

RESIDENTIAL DECARBONIZATION RETROFITS



Residential Decarbonization Retrofits Introduction

Whether we are owners or renters, everyone depends on safe, healthy, and resilient housing. At the same time, residential buildings account for a significant share of global energy use and greenhouse gas emissions, and meaningful progress on climate goals will require substantial improvements to the performance of existing homes. These upgrades are often complex and costly, and homeowners increasingly face climate-related risks such as extreme temperatures, flooding, drought, hailstorms, wildfires, and the loss of insurance coverage.

ASHRAE offers a wide range of resources to support the design and retrofit of residential buildings that reduce carbon emissions while improving occupant health, comfort, and resilience. On this page, you'll find:

1. **A concise set of priority considerations** for decarbonization retrofits in single-family homes that integrates emissions reduction with occupant health and comfort and emphasizes a logical sequence of actions to maximize performance, cost-effectiveness, and long-term value.
2. **A curated collection of residential decarbonization retrofit resources** that emphasize occupant-focused guidance on electrification, home performance, health, comfort, and practical implementation tools.

Residential Decarbonization Retrofit Strategies

Understand your baseline and make a plan.

A comprehensive home energy audit identifies where energy is lost, which systems are most inefficient, and the optimal sequence of upgrades. This can prevent costly mistakes, such as oversizing equipment or replacing systems before addressing the building envelope. Staged or partial retrofits can also be very effective, allowing improvements to be completed over time while still capturing significant energy and carbon savings.

Focus on passive strategies first.

Reduce heating and cooling loads by sealing leaks and upgrading attic, wall, and floor insulation. Use interior shades and/or exterior deciduous vegetation to minimize solar heat gain during summer. Assess whether window replacements are cost-effective (e.g., replacing single-pane units with high-performance double- or triple-pane models). Consider using operable windows, if available, for adaptive comfort cooling. Check refrigerant line pressures regularly for leakages. These measures reduce drafts, improve comfort, and allow for smaller, less expensive HVAC systems.

Upgrade electrical panel and wiring as needed.

Where possible, avoid panel upgrades by selecting efficient appliances and using load-sharing devices. If upgrades are required to support new electric loads from heat pumps, electric vehicles, or solar, ensure the panel and wiring are properly sized for current and future needs.

Upgrade HVAC and water heating systems.

Replacing HVAC and water heating equipment with high-efficiency systems reduces carbon emissions and improves performance. Cold-climate heat pumps provide year-round comfort with lower carbon intensity, while high-efficiency water heaters—installed in conditioned or semi-conditioned spaces and paired with off-peak controls—cut energy use and further reduce emissions. Ask your contractor to recommend equipment with lower GWP (Global Warming Potential) refrigerants and ensure they recycle refrigerants at end of life.

Prioritize healthy indoor air, kitchens, and materials.

Retrofit projects should address indoor air quality by reducing pollutant sources, providing continuous filtered ventilation, and ensuring effective kitchen exhaust. Choosing low-emitting materials and considering induction cooking can further reduce exposure to harmful pollutants during and after upgrades.

Add solar, battery storage, and smart controls.

Incorporate on-site solar and consider battery storage to offset electricity use, improve resilience, and support future efficiency upgrades or new electric loads. Pair these systems with smart thermostats, water heater timers, and load-shifting strategies to reduce costs, manage peak demand, optimize renewable use, and enhance grid stability.

Prioritize low embodied carbon solutions.

Prioritizing repair and retrofit over demolition extends the life of existing materials and structures. When replacement is necessary, using low-carbon materials for upgrades—such as sustainably sourced timber or recycled wood—and specifying low-GWP materials and furnishings reduces emissions. Additionally, repurposing or recycling building components during renovations helps minimize impacts.

Plan for ongoing monitoring and maintenance.

Track system performance, review seasonal energy use, and perform regular maintenance to ensure retrofits continue to deliver energy savings, carbon reductions, and occupant comfort over time.

Residential Decarbonization Retrofit Resources

ASHRAE Resources

- ASHRAE's [Residential Buildings Committee](#) (RBC) identifies and assesses major residential trends affecting HVAC&R practice, advises ASHRAE leadership and membership on their implications, and recommends policies, activities, and partnerships to address emerging residential building needs. They also maintain a [Residential Buildings Resource](#) page that consolidates many resources such as ASHRAE articles, sizing calculations, and links to applicable Standards and Guidelines.

Resources from Other Organizations*

- Rewiring America's [Electrify everything in your home](#) is a practical guide to replacing fossil-fueled household appliances with modern electric alternatives, offering upgrade options, project guidance, contractor questions, and checklists for homeowners, renters, and landlords.
- The Switch Is On provides [general information](#) and tools to find [incentives](#) and [contractors](#) near you.
- [A Pocket Guide to All Electric Retrofits of Single Family Homes](#) provides a practical how-to overview of replacing gas appliances with efficient electric alternatives, highlighting costs, benefits, strategies, and lessons learned from real-world case studies. It also includes a product guide to help homeowners and practitioners select electrification-ready appliances.
- Nate the House Whisper's [Home Comfort 101](#) explains how homes function as integrated systems, helping homeowners diagnose the root causes of comfort, moisture, and indoor air quality problems and emphasizes building science fundamentals to avoid costly, ineffective retrofit decisions.
- The [Watt Diet Calculator](#) summarizes pathways to avoiding electric panel upgrades by selecting efficient products and using load sharing devices with this tool.
- ACEEE's [Deep Retrofits Can Halve Homes' Energy Use and Emissions](#) report shows that upgrading homes with insulation, air sealing, and efficient heat pumps can cut energy use and emissions by more than half while improving comfort and lowering utility bills.

****Information on these pages is provided as a service to the public. While every effort is made to provide accurate and reliable information, this is advisory, is provided for informational purposes only. These are not intended and should not be relied upon as official statements of ASHRAE.***