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Sustainability

Making a house a (green) home

04 April 2024

Key takeaways

- Did you know residential buildings constitute 20% of both total energy usage and CO2 emissions in the US? However, sustainable practices such as investing in weatherization and energy-efficient appliances can help reduce energy consumption by up to 30%, water usage by up to 50% and GHG (greenhouse gas) emissions by up to 40%.
- Looking more broadly, integrating sustainable components, such as recycled waste, into construction materials not only contributes to improved waste management and promotes circularity but also aligns with consumer preferences for more durable and longer-lasting materials, potentially reducing maintenance and upkeep costs.
- So, while the initial investment in greening homes may be higher than non-green alternatives, federal (e.g. the Inflation Reduction Act) and local incentives and rebates can effectively offset these costs over a period of time. Ultimately, green homes can mean lower utility bills, higher sales premiums & lower costs of capital.

Advancing sustainability at home

Homebuilders and companies selling building materials play a crucial role in advancing sustainability in construction, including increasingly incorporating recycled materials, not only for their cost-effectiveness but also to contribute to a circular economy. In the US, buildings account for a substantial 40% of total energy use, 75% of electricity consumption, 35% of carbon dioxide (CO_2) emissions, and 14% of potable water use.[1] Specifically, residential buildings contribute to 21% of total energy consumption and 19% of total CO_2 emissions in the US.[2]

Energy efficiency concerns are shaping consumer choices, leading to a surge in demand for insulation, high-performance windows, and more efficient HVAC (heating, ventilation, and air conditioning) systems and appliances. Notably, the growing popularity of rooftop solar installations is influencing decisions regarding roof replacements. Additionally, adoption of EVs (electric vehicles) is prompting the need for in-home wiring tailored for EV charging infrastructure. This transformative trend benefits various companies, including homebuilders and building material firms, whose strategic positioning allows them to capitalize on rising demand for sustainable and energy-efficient building practices.

Greener homes pay off

Green homes offer substantial financial benefits to homeowners by reducing utility bills through decreased water, electricity, and heating usage. This cost-saving effect positively impacts mortgage payments, resulting in a 32% reduction in default risks and allowing banks to provide lower-cost capital.[3]

Beyond financial advantages, lower utility bills and improved indoor air quality drive consumer demand for these eco-friendly homes, which translates into enhanced returns, including higher leasing rates, faster sales, elevated sales prices, and increased rent prices.

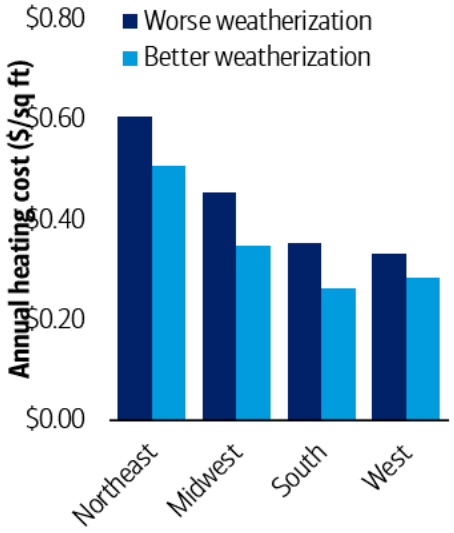
Moreover, green buildings with lower operational costs and healthier living environments experience heightened consumer demand, leading to higher sale prices, rent rates, and occupancy rates. Green certifications, based on an analysis of 42 studies by Dalton and Fuerst, result in a rent premium of 6.0% and a sales premium of 7.6%.

[1] NREL, US Green Business Council

[2] Department of Energy (DOE)

[3] Institute for Market Transformation

Exhibit 1: Greener building characteristics reduce space heating costs by 15-30%
Average annual cost for space heating (USD per square footage of the house that is heated), by region and weatherization



Source: BofA Global Research, US Energy Information Administration (EIA) 2020 Residential Energy Consumption Survey (RECS), released in 2023. Better weatherization means the house is either well-insulated or adequately insulated (as reported by the home's residents) and has double- or triple-pane windows. Worse weatherization means the house is poorly insulated or not insulated (as reported by the home's residents) and/or has single-pane windows.

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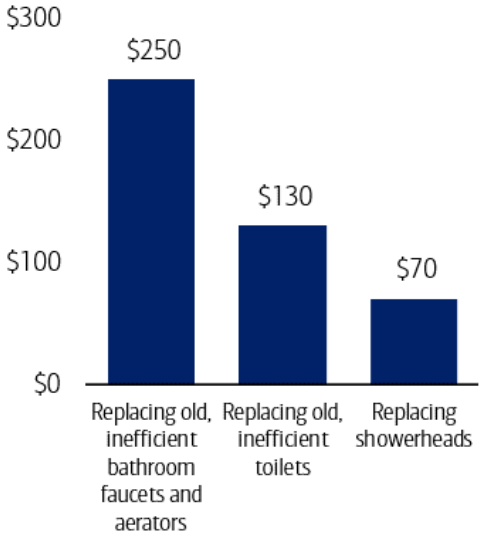
Exhibit 2: The average family can save $70-$250 p.a. with more water-efficient products
Annual savings for the average family by upgrading to WaterSense-labeled products



Source: US Environmental Protection Agency

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Greener homes = lower operational costs

While the initial investment in greening homes may be higher, federal, and local incentives and rebates can effectively offset these costs over time. The Inflation Reduction Act (IRA), for example, provides tax credits worth up to $5,000 for homes certified as Zero Energy Ready Home, $2,500 for ENERGY STAR certified homes, and $3,200 for energy efficiency and heat system upgrades.

Green homes can lower:

- **Heating costs**: Homes lose less heat when they are "weatherized" – when a home's interior is shielded and/or protected from external elements with better insulation and thicker windows. In fact, BofA Global Research's analysis of data from the US Energy Information Administration's (EIA) Residential Energy Consumption Survey shows that homes with better weatherization see 15-30% lower heating costs per square foot on average. The analysis also suggests that saved heating costs can add up to $1,000 -$4,000 over 10 years, outweighing the initial installation costs in many cases—particularly when tax credits from the IRA are factored in. This is especially beneficial for homes in colder climates, larger homes with older systems, and those in high-energy cost areas.

- **Water utility costs**: Did you know that upgrading a main bathroom with more water-efficient products can pay for itself in just one year, saving homeowners $70-$250 annually? This is because water-efficient appliances consume up to 35% less water than alternative products.[4]

- **Electricity usage**: By replacing older appliances with energy-efficient models, the average household can save $450 a year.[5] At a national level, the Department of Energy (DOE) has estimated that its federal building energy codes and proposed standards for consumer appliances could save more than $15 billion in net costs to electricity users over the next 30 years, and installing solar panels at homes can reduce electricity costs by more than $1,000 annually.[6]

[4] American Water Works Association
[5] ENERGY STAR
[6] Illinois Power Agency

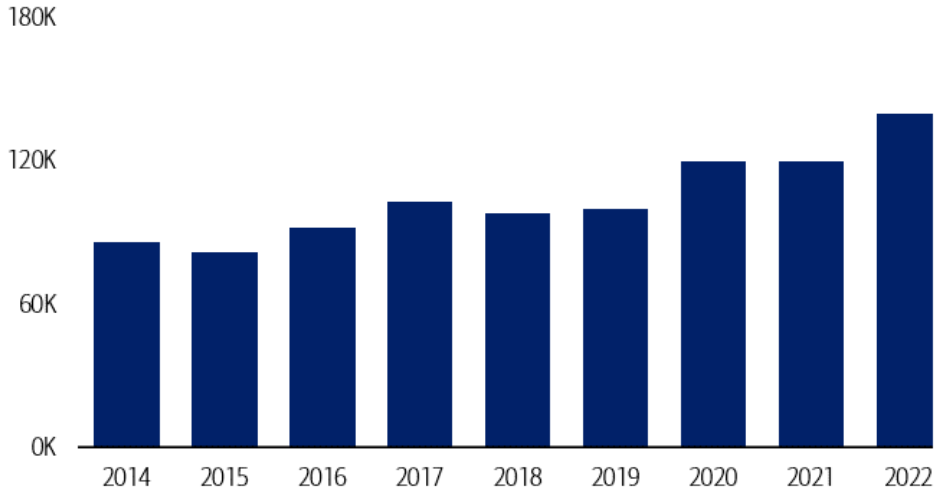
- **Maintenance and replacement costs**: Choosing more durable materials can reduce costs associated with maintenance and replacement. For example, recycled plastic fences can cost less on a lifetime basis compared to wood fences thanks to longer life spans and less required maintenance. Unlike a plastic fence, a wood fence requires re-painting or staining every two to three years, which runs $1,700 on average.[7]

- **Equipment costs**: Heat pumps are $2,000 to $10,000+ more expensive versus comparable air conditioning (AC) units without a heat pump. However, better weatherized homes require less powerful heat pumps, which cost less to purchase and operate.

Greener building solutions

The growing emphasis on demand and cost factors is driving building and construction materials companies to expand their offerings to include more sustainable building products. These encompass solutions geared towards enhancing energy efficiency, water efficiency, and incorporating more environmentally friendly raw materials. Notable examples of sustainable raw materials involve the use of green concrete, green steel, and recycled plastic. Additionally, building upgrades also play a pivotal role in advancing energy efficiency, with measures such as weatherization, transitioning to energy-efficient appliances and lighting, and integrating smart home devices – all contributing to the overall goal of creating more sustainable homes.

Exhibit 3: Increasing number of ENERGY STAR certified homes being constructed in the US
Number of ENERGY STAR certified homes built in the US during the year, 2014-2022



Source: US Environmental Protection Agency's ENERGY STAR Annual Reports

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Building upgrades can improve home efficiency

Green certification and labelling programs allow homeowners to assess their homes' efficiency and/or to choose more efficient products when making home upgrades. Some programs focus specifically on energy efficiency (like ENERGY STAR and the Home Energy Rating Score) or water efficiency (like WaterSense), while others take a more holistic assessment of a building's sustainability (like LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Methodology)). With nine in ten US households aware of the ENERGY STAR label, a program run by the US Environmental Protection Agency (EPA) and US Department of Energy (DOE) that promotes energy efficiency, there has been an increase in construction of ENERGY STAR homes over the last decade.

[7] Angi

Exhibit 4: Popular green building labelling programs
Description of green building labelling program characteristics

Program	Run by	Applies to	Focuses on
Building Research Establishment Environmental Assessment Methodology (BREEAM)	BRE Group	Buildings (both commercial and residential)	Broad set of metrics, including energy efficiency, water efficiency, low impact design, design durability and resilience, adaption to climate change, ecological value and biodiversity protection, health & wellbeing
ENERGY STAR	US Environmental Protection Agency (EPA)	Buildings (both commercial and residential) and products	Energy efficiency
Home Energy Rating Score (HERS)	RESNET	Residential buildings	Energy efficiency
Indoor Air Plus (IAP)	US Environmental Protection Agency (EPA)	Residential buildings	Indoor air quality
LEED (Leadership in Energy and Environmental Design)	US Green Building Council (USGBC)	Buildings (both commercial and residential)	Broad set of metrics, including energy efficiency, water efficiency, emissions reduction, and indoor environmental quality
National Green Building Standard (NGBS)	American National Standards Institute (ANSI)	Residential buildings	Broad set of metrics, including energy efficiency, water efficiency, resource efficiency, lot development, operation & maintenance, indoor air quality
Passive home certification	Passive Home Institute US (PHIUS)	Buildings and products	Energy efficiency, indoor air quality
WaterSense	US Environmental Protection Agency (EPA)	Residential buildings and products	Water efficiency
Zero Energy Ready Home (ZERH)	US Department of Energy (DOE)	Residential buildings	Energy efficiency

Source: BofA Global Research; online research. Note: this is a non-exhaustive list.

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Home upgrades can support the energy transition

Decarbonization trends are driving electrification and a shift to renewable power, with several implications for home construction and renovation.

- **Solar**: Installations of residential solar panels have risen >5x over the last decade. The IRA further incentivizes solar panel installation by offering a 30% tax credit (with no dollar limit) for panels installed between 2022-2032. Because it can cost between $1,500-$6,000 to uninstall and re-install solar panels, homeowners will replace the roof when installing solar panels if it's likely the roof would need to be replaced during the solar panels' lifetime, which, in turn, suggests that solar installations increase homeowner spending on roofing materials.

- **Electric vehicles (EVs)**: The IRA offers tax credits of up to $7,500 for new electric cars. Although challenges like affordability and range anxiety are slowing EV demand growth (see: Is the EV transition running out of charge?), BofA Global Research still expects EVs to make up one-third of new vehicle sales by 2030. The typical EV charging station requires a 240-volt dedicated circuit, so homes with less electrical capacity will need to be upgraded to be able to support these chargers. This often involves installing a heavy-duty electrical outlet and upgrading electrical panels, which can cost $850-$4,000.[8] On the back of increasing homeowner demand for EV charging capabilities and new laws in states like California and Illinois mandating EV charging infrastructure in new homes, more homebuilders are pre-wiring garages with enough electrical capacity for EV charging.

- **Heat pumps**: Electric heat pumps can run on renewable electricity rather than fossil fuels, reducing emissions and air pollution. The IRA contains approx. $4 billion in heat pump incentives (relative to approx. $60 billion US HVAC market). The share of new homes built with heat pumps jumped 5ppt between 2021 and 2022 following the enaction of the IRA.

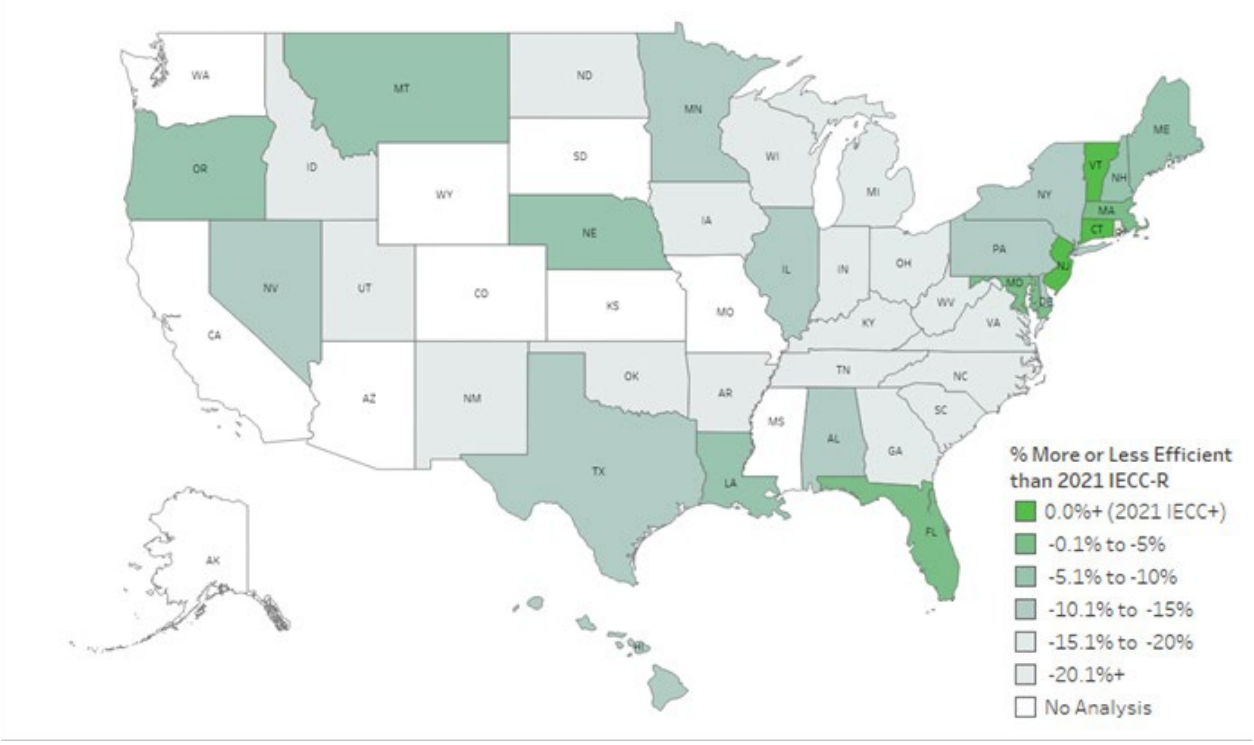
[8] CapitalOne Auto Navigator

Making homes more airtight and energy efficient enables homeowners to install less powerful heat pumps, which makes this upgrade more affordable.

Investing in weatherization pays off

Weatherization plays a crucial role in regulating building temperature. Even well-insulated homes lose 1-5% of heat per hour through walls, windows, ceilings, and doors; poorly insulated homes can lose even more.[9] Weatherization focuses on improving insulation and upgrading windows, addressing over 90% of heat loss due to cracks and inefficient structures while also helping to make homes more resilient to grid interruptions, as better insulated homes hold heat and cooling for longer periods.

Exhibit 5: Majority of the US is less efficient than the national model code
Map of residential energy by state index relative to current model code
(2021 IECC(International Energy Conservation Code))



Source: US Office of Energy Efficiency & Renewable Energy; Data as of 12/28/2023

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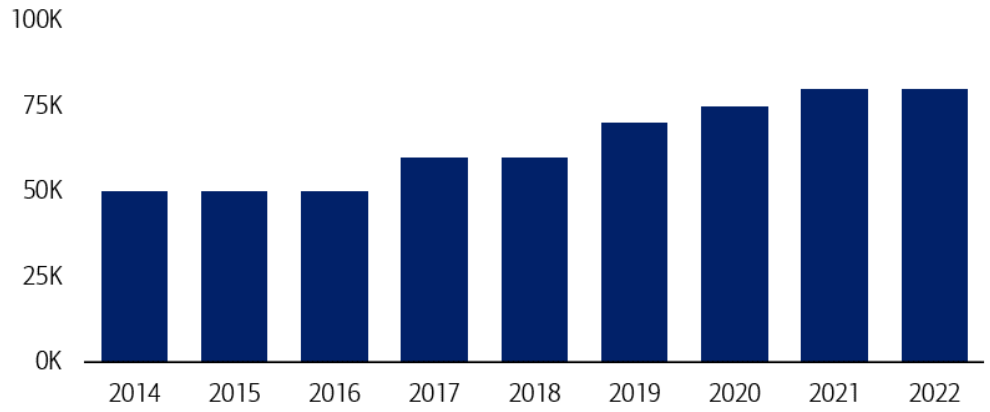
Appliance and lighting upgrades help in using less energy

Appliances and lighting consume two-thirds of all electricity used by US households.[10] However, households can benefit from the increasing number of energy-efficient products that are coming to the market. ENERGY STAR has added over 30,000 certified product models in the last five years, representing an increase of 60%. Bolstering this, the IRA offers tax credits of 30% of total energy efficient home improvement expenses for a maximum annual limit of $1,200.

[9] Green Wave Distribution
[10] US Energy Information Administration (EIA)

Exhibit 6: ENERGY STAR certified products on the rise
Number of ENERGY STAR certified product models, 2014-2022



Source: US Environmental Protection Agency's ENERGY STAR Annual Reports

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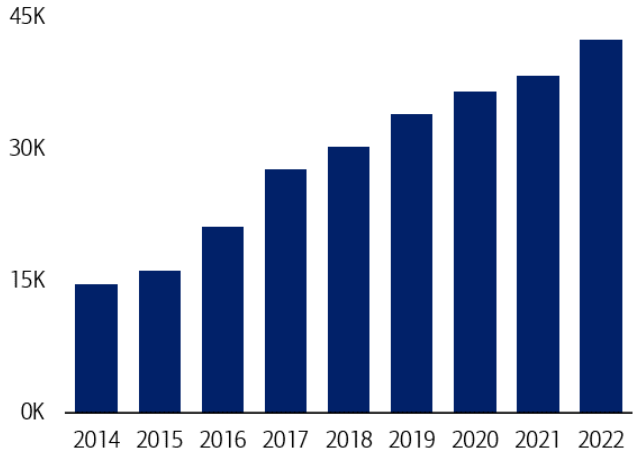
Building upgrades can improve water efficiency

Over the last two decades, the western US has experienced some of the driest conditions on record, making water efficiency measures more critical (see: Global water scarcity: H2O no!). Switching to water-efficient appliances can cut indoor household water use by more than 35%.[11] Perhaps as a result, the WaterSense program, which identifies products that are at least 20% more water-efficient, has seen a 40% increase in the number of labeled products in the last five years. The program focuses particularly on bathroom appliances, which contribute two-thirds to indoor water use.

Exhibit 7: The number of WaterSense-labeled products is +40% over five years
Number of WaterSense-labeled product models, 2013-2022



Source: US Environmental Protection Agency (EPA)

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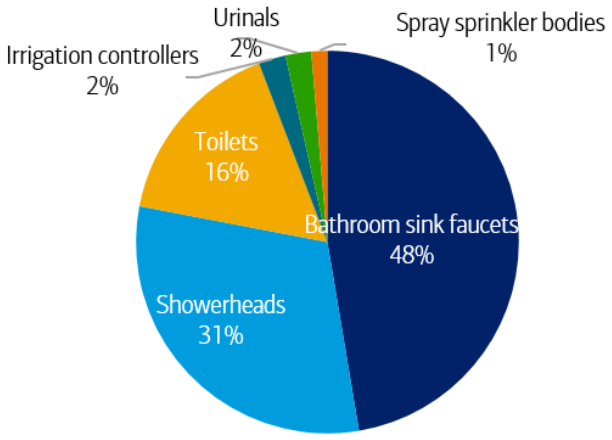
Exhibit 8: Water-efficient products focused on the bathroom
Percent of WaterSense-labeled product models by type of product, as of 2022



Source: US Environmental Protection Agency (EPA)

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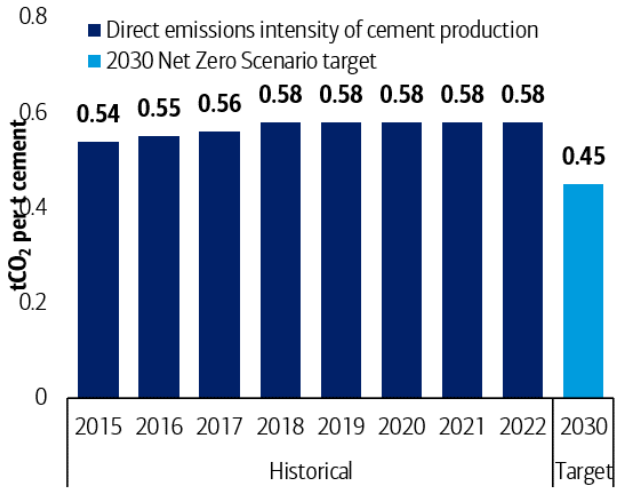
Choosing more sustainable raw materials

Achieving net-zero emissions in the construction sector is challenging, especially in steel and cement production, which collectively contribute nearly 7% of global emissions.[12] These industries face formidable obstacles due to the high heat required for essential chemical reactions. Yet, to reach net-zero targets by 2030, cement and steel emission intensity must decrease by 22% and 24%, respectively. Meeting these goals necessitates efficiency improvements, reducing material usage, and implementing innovative technologies. Sustainable building materials that encompass steel and concrete with lower embodied carbon, responsibly sourced lumber and engineered wood, and recycled plastics are crucial in this transformative journey.

[11] American Water Works Association
[12] International Energy Agency (IEA)

Exhibit 9: Cement emissions intensity needs to fall 22% by 2030 to achieve net zero

Historical direct emissions intensity of cement production, 2015-2022; target direct emissions intensity in 2030 under the Net Zero Scenario



Source: International Energy Agency (IEA)

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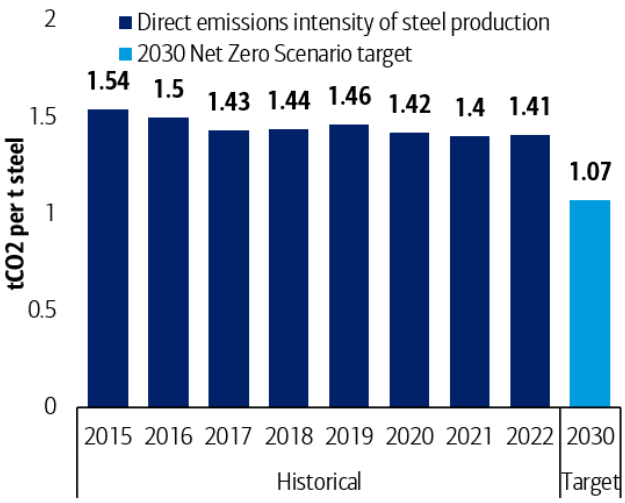
Exhibit 10: Steel emissions intensity needs to fall 24% by 2030 to achieve net zero

Historical direct emissions intensity of steel production, 2015-2022; target direct emissions intensity in 2030 under the Net Zero Scenario



Source: International Energy Agency (IEA)

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Cement: More sustainable formulas can reduce emissions

Strategies for decarbonization include implementing emissions abatement through carbon capture, utilization, and storage (CCUS), utilizing less clinker in cement production, exploring innovations in alternative cement, and substituting cement with other eco-friendly materials, such as sustainable timber.

Plastic: Using recycled materials supports circularity and adds longevity

Incorporating recycled plastic into building materials not only addresses plastic waste and promotes circularity but also provides additional functional benefits. Currently, less than 10% of plastic waste in the US is recycled. However, recycled plastic is increasingly replacing lumber in decks or fences, extending their lifespan from 14 years to 20-30 years. Additionally, it serves as an additive in concrete, enhancing its lightweight properties to reduce emissions during transport, impeding water absorption, and improving insulation. This versatile material can also substitute virgin materials in floor tiles, roofing tiles, and bricks.

Steel: Recycling and material reduction critical while new tech is developed

In the US, various steel decarbonization projects employing diverse technologies have been actively announced. These initiatives involve implementing CCUS and replacing fossil fuels with green hydrogen. However, current green steel technologies are significantly more expensive than unabated production, posing challenges for widespread adoption in the construction sector, where thin margins prevail.

Although economies of scale are expected to reduce these costs over time, recycling and enhancing steel efficiency present more immediate, cost-effective strategies. Recycling scrap steel consumes 75% less energy than processing iron ore and can be achieved using renewable electricity. Additionally, reducing steel emissions can be accomplished by extending building lifetimes by 30-40 years and employing steel more efficiently in construction. US steel companies are actively pursuing emission reduction through energy efficiency initiatives, renewable energy policies, and the adoption of net-zero targets.

Wood: Building alternative with lower manufacturing and transport emissions

Wood is by far the most common framing material in in the US, particularly in single-family homes (94% of single-family homes built in 2022 used wood framing, versus 73% of multi-family homes). The share of wood used in multi-family homes could rise further given growing interest in mass timber (a type of load bearing engineered wood that can replace steel and concrete). There are now over 2,000 mass timber projects in the US.[13]

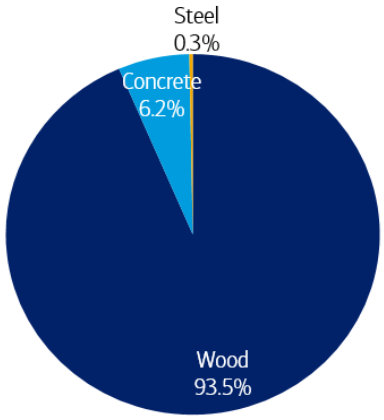
Whether wood should be considered a sustainable building material is heavily debated. Proponents highlight that wood is a renewable and reusable resource that continues sequestering carbon even after harvested. Manufacturing engineered wood uses 24x less energy than producing steel and 5x less energy than concrete, making it a less carbon-intensive building material.[14]

[13] WoodWorks; as of December 2023

[14] Engineered Wood Association

Moreover, wood is 5x lighter than concrete and 15x lighter than steel, reducing transport emissions.[15] The utilization of well-established certification systems is an important tool to ensure the sustainability of wood and other forest products used in construction.

Exhibit 11: Wood is by far the most popular framing material for single-family homes…
Percent of single-family homes built in the US in 2022 by framing material



Source: BofA Global Research, US Census Bureau

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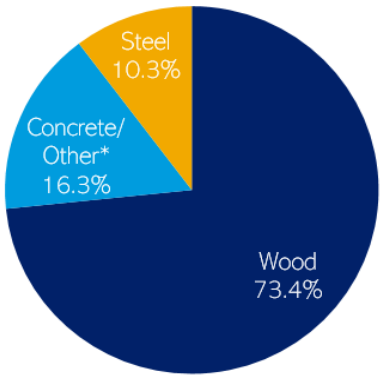
Exhibit 12: …while steel and concrete make up a larger percentage of framing in multi-family homes
Percent of multi-family homes built in the US in 2022 by framing material



Source: BofA Global Research, US Census Bureau. *Note: Includes concrete, insulated concrete forms, and other types of framing (not shown separately).

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Green building policies drive spending

To champion energy efficiency in buildings, the US federal government launched the National Building Performance Standards Coalition in January 2022. This coalition enables state and local governments to collaborate in advancing building performance legislation. Participating jurisdictions, representing one-quarter of US buildings, are committed to passing a building performance policy by Earth Day this year (April 22, 2024). Additionally, the federal government introduced the first-ever Federal Building Performance Standard in 2022, applicable solely to federal buildings in the US. This standard aims to reduce energy consumption and transition equipment and appliances to electrification in 30% of federal building space by 2030. Given that the federal government is the largest building owner and manager in the US, this standard could inspire state and local governments to enact similar laws.

The IRA is the bigger talking point…

The Inflation Reduction Act (IRA) and the Bipartisan Infrastructure Law (BIL) collectively offer US state governments over $1.2 billion to encourage the adoption of building energy codes. The Energy & Climate provisions of the IRA allocate $27 billion for building efficiency and electrification through grants and government loan programs. This includes $8.5 billion for states to implement home energy rebate programs.

The IRA also incentivizes homeowners by making tax credits available for a portion of qualifying expenses. Starting in 2023 through 2032, 30% of total energy efficient home improvement expenses can be applied to tax credits, for a maximum annual limit of $1,200. For heat pumps, biomass stoves and boilers, there is a separate annual credit limit for $2,000. There are no lifetime limits for energy efficient credits. Included with the IRA, the High-Efficiency Electric Home Rebate Act (HEEHRA) is a voluntary program that covers 100% of electrical efficient projects (up to $14,000) for low-income households and 50% of costs (up to $14,000) for moderate-income households. HEEHRA also provides up to $1,600 in weatherization rebates to improve windows, insulation, and air seals in existing homes. For new residential construction, the IRA provides tax credits worth up to $5,000 for homes certified as Zero Energy Ready Home and up to $2,500 for homes certified as ENERGY STAR. See IRA ripple effect: 10 areas of impact for more on this topic.

Patchwork of US state- and local-level laws encourage greener buildings

While the benefits of the IRA seem to be widely understood among investors, state- and local-level policies are an underappreciated driver of spending on green building products, in the view of BofA Global Research. The sheer number of policies make this impact difficult to quantify, yet these policies are meaningfully impacting spending at the local level. Based on a BofA Global Research analysis of the US Green Building Council's Policy Library, there are over 420 green building policies (targeting both residential and commercial properties) in effect at the state- and local-level across the US. The vast majority of

[15] Kirksey Architecture

these (86%) fall at the city, town, or county level and 98% of policies focus on new construction. Only half of the policies set a requirement, with the remainder providing incentives and/or enabling future legislation instead.

In fact, 30 states have at least one policy in effect that incentivizes, requires, or encourages high-performance buildings (residential and commercial). Nearly all of these states (25) have mandated certain building standards (e.g., requiring LEED certification for any new construction), while 16 states are offering incentives, which may be structural (like density and height bonuses and expedited or no-cost permitting) or financial (like tax credits, grants and low interest loans).

New Europe legislation could lead the way for US state and local governments

Proposed building energy performance bills in the United Kingdom (UK) and the European Union (EU) could offer US states and localities a framework for their own policies. Many of these bills apply to both residential and commercial buildings.

The Minimum Energy Performance of Buildings Bill (MEPB) is making its way through the UK Parliament. Although the precise text is yet to be finalized, the bill proposes a new Minimum Energy Efficient Standard (MEES) for buildings in the UK. The bill seeks to improve the UK's housing stock to a minimum Energy Efficient Rating (EER) of C, with deadlines varying from the end of 2025 for new private rentals to 2035 for homes. Additionally, 80% of privately rented properties in the UK with an energy efficiency rating below C would need to spend around £10,000 to achieve compliance with the UK's MEES.[16]

Similarly, in the EU, a revision to the Energy Performance of Buildings Directive is now pending formal adoption after legislators reached a provisional agreement on the directive in December 2023. The directive sets out a range of measures to improve the energy performance of buildings, including requiring EU countries to set minimum energy performance requirements and establish long-term renovation strategies to decarbonize the building sector.

[16] Propflo

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