creation of a publicly accessible, standardized dataset. This could help address challenges posed by a lack of data on new technologies for officials regulating the use of new technologies, builders looking to use new technologies, and lenders and insurers providing coverage for new technologies.

Example implementation approaches

Government and industry stakeholders could support development of a data infrastructure that could be used by stakeholders to identify basic information about the national housing inventory.[a] For example:

- Government and industry stakeholders could establish standardized housing terms and require builders to report the number, location, cost, and other relevant information about constructed or assembled units.
- Researchers, government agencies, and others could use open-source access to builder data to understand the composition of the national housing stock, identify trends, and support decision-making.
- Policymakers could design data infrastructure as an integrated extension of existing systems (e.g., Census Bureau, American Housing Survey, Federal Housing Authority loan reporting, Bureau of Labor Statistics occupational data) rather than as new, parallel systems.
- Policymakers could digitize building codes so individual sections can update independently without requiring full revision and use blockchain-style version control so code editions can be pinpointed by date.
- Government and industry stakeholders could create a machine-readable database that jurisdictions can query to determine whether a given product or system has been approved elsewhere, reducing the burden on building officials to independently evaluate previously approved technologies.

Opportunities

A data infrastructure could provide consolidated information about the national housing inventory that replaces existing unreliable or fragmented data sources.

Data could be useful for a range of users, such as lenders setting interest rates and insurers assessing risks and establishing insurance premiums.

Currently, lenders price housing constructed off-site conservatively, and insurers reflect this in actuarial models because performance data are lacking. A well-functioning data clearinghouse would directly address this gap by providing the evidence base for more favorable financing and insurance terms.

In addition, builder data could provide transparency on costs and spur competition among innovative housing products.

Considerations

Builders could resist providing data deemed to be proprietary or that reflect negatively on them.

Ongoing investment and governance could be necessary to maintain reliable data and comply with privacy laws and regulations.

Establishing a data infrastructure may require determining which data remain proprietary and developing standards for appropriate levels of data sharing.

Data collection could duplicate other data collection efforts, such as data collected by the Census Bureau or the Federal Housing Administration.

Policy option: Prioritize federal research and development (R&D) activities to better support housing construction technologies

This would involve supporting or creating regional physical testing facilities where technologies can be evaluated and observed by interested stakeholders. This would also involve working with industry stakeholders in co-designing research activities that consider commercialization pathways, cost and time metrics, practical constraints, and effects of building code changes. This could help address the challenges posed by a lack of funding for developing new housing construction technologies and education gaps for regulators and designers about new technologies.

Example implementation approaches

Federal agencies and industry stakeholders could focus attention on addressing research gaps affecting the use of innovative housing construction materials or products, including a need for testing and demonstration facilities. For example:

- Federal research agencies could prioritize housing-related testing in federally owned laboratories and at partner research facilities.
- Federal and industry stakeholders could establish multiparty groups to identify crosscutting research needs, such as on hazard-specific, whole-building performance when new construction technologies are used, and develop approaches to implementation.
- Federal agencies could use a portion of their research and development (R&D) programs, such as the Small Business Innovation Research program, to support research for innovative housing products.
- The federal government could sponsor housing-related research challenges that reward winning teams.

Opportunities

Federally supported testing and demonstration efforts could help change regulatory postures, such as those reflected in building codes, for new and emerging technologies.

Federal government and industry collaboration could minimize the disconnect between academic research and commercial practice through direct industry involvement.

Federal R&D funding could help entrepreneurs and innovators finance and test early-stage ideas that are too risky for venture capital and help new technologies achieve scale in production.

Considerations

Involving industry in research partnerships could create data privacy and intellectual property conflicts that would need to be resolved.

Research timelines could exceed expectations and delay the introduction of innovative materials and housing products.

Prioritizing funding for housing-related research could mean that fewer resources are directed to other research areas.

Source: GAO analysis of agency and expert information. | GAO-27-108037

[a]The 21st Century ROAD to Housing Act contemplated a similar database for appraisal information, with a provision for GAO to issue a public report assessing the feasibility of creating a publicly available appraisal database that would be used to help determine how effectively appraisal-related technology and institutions are serving the housing market. Appraisal Modernization Act, Pub. L. No. 119-101, § 704(b), 140 Stat. 849, 956–958 (2026).

5 Agency and Expert Comments

We provided a draft of this report to the Department of Agriculture, Department of Energy, Department of Housing and Urban Development, the Federal Housing Finance Agency, and the National Institute for Standards and Technology with a request for technical comments. We incorporated agency comments into this report as appropriate.

We also offered our selected experts the opportunity to review and comment on the draft of this report, consistent with previous technology assessment methodologies. Twelve of those experts reviewed our draft report and we incorporated their comments, as appropriate.

We are sending copies of this report to the appropriate congressional committees, relevant federal agencies, and other interested parties. In addition, the report is available at no charge on the GAO website at https://www.gao.gov/.

If you or your staff members have any questions about this report, please contact Karen L. Howard, PhD, at HowardK@gao.gov. Contact points for our Offices of Congressional Relations and Media Relations may be found on the last page of this report. GAO staff who made contributions to this report are listed in appendix III.

//SIGNED//

Karen L. Howard, PhD
Director
Science, Technology Assessment, and Analytics

Appendix I: Objectives, Scope, and Methodology

Objectives

We prepared this report at the initiative of the Comptroller General to assist Congress with its oversight responsibilities, in light of the evolving housing construction technology and policy environment and the need for housing that is more affordable. For this report, we (1) described the potential benefits and status of available or developing housing construction technologies, (2) described the challenges of developing and using these technologies, and (3) identified policy goals and subgoals that policymakers could pursue through various policy options that could help realize benefits or address challenges. Specific objectives for this report were to examine:

- What current and emerging technologies could help improve production or reduce the costs of housing to increase supply and affordability?
- What are the benefits and challenges associated with these technologies and how do they compare to traditional construction methods?
- What policy options could support various policy goals?

Scope

The scope of this technology assessment focused on housing construction innovations intended to improve production or reduce construction costs, which may help increase supply and affordability. Technologies identified in this report relate to planning and design; means and methods of construction; and building materials and components. We examined technologies focused on a variety of housing stock, including but not limited to single-family housing, townhouses, duplexes, and multiunit residential dwellings such as apartment and condominium buildings. We examined construction innovations related to housing built using traditional on-site construction methods and off-site constructed housing. In addition, we reviewed housing construction and component materials and systems technologies that are commercially available, as well as those under development. We defined those under development as technologies that are not yet widely available for purchase or are being researched. The identified technologies were not independently evaluated for their effectiveness. The technologies described in this report, while comprehensive, are illustrative examples and are not an exhaustive list, nor are they presented in any particular order of importance.

Methodology

For all objectives, we reviewed relevant literature and agency documents; interviewed a variety of agency officials, industry representatives, and other stakeholders; conducted site visits; attended conferences and workshops; and convened a 2-day meeting of experts. For objective 3 (in addition to the steps above), we identified one broad policy goal and five subgoals from a variety of sources, including laws,

regulations, executive orders, agency directives, and other authoritative government sources.

Review of literature and documents

For all objectives, we reviewed relevant literature and documents identified by agency officials, stakeholders, and our literature search. A GAO research librarian conducted a background literature search to find articles on residential housing construction innovations relevant to all objectives. The literature search used a variety of databases, including ProQuest, EBSCO, Scopus, Dialog: ICONDA, and Civil Engineering databases. We narrowed our search to articles published since 2020 to capture recent housing innovations and building techniques. Results of these searches included scholarly or peer-reviewed material; conference papers; government reports; trade or industry papers; association, nonprofit, and think tank publications; and news articles. The search results yielded 130 articles for initial selection and review. We selected 20 articles most relevant to our objectives for further review.

Interviews and site visits

For all objectives, we conducted semi-structured interviews covering the above objectives with a non-probability selection of relevant agency officials, experts, and stakeholders. We identified groups or individuals to interview through our review of the literature, the conferences we attended, and through a snowball technique, based on recommendations from other interviewees.[28]

While we asked a standard set of questions, we tailored some of the interview questions based on interviewees' roles, responsibilities, and expertise. We ensured that interviewees represented a diversity of views by selecting individuals or organizations from multiple sectors (e.g., government, industry) and roles (e.g., builders, housing developers, manufacturers). Interviewees included officials or representatives from:

- five relevant federal agencies—the Department of Housing and Urban Development (HUD); the Federal Housing Finance Agency; the National Institute of Standards and Technology within the Department of Commerce; the Department of Energy, including Oak Ridge National Laboratory and the National Laboratory of the Rockies;[29] and the U.S. Department of Agriculture, including the U.S. Forest Service, Forest Products Laboratory;
- two local government agencies and one state government department;
- one government-sponsored enterprise—Freddie Mac;
- five academic researchers or research groups;
- 27 private companies (e.g., builders, manufacturers, and technology companies);

[28]The snowball technique involves identifying additional articles or reports from citations in those we had already reviewed on the topic or during an interview with an expert.

[29]Before December 2025, the National Laboratory of the Rockies was named the National Renewable Energy Laboratory.

- nine industry associations; and
- six nonprofits.

For the nongovernmental organizations, we focused on organizations that conduct or fund research on housing technologies and innovations, oversee or advocate for the use of housing construction technologies to increase supply and reduce housing construction costs, develop and sell housing construction technologies, and use housing construction technologies or help others in doing so.

We conducted 21 of these interviews in person as part of site visits, where, among other things, we observed current housing construction technologies or innovations and those under development. This included visiting the Department of Energy's National Laboratory of the Rockies, the U.S. Forest Service's Forest Products Laboratory, and the National Institute of Standards and Technology. It also included visits to California, Colorado, Illinois, Indiana, Oregon, and Wisconsin to observe building or housing development companies, including off-site construction facilities or sites where housing construction technology companies were based and where the technology was used. In addition, we attended six housing construction innovation or supply conferences and workshops.

In our report, we refer to individuals representing an agency as "agency officials." Individuals who participated in our expert meeting and interviews included experts and stakeholders, and we attribute them as "experts." When statements include a mix of agency officials, stakeholders, and experts, we attribute them as "experts." Because this is a nongeneralizable selection of individuals and groups, the results of our interviews are illustrative and represent diverse perspectives but are not generalizable.

Expert meeting

We convened a 2-day, virtual expert meeting to help provide additional context and information for the evidence we obtained from literature, documents, and interviews, with a focus on policy options related to housing construction innovations that could help achieve the goal of increasing housing supply and lowering housing costs.

We divided the meeting into moderated sessions, with policy sessions related to regulations, financial issues, workforce development, education, research and development, supply chain and manufacturing, and technology-specific policy considerations. For each of the topics, the experts were asked open-ended questions, such as the current state of technologies, the primary challenges facing the adoption of those technologies, and actions that policymakers could take to mitigate challenges or enhance benefits associated with their use.

The meeting included a nongeneralizable group of 17 experts from industry, academia, code bodies, advocacy, and nonprofit organizations. The experts, along with their titles and affiliations, are listed in appendix II. We selected the experts using a criteria-based approach, considering factors such as technical expertise in architecture, civil engineering, manufacturing, and automation. We also considered other expertise, including experience with affordable housing programs, land and building development issues, policy,

and regulatory and enforcement experience. In addition, we reviewed each expert's background to determine the diversity of their experience in three construction domains: planning and design, construction means and methods, and building materials and components. We therefore selected a group that would include a balanced and diverse set of views from nongovernmental organizations, industry, and academic researchers.

Prior to the meeting, we asked the experts to identify any potential conflicts of interest, which we considered to be any current financial or other interests that might conflict with the participation of an individual because it could impair objectivity or create an unfair advantage for any person or organization. We determined 15 experts to be free of reported conflicts of interest. Two experts reported conflicts of interest, which we determined to be outside the scope of the meeting or sufficiently addressed by the overall design of our meeting and methodology because discussions did not revolve around any specific technology, company, or vested interest. We also judged the group as a whole to have no inappropriate biases. The comments of these experts generally represented their individual views and not the organizations with which they were affiliated and are not generalizable to the views of others in the field.

The meeting was professionally transcribed to ensure that we accurately captured the experts' statements. Following the meeting, we reviewed the transcripts to synthesize the responses and to inform our understanding of our research objectives. We also provided the experts with an opportunity to provide feedback on potential policy options and implementation approaches. We continued to draw on the expertise of those individuals who agreed to work with us during the remainder of our study, providing the experts with an opportunity to review a draft of our report and provide technical comments, which we incorporated as appropriate.

Policy options

Based on our research, we developed a series of policy options. Policy options are intended to represent possible options policymakers could take to address a policy goal.[30] These options are not listed in any particular order, nor are they inclusive of all possible policy options. For each policy option, we discussed example implementation approaches, opportunities, and considerations. We limited policy options to those that fell within the report scope.

We developed our policy options over the course of our work based on review of the literature, interviews with government officials, stakeholders, and experts, and our expert meeting. We further assessed and refined these options to ensure they were adequately supported by the evidence we collected, could be feasibly implemented, and fit into the overall scope of our work. We did not conduct work to assess how effective the options may be or the extent to which they may have been implemented in the past or are being considered currently and express no

[30]As discussed in the report, policymakers include individuals from legislative bodies, government agencies, standards-setting organizations, industry, and other groups.

view regarding the extent to which legal changes would be needed to implement them. We offered the expert meeting participants an opportunity to review and comment on the proposed policy options and example implementation approaches, which we incorporated as appropriate.

Quality assurance

We conducted our work from January 2025 to November 2026 in accordance with all sections of GAO's Quality Assurance Framework that are relevant to technology assessments. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to meet our stated objectives and to discuss any limitations to our work. We believe that the information and data obtained, and the analysis conducted, provide a reasonable basis for any findings and conclusions in this product.

Appendix II: Expert Participation

We convened a meeting of experts to provide supporting information on policy options and example implementation approaches related to housing construction innovations that could help achieve the goal of increasing housing supply and lowering housing costs. The information gives additional context and information for the evidence we obtained from literature, documents, and interviews. All final decisions regarding meeting substance and expert participation were made by GAO. The meeting was held virtually in February 2026.

The 17 experts who participated in this meeting are listed below, along with their titles at the time of the meeting. We sent the draft of this report to 13 of those experts who volunteered to review it, and 12 of the experts provided comments, which we incorporated as appropriate. The comments of these experts generally represented their individual views and not the organizations with which they were affiliated and are not generalizable to the views of others in the field.

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Appendix III: GAO Contact and Staff Acknowledgments

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In addition to the contact named above, the following staff made key contributions to this report:

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