Sustainable housing

Berril, P.; Akenji, L.; Vergragt, P.J.; Brown, H.S.; Smith, T.S.J; Wallnöfer, L.M.

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Peter Berrill

Definition

Sustainable housing can be defined as the affordable and safe provision of shelter and domestic services with minimal negative impacts on the environment. Aspects of environmentally sustainable housing include the use of renewable energy, passive provision of thermal comfort and lighting (using naturally available energy inputs), high thermal efficiency, and use of construction materials with low lifecycle environmental impacts. From an economic perspective, sustainable housing should be affordable and retain its value. From a social perspective, sustainable housing should be safe, accessible, and provide a healthy indoor living environment.

History

Fundamental aspects of sustainable housing have been considered and incorporated into the design of housing for millennia (see **Ecodesign**). Prominent examples include design for structural stability, resistance to fire damage, and provision of ventilation to maintain healthy indoor air quality. There is evidence of energy efficiency and passive provision of indoor thermal comfort and lighting in pre-industrial housing, hundreds or thousands of years before design standards existed. Examples include constructing buildings partially in the ground, introducing passively heated or cooled air into buildings, and using materials with large thermal capacity to minimize indoor temperature fluctuations.

Energy efficiency entered building codes and standards in the mid-20th century, particularly after the 1970s energy crises. The existence and stringency of energy standards varies considerably by country and climatic region within countries. Colder regions, for example, tend to require higher levels of insulation. Jurisdictions with building energy efficiency standards typically update their standards to higher levels periodically. In 2020, California's energy efficiency plans stipulated that all new residential buildings must be "zero net energy", meaning that buildings must produce as much clean renewable energy as they consume over the course of a year. Since 2021, new buildings in the European Union must be "nearly-zero energy", a term defined and implemented differently by member states. Improving the energy efficiency of entire building stocks requires paying attention to existing buildings in addition to new construction. In countries with mature (slowly growing) building stocks, strategies to reduce energy demand and environmental impacts will focus primarily on existing buildings (see **Stocks Versus Flows**). The European Union, for instance, announced ambitions for a "renovation wave" in 2020, referring to an increase in the rate and depth of energy renovations. Many (mostly high-income) countries offer subsidies and other incentives for householders and building owners to undertake energy-efficiency renovations.

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Voluntary building sustainable certifications (e.g., BREEAM, LEED, HERS) have existed since the 1990s. These award different levels of sustainability performance based on sustainable choices made during building design. "Passive house" buildings embody another approach to sustainable design optimized for energy efficiency.

Standards have recently been developed to measure the "embodied" emissions of new construction, which covers environmental impacts from producing construction materials. In a few jurisdictions (e.g., Canada, California, and some European countries), regulations on the embodied carbon of new construction already exist. Future standards may assess and regulate the "whole-life carbon" of construction, including embodied and energy-related emissions over the building's estimated lifetime.

Different Perspectives

The sustainability of housing can be assessed from different perspectives. The social sustainability of housing can be considered from a household or societal perspective. For individual households, socially sustainable housing would be safe, healthy to occupy in terms of air quality and sanitation, and accessible for different ages and abilities. Resistance to extreme temperatures and acute environmental hazards like earthquakes, flooding, and hurricanes can be included as aspects of housing safety, in addition to basic structural soundness. On a societal level, in addition to being safe, healthy, and accessible, a sustainable housing stock would be affordably available to the entire population, located in regions that are healthy to occupy, and where basic needs and services (education, food, water, healthcare, employment, energy) can be provided (see **Urban Planning and Spatial Allocation**).

The economic sustainability of housing has close connections with social sustainability, particularly at the societal level. For housing to be economically sustainable at the household level, it should be affordable and preserve or grow its value over time. At the societal level, housing should be affordable for all sectors of the population. Tensions can arise between economic sustainability at the household and societal level. Regulations that restrict new construction increase the value of existing housing and the costs of new housing, benefiting incumbent homeowners and landlords at the expense of first-time home buyers and renters. Meanwhile, housing rental markets with rent controls benefit existing tenants at the expense of new tenants (to the extent that controls reduce the supply of new housing). Regulations that reduce housing affordability or availability at the societal level can exacerbate homelessness and housing precarity.

The environmental sustainability of housing can consider impacts beyond those arising from material and energy use during building construction and operation. The location of housing can influence travel behaviors and how people spend their time. Different dimensions of local "urban form" including population density, distance to employment and services, and public transport accessibility can all influence how people travel daily, with clear implications for environmental impacts (see **Sustainable Mobility**, **Social Practice Theory**). Zooming out from the building level to the community or neighborhood level can allow more flexibility in achieving "zero net energy" and lower environmental impacts.

"**Sufficiency**" is a relatively new addition to conceptualizations of sustainability. In buildings, sufficiency predominantly refers to achieving levels of floor space consumption that are "enough" but not "excessive". Suggested values of sufficient residential floor space in the literature range from 15 to 40 m^2 per person. Sufficiency is closely related to the concept of "decent living standards" whereby basic needs for a good life are met for entire populations, and to "**doughnut economics**" where basic needs are met but ecological limits are not transgressed (see also **Fair Consumption Space**, **Consumption Corridors**).

Application

Sustainable housing assessments can be applied at different levels, for different purposes. For a new building, a designer can assess the environmental impacts of alternative designs, ideally from a whole-life perspective. Policies such as energy standards can influence new construction: new homes in many European countries must now use a heat pump as the heating technology. For an existing home, an analyst can assess the multifaceted sustainability outcomes of energy renovation and lifetime extension versus demolition and reconstruction (see **Circular Economy and Society**). This exercise, more common in academic studies than in real-world planning, usually finds it more sustainable to renovate than to demolish and rebuild.

Larger developments, such as plans to deliver hundreds or thousands of new dwellings, can consider the regional environmental impacts of development alternatives (see **Urban Planning and Spatial Allocation**). At a regional or national level, assessments can be made of entire building stocks to identify the relative potential of strategies to reduce environmental impacts for existing and new buildings over a planning horizon of decades. Prospective assessments can incorporate anticipated technological and social changes, assisting comprehensive strategies to maximize the sustainability of the built environment. These are especially important when considering potential requirements to provide many new dwellings to accommodate population growth and reduced household sizes.

Application of sufficiency strategies has not begun in earnest in buildings, but possible approaches include reducing per-capita floor space through constructing smaller new dwellings, internal renovations to create additional dwellings within existing buildings, or encouraging larger household sizes (for a given population). In certain cases, the provision of shared spaces for leisure, storage, or services (e.g., cooking, utilities) can reduce the total space required for all households (see **Product-Service Systems**, **Sharing Economy**).

Further Reading

Berrill, P., Wilson, E.J.H., Reyna, J.L., Fontanini, A.D., & Hertwich, E.G. (2022). Decarbonization pathways for the residential sector in the United States. *Nature Climate Change*, 12(8), 712–718. https://doi.org/10.1038/s41558-022-01429-y.

Hasik, V., Escott, E., Bates, R., Carlisle, S., Faircloth, B., & Bilec, M.M. (2019). Comparative whole-building life cycle assessment of renovation and new construction. *Building and Environment*, 161, 106218. https://doi.org/10.1016/j.buildenv.2019.106218.

Ionescu, C., Baracu, T., Vlad, G.E., Necula, H., & Badea, A. (2015). The historical evolution of the energy efficient buildings. *Renewable and Sustainable Energy Reviews*. https://doi.org/10.1016/j.rser.2015.04.062.

Næss, P., Peters, S., Stefansdottir, H., & Strand, A. (2018). Causality, not just correlation: Residential location, transport rationales and travel behavior across metropolitan contexts. *Journal of Transport Geography*, 69, 181–195. https://doi.org/10.1016/j.jtrangeo.2018.04.003.

Röck, M., Saade, M.R.M., Balouktsi, M., Rasmussen, F.N., Birgisdottir, H., Frischknecht, R., Habert, G., Lützkendorf, T., & Passer, A. (2020). Embodied GHG emissions of buildings – The hidden challenge for effective climate change mitigation. *Applied Energy*, 258, 114107. https://doi.org/10.1016/j.apenergy.2019.114107.