

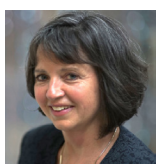
Don't Supersize Me: Smaller Homes for Net-Zero



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Home buyer preferences, building codes and government incentives are at odds with the path to a net-zero carbon economy. America's residential housing energy requirements contribute roughly 20% of total US greenhouse gas (GHG) emissions.¹ Despite efforts towards energy efficiency and lower embedded carbon, average house sizes in the US and the world are increasing.² A glaring example are "McMansions," ostentatious 3,000+ square foot homes that prioritize size and impressive curb appeal over quality and longevity, and satisfy homebuyer preferences for larger living spaces to accommodate home offices and gyms.³ These supersized "Big-Mac" style US homes generate massive carbon footprints and account for 10-20 times more GHG emissions per capita compared to multi-family housing.⁴ Nevertheless, floor plans continue to expand to meet demand, even in the face of rising material and labor costs. Meeting the 2050 Paris GHG goals will require a shift to significantly smaller homes and denser settlements, in addition to aggressive home energy retrofits and transition to low-carbon energy sources.⁵

Improving efficiency is not enough

Environmental benefits from more modern, efficient buildings are being offset by growing housing floor plans. The US Energy Information Administration (EIA) estimates that residential homes are responsible for 28% of United States energy consumption and 20% of CO₂ emissions for 2020.⁶ New homes are greener, last longer, and are more energy efficient. Rising insulation standards help lower residential America's environmental footprint by increasing home efficiency. While GHG emissions from residential energy use has dropped 2 percent per year on average, helped by improved appliance efficiency and building techniques, most GHG reduction has come from changes to the energy grid.⁷ The lack of significant efficiency reduction is due to the simple fact that American homes are growing bigger. As of 2Q 2021, new single-family homes averaged 2,540 square feet, with a median of 2,297.⁸ The average number of people per home is also decreasing. All of this means that per capita housing square footage has doubled since 1973, offsetting efficiency and emissions improvements.



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Reversing the supersize trend

To achieve sustainability, US residential energy demand needs to decrease in absolute terms. The housing industry must continue to improve its resource efficiency, with the greatest potential impact coming from reversing the supersizing trend in housing. Larger homes exacerbate key residential environmental issues; they use substantial amounts of raw material in construction, and more energy to keep them running. Homes simply must be smaller. Maurie Cohen (2020), of the New Jersey Institute of Technology, argues that a four-person sustainable home should be around 860 square feet,⁹ 123 square feet smaller than the average-sized home in the early 1950s,¹⁰ and significantly smaller than the current median per capita square footage in the US. Reducing home size is the best option for reducing waste in the housing sector, while achieving environmental benefits. Multi-family homes and denser settlements promise lower average greenhouse gas emissions per capita; when walls are shared, material use and heat loss is minimized.

Smaller homes can not only accelerate progress towards US and global climate targets, but they can also make the US housing market more inclusive. Tight housing markets since the onset of the COVID pandemic have highlighted gaps in US markets for smaller dwellings and multi-family housings. Though many Americans are moving to the suburbs or rural areas because of the pandemic, many are also looking for smaller homes and affordable apartments. Millennials, for example, seem to want to live in car independent, micro luxury apartments in cities.¹¹ Other millennials need starter homes, while Baby boomers want smaller manageable settlements. Many Americans seem to desire denser living - apartments, multifamily and attached homes - than local zoning laws currently allow.

Managing embodied emissions for CO2 reduction

Environmental footprint of a residential home is an aggregate of embodied emissions during material production, transportation, construction, and lifetime operations. However, embodied energy use and emissions are often difficult to assess. London Energy Transformation Initiative (LETI) has come up with one methodology to assess the carbon life-cycle of UK homes. According to LETI, up to 33% of a structure's carbon emissions are generated in the construction phase and come from repair and maintenance.¹² Therefore, it isn't enough to focus

on minimizing carbon from living in a home. The embodied carbon in construction and repair needs to be offset during the life of the building.

Dramatic improvements in energy efficiency and grid electrification are needed to outpace the counteractive environmental costs of supersized floorplan homes. The National Office of Energy Efficiency and Renewable Energy projects that 75% of U.S. buildings will be new or renovated by 2035.¹³ Green designs with smart electric appliances, active and passive solar, heat pumps, and better insulation provide one way to improve the environmental footprint of these homes. However, to reach the Paris Agreement goals, the absolute GHG emissions of the housing sector need to be lower. For that, new homes need to be smaller and built to achieve net-zero emissions

Changing market incentives

Home size has been largely ignored and left unchecked by policymakers and capital providers, with supply-side incentives seemingly favoring the supersized McMansion. Median US home sizes are typically 20% larger when constructed by general contractors (2437 sq ft) than when owner-built (2029 sq ft).¹⁴ Industry experts note that an underlying bias among housing developers fuels the McMansion trend. Developers assume building larger houses leads to larger margins: if every 3-bedroom home is equipped with one kitchen and living room with fixed costs like permitting, why not add floorspace and boost profits?¹⁵ However, there is empirical evidence that construction cost and construction area in the US may follow a linear relationship.¹⁶ Developers should be able to achieve industry margins even by constructing smaller houses.

Market forces may eventually push homeowners away from large homes, especially as the cost of carbon starts getting priced in across the economy, but more effort is needed in the US. Reforms to national building codes, particularly in energy efficiency, are important and need to be more strongly enforced.¹⁷ Local and state jurisdictions can make a difference through zoning laws and code. For instance, homes over 4,000 square feet in Marin County, California must conform to green building standards and meet energy efficiency requirements.¹⁸ Some regions, like Palo Alto in California, are placing maximum square foot limits to control dwelling size.



President Biden's new infrastructure bill and legislation seems focused on improving the supply of smaller homes in the US market and would be a welcome move for those looking for smaller swells. The housing market was especially tight in 2020, and especially so for homes under \$500,000.¹⁹ New home starts for smaller homes need to be incentivized, but so do efforts for energy retrofits among low-income homeowners and landlords.²⁰ 30% of the US population suffers from energy insecurity, and housing and energy affordability needs to be tackled concurrently, especially for those living in the middle of the country and northern states.²¹

Alongside homeowners, developers and contractors need incentives to boost environmental practice. For example, immediate midstream rebates could benefit homebuilders and make smaller projects cost effective and profitable.²² Today's new buildings will impact emissions for 50 - 70 years. New American homes and their owners must avoid a carbon lock-in by avoiding investments in large, luxury homes that will supersize GHG emissions for years to come.

To make the residential building sector more sustainable, commercial and regulatory practices must incentivize builders and buyers to go greener, denser, and smaller.

Investing for housing sustainability

There are many opportunities for investors to use capital to drive change and achieve improved sustainability and net-zero targets for housing. The following is a short list of companies who are contributing to the improvement:

- Companies such as Kingfisher and Saint Gobain are suppliers with high environmental standards for their products, ensuring that embodied carbon is minimized for housing projects in Europe, where need for retrofitting and refurbishing is high.
- France's Nexity and Sweden's Castellum are focused on high efficiency condominiums and multi-family complexes for the millions of new households that will need homes in Europe over the coming decade.
- Japan's Sekisui has begun building and selling net-zero homes, which is attracting strong interest among younger buyers.
- Insulation providers TopBuild and Saint Gobain have product portfolios that support the continued efficiency improvements of residential buildings.

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