# Equitable Strategy Map: A Toolkit for Greenhouse Gas Reduction through the Greening of the Affordable Multifamily Market Sector in Low-Income and Disadvantaged Communities

**Business as usual is no longer enough**. Communities of color, Native communities, and those who are economically marginalized are disproportionately impacted by the risks and realities of climate change. Homes and farms are damaged. Workers and businesses face the impact of ongoing economic and climate-related shifts. Lives and livelihoods are at stake. At the same time, the unprecedented level of investment flowing into our new clean energy economy represents a significant opportunity for low-income communities and communities of color to address longstanding systemic inequities. To meet this vision of an equitable clean energy transition, we need to structure investments ***to ensure that resilience and greenhouse gas reduction are engineered into*** ***every investment, every building, every business, every project, everywhere, for everyone***.

The Inflation Reduction Act (IRA) includes historic funding and opportunities to fuel greenhouse gas reduction for low-income and disadvantaged communities. ***In particular, the Environmental Protection Agency’s (EPA) $27 billion Greenhouse Gas Reduction Fund (GGRF) represents a critical tool in realizing the vision of a more equitable, climate resilient future.*** Over the past several months, the University of New Hampshire’s Center for Impact Finance (CIF) and the Natural Resources Defense Council (NRDC) have led a “sprint design process” to develop “equitable strategy maps” to inform equitable greenhouse gas reduction with GGRF funds through traditional lending lines of business in key market sectors.

Through this "sprint design lab" process, supported by CIF and NRDC staff and consultants, ***expert teams have shared knowledge and developed recommendations for delivering equitable resilience and greenhouse gas reduction through coordination, cooperation, and collaboration by all members of the project development ecosystem***: Community Development Financial Institutions (CDFIs), community development banks and credit unions, Minority Depository Institutions (MDIs), Green Banks, and other mission lenders; community development corporations; environmental advocates; contractors; community groups; and others committed to a just, resilient future.

The resulting strategy maps address how to (1) integrate and normalize greenhouse gas reduction into development services, financing, and asset management and (2) coordinate and collaborate on the most impactful ways to deploy EPA’s GGRF dollars to scale clean energy financing in low income and disadvantaged communities and maximize community benefits such as economic development, quality jobs, resilience, affordable housing, and sustainable food systems. Recommendations are grounded in deep, hands-on expertise, developed through working groups of dozens of relevant market participants and stakeholders who together estimated the investment opportunity in each market sector, identified barriers and potential solutions to scaling each lending line of business brainstormed about collaborations necessary for project development, and discussed funding priorities.

Each design lab engaged a cohort of experienced lenders, developers, and thought leaders reflective of the project development and finance process for that market sector to develop an Equitable Greenhouse Gas Reduction Strategy Map. Many thanks to all who participated.

## Scope

In this guide, we make the case that ***equitable investments in energy efficiency and electrification in multifamily housing properties for low-income and disadvantaged communities (LI/DAC) should be a key strategy for the EPA’s GGRF***. Below, we describe the potential opportunities in this sector, and make concrete recommendations to ensure efficiency, effectiveness, accountability, and above all else equity in implementation. We have attempted to keep our focus tight on these specific assets and the market sector that designs, develops, and finances them. For overall recommendations around the implementation of the GGRF and for additional equitable strategy maps, please consult the Center for Impact Finance’s webpage “[An Equity-Centered, Collaborative Approach to Greenhouse Gas Reduction for Low-Income and Disadvantaged Communities](https://carsey.unh.edu/center-for-impact-finance/current-projects/equity-centered-collaborative-approach-greenhouse-gas-reduction-low-income-disadvantaged-communities)”.

## Overview of the Opportunity

Increased investment in energy efficiency and building electrification for affordable multifamily buildings could deliver significant greenhouse gas reduction as well as meaningful benefits in health, resilience, and economic development. What’s more, prioritizing decarbonization of affordable housing in ways that provide stable, affordable electricity; healthy indoor air quality; and resilience for the millions of low-income renters in the US is critical for environmental justice. Multifamily housing is big business, and the markets for the development, financing, and management of multifamily properties are mature. However, many actors in this industry have yet to fully embrace building decarbonization in their day-to-day operations and business plans. GGRF dollars represent a key opportunity to transform this mature sector into a force for not only GHG reduction, but for improved quality of life for millions of residents across the country.

* ***Overall, the multifamily sector is responsible for 13.9% of nationwide greenhouse gas (GHG) emissions (CO2 equivalent)[[1]](#footnote-1).*** Beyond reducing GHG emissions, the Greenhouse Gas Reduction Fund (GGRF) represents a critical opportunity to address other issues in multifamily buildings, particularly:
	+ Buildings are long-lived structures – opportunities to decarbonize buildings happen relatively infrequently and inaction has long-term negative impacts.
	+ Investing in measures that reduce GHG emissions in multifamily buildings can drive tangible benefits (health, comfort, resiliency, and quality of life improvements)[[2]](#footnote-2).
	+ Unlike the power and transportation sectors, a critical mass of major players within the buildings industry (e.g. developers; owners; lenders; contractors; etc.) have yet to embrace a transition to carbon neutrality.
	+ Physical standards for affordable multifamily buildings are often stipulated by financing requirements so there is high potential for implementing GHG emissions reductions through the combination of private and government-supported financing strategies.
	+ Subsidized, long-term financing is a high-impact strategy to decarbonize buildings.
* [According to a report by the American Council for an Energy Efficient Economy (ACEEE),](https://www.aceee.org/sites/default/files/pdfs/u2204.pdf) there are an estimated 12,455,350 low- to moderate-income households living in multifamily buildings that could benefit from decarbonization upgrades. ***Conducting deep decarbonization retrofits (e.g. at least 50% efficiency improvements) in these buildings could result in nearly 300 trillion Btus of energy savings, which would result in an estimated reduction of 38 million metric tons in CO2 equivalent emissions*** – an 41% reduction from the current estimated emissions from the multifamily housing sector as a whole.
* For the purpose of this guide, a ***multifamily building is defined as housing with five or more units***, where a significant number of those units are affordable to households 80% of median family income and below. Many of these properties are subsidized by local, state, or federal assistance programs, financed through the Low-Income Tax Credit Program (LIHTC), or have other financing mechanisms in place that require certain levels of affordability. “Naturally Occurring Affordable Housing” (NOAH) also represents a significant segment of this population.
* While we discuss the estimated market size of different multifamily types below, a glimpse at a few larger mission-based intermediaries in the multifamily housing space demonstrates the significant decarbonization opportunity that exists. For example, almost 1 million multifamily housing units are either owned or currently under asset management between just four community development intermediaries – Enterprise Community Partners; Housing Partnership Network; LISC/National Equity Fund; and NeighborWorks.
* ***Different Multifamily Types and Estimated Market Size[[3]](#footnote-3):***
	+ Low-Income Housing Tax Credit (LIHTC) program[[4]](#footnote-4): Federal tax credits distributed through state and local agencies to subsidize the acquisition, rehabilitation, or new construction of rental housing targeted to lower-income households.
		- [According to HUD](https://www.huduser.gov/portal/datasets/lihtc/property.html), there are over 3.4 million units in service across over 50,000 projects that received low-income housing tax credits.
	+ “Naturally Occurring Affordable Housing” (NOAH): Privately-owned multifamily rental properties without public subsidy of any kind with rents below regional market rate. Typically, older (built pre-1990) Class B and C buildings and complexes are clustered in historically redlined areas.
		- [According to a CoStar analysis for the Urban Land Institute](https://americas.uli.org/new-costar-data-identifies-5-5-million-units-naturally-occurring-affordable-housing-markets-across-united-states/), there are roughly 5.5 million NOAH units (in multifamily buildings with 5+ units) in the U.S.
	+ HUD-Assisted: Includes public housing, tenant and project-based vouchers, as well as HUD programs like Section 202/801, the Community Development Block Grant (CDBG), and HOME Program, to name a few.
		- [According to HUD](https://www.huduser.gov/portal/datasets/assthsg.html), there are nearly 5.1 million HUD-Assisted units housing over 9 million people, not including those funded via CDBG; HOME; and Indian Housing.
	+ Fannie Mae & Freddie Mac: Facilitating a secondary market for mortgages on housing for very low-, low-, and moderate-income families, with annual goals for the number of units backed by Fannie/Freddie purchased mortgages; refinancing for loans supporting energy and water efficiency upgrades; and additional funding for borrowers looking to improve energy and/or water efficiency.
		- [According to the FHFA](https://www.fhfa.gov/PolicyProgramsResearch/Programs/AffordableHousing/Pages/Fannie-Mae-and-Freddie-Mac-Housing-Goals-Performance.aspx), there are nearly 750,000 low-income multifamily housing units in properties backed by mortgages purchased by Fannie Mae or Freddie Mac.
	+ USDA Rural Housing Service: Includes direct loans, loan guarantees, and grants for the development and revitalization of multifamily housing in rural areas.
		- [According to USDA](https://www.rd.usda.gov/programs-services/multi-family-housing-programs#:~:text=Multifamily%20Housing%20utilizes%20a%20variety,in%20USDA's%20rural%20rental%20portfolio.), there are over 14,000 multifamily properties currently in the USDA’s rural rental portfolio.
* For the purposes of this guide, building decarbonization refers to the reduction of GHG emissions associated with owning and operating of a multifamily building. Typically, this is done via a combination of building energy efficiency approaches, electrifying all building systems, and sourcing electricity from clean, renewable sources.
	+ ***Energy efficiency*** is the use of less energy to perform the same task. Energy-efficient homes and buildings use less energy for heating, cooling, running appliances, building systems and, electronics. Energy efficiency measures generally lower a property’s utility bills (electric, gas, oil and hot water).
	+ ***Building electrification*** entails replacing natural gas-powered furnaces, boilers, water heaters, stoves, and clothes dryers with highly efficient electric appliances, able to be powered by increasingly clean sources of electricity.

## Policy Landscape: Existing Buildings

* ***Federal, state, and local programs incentivizing energy efficiency retrofits in existing buildings have been in the market for some time and have seen some success in motivating voluntary building upgrades, but requirements are on the rise.*** Now, emerging policies at the local and state level are *mandating* maximum thresholds of building energy use intensity and/or emissions intensity. While not prescriptive, these policies, known as Building Performance Standards or BPS for short, require building owners to meet energy performance targets that often necessitate investments in improved energy efficiency and building electrification. These policies span the geography of the U.S., with standards already enacted in the jurisdictions identified below. As such standards become more prevalent, lenders should be tracking these requirements in the markets they serve and developing financing products that assist the buildings they finance to comply with local mandates. This will help lenders to manage risk within their own portfolios and to help ensure competitive asset values for the properties they finance.



*Source:* [*IMT.org*](https://www.imt.org/resources/map-building-performance-standards/)

* ***As the targets are generally quite aggressive, anywhere from 25-50% of covered properties for a given BPS will be required to take action in the form of retrofit capital projects to comply in the near term, and that percentage will increase as the targets ratchet up over time***. The stringency of these requirements further underscores the need to ensure that developments being built now are built all-electric and highly efficient, or else they may be subject to more costly retrofits down the line.
* ***Many more BPS are likely to be passed in the near term.*** In early 2022, President Biden launched the [National Building Performance Standards Coalition](https://nationalbpscoalition.org/), comprised of a group of state and local governments that have formally committed to design and implementation of BPS. Twenty-seven of the participating jurisdictions have not yet passed BPS, and many of those are still in the early phases of policy design. This coming wave of BPS will be prioritizing emissions reductions alongside social equity goals including health, energy and housing affordability, and resilience[[5]](#footnote-5) – with a keen eye on how the GGRF might be leveraged to assist local multifamily housing with compliance.



*Source:* [*IMT.org*](https://www.imt.org/resources/map-national-bps-coalition-participating-jurisdictions/)

* In addition to BPS policies, ***cities and states are also considering and enacting a range of other policies and standards that incentivize energy efficiency and electrification for existing buildings.*** Point-of-replacement policies, rental efficiency standards, appliance emissions standards, date-certain equipment replacement requirements, among others, are all examples different localities and states are pursuing in the path toward building decarbonization.[[6]](#footnote-6)

## Policy Landscape: New Buildings

* ***Most regions are increasingly requiring stringent energy efficiency codes, which can be an effective “stick” for many building owners to make energy efficient investments.*** In many cases, all-electric multifamily new construction is less costly to build than mixed fuel construction.[[7]](#footnote-7) Even if not directly required at the time of construction, building owners and tenants alike stand to benefit from both energy efficiency and electrification in the pursuit of fully decarbonized developments.

## Key Players

Meaningful greenhouse gas reduction in this sector will require coordination and collaboration by all players in the affordable multifamily ecosystem. A successful strategy should consider and leverage the unique role each actor plays in delivering building decarbonization and quality of life improvements for residents. Below, we highlight some of these players and how they fit into the building decarbonization puzzle.

* ***Affordable Housing Owners/Developers***: The entities who will make the ultimate decision to pursue building decarbonization or not – are key players to consider in the design of GGRF-related investments. The sophistication of these actors, which can be individuals or corporate entities, varies widely, and ranges from mom-and-pop small landlords, who may own a 5-unit building, to national nonprofit and for-profit operators with thousands of units under management. In addition, a small but critical piece of the ecosystem are community-owned buildings, such as cooperative and community land trusts.
* ***Private and Public Financing Entities***: Are also key players in the scaling of multifamily decarbonization, and the structure of their investments will ultimately determine how deeply projects can go in terms of GHG-reducing improvements. Below, key players are broken into the different categories of investment provided in the multifamily capital stack:
	+ Debt
		- ***Banks and Housing Finance Agencies (HFAs)*** will typically provide long-term, first trust loans for multifamily buildings. Banks may sell their loans on the secondary market to Fannie Mae or Freddie Mac, or provide loans insured by the Federal Housing Administration. HFAs are able to provide low-cost loans (typically in combination with 4% LIHTC) with capital raised from investors who purchase tax-exempt private activity bonds.
		- ***Mission-based lenders such as CDFIs*** provide both early-stage financing (predevelopment; acquisition) critical to scoping out building decarbonization pathways, as well as subordinate, gap-filling debt (bridge; construction) key to financing deeper GHG-reducing improvements.
	+ Equity
		- ***The LIHTC Program, the primary way affordable housing is financed in the country, uses the tax code to entice equity investors into affordable housing projects.*** In exchange for federal tax credits, these investors (or the syndicators that represent the investors) provide cash that is then used by the developer to pay for project costs. LIHTC affordability requirements typically run 30 years and are supposed to structure exists that protect affordability further. Without this level of equity infusion, most affordable housing projects would not be financially feasible.
		- Similar to the down payment a homeowner would have to invest in order to receive a mortgage, ***many affordable housing projects require some level of owner equity investment as part of the financing package***.
	+ Government Subsidies
		- ***Capital Subsidy/Project-Based Grants/Soft Debt*** can be provided by housing or environment departments at the local, state, or federal levels. These dollars are typically structured as either project-based grants or long-term, low-interest, highly subordinated “soft” loans that cover a portion of development costs and are paid back based on remaining cash flow. Usually, these funds come with affordability covenants.
		- ***Operating Subsidies***, unlike Capital Subsidies, are funds that flow into the project on an ongoing basis. The most common operating subsidy is HUD’s Housing Choice Voucher Program, which provides monthly payments to building owners who provide housing to low-income households and can either be tenant- or project-based.
* ***Another core component of a successful multifamily building decarbonization strategy includes the technical expertise provided by building science firms, architecture and engineering, the building trades, and energy technology software***. Any energy efficiency or electrification process will necessarily involve these players. These players range enormously in their knowledge, skills, sophistication, access to building components and technologies, and ability to access working capital across types and sizes of firms, geographic regions, etc.
* ***Community-based and grassroots nonprofits focused on tenant organizing have long been engaged in advocating for the creation and preservation of affordable housing that responds to local needs and tenant priorities.*** While some groups may already have a specific environmental justice or energy justice lens, many do not. Connecting the dots between building decarbonization and tenant health outcomes, addressing concerns about temporary relocation due to deep energy retrofits, and addressing split incentive issues are some of the top priorities many groups will want to see addressed in any decarbonization strategy.
* ***Local utilities and other energy efficiency entities:*** ([NYSERDA](https://www.nyserda.ny.gov/); [Mass Save](https://www.masssave.com/); etc.) also play a key role in building decarbonization.[[8]](#footnote-8) Many of these entities have energy efficiency programs that affordable multifamily owners can use to buy down the cost of decarbonization and to access technical services to assist with implementation. Public Utility Commissions are also key entities that can set policies and regulations utilities must follow in relation to building decarbonization and potential grant programs.

## Social Equity Concerns

If designed and implemented well, investments in energy efficiency and electrification can significantly address economic and racial inequities across a number of outcomes, from health to supporting wealth creation. However, if these goals and considerations are not centered at the beginning of a building decarbonization strategy, investments have the potential to exacerbate existing inequities. Below, we discuss some important issues to keep in mind, as well as key opportunities to further environmental justice.

* ***Energy Burden:***
	+ ***Not only does decarbonization stand to dramatically reduce emissions, such investments also have the potential to alleviate energy burden (percentage of gross household income spent on energy costs) and decrease overall costs of living for tenants of affordable multifamily housing***. [In Illinois](https://www.elevateenergy.org/wp/wp-content/uploads/Energy-Burden-in-IL.pdf), low-income families spend an average of 13 percent of their income on energy. [In Michigan](https://www.elevateenergy.org/wp/wp-content/uploads/Energy-Burden-in-MI.pdf), that number is 15 percent. These burdens are borne disproportionately by Black and Latinx households. [A study of 48 U.S. metropolitan areas](https://www.aceee.org/press/2016/04/report-energy-burden-low-income) found that Black households experience a median energy burden 64 percent greater than white households while Latinx households experience a median energy burden 24 percent greater than white households. Building decarbonization presents an opportunity to reduce customer bills. Pairing electric appliances with energy efficiency, building upgrades, and protections against bill increases can help families spend less of their income on energy.
	+ ***However, without an eye toward equity, building decarbonization can run the risk of deepening energy burden.*** Low-income customers, locked out of accessing new electric appliances, could end up stuck on the gas system as wealthier customers exit, leaving a smaller and smaller group of people behind to cover the cost of an increasingly expensive system. On the other hand, installing electric appliances without taking care to reduce overall energy usage could inadvertently leave customers with higher electricity bills, deepening energy burden.”[[9]](#footnote-9) Further, decarbonization may result in no impact on household costs. For instance, for HUD-assisted properties that include a utility allowance, an energy efficient upgrade that reduces utility costs can be transferred over to increased rent, leaving the household with the same combined utility and housing costs as before. GGRF-funded approaches to decarbonization should drive the economic benefits of decarbonization to households.
	+ [According to a report by the American Council for an Energy Efficient Economy (ACEEE),](https://www.aceee.org/sites/default/files/pdfs/u2204.pdf) there are an estimated 12,455,350 low- to moderate-income households living in multifamily buildings eligible for decarbonization upgrades. ***Conducting deep decarbonization retrofits in these buildings could result in nearly 300 trillion Btus of energy savings, which would result in an estimated reduction of 38 million metric tons in CO2 equivalent emissions*** – a 41 percent reduction from the current estimated emissions from the multifamily housing sector as a whole.
* ***Housing Quality, Air Quality, and Health Outcomes:***
	+ Buildings can contribute to dangerous air pollution. Gas appliances like stoves, furnaces, and water heaters release carbon monoxide, nitrogen compounds, and other air pollutants (e.g. methane leaks), meaning they can have negative impacts on [health](https://www.nrdc.org/experts/pierre-delforge/gas-appliances-pollute-indoor-and-outdoor-air-study-shows), particularly when not vented[[10]](#footnote-10). A [comprehensive review](https://academic.oup.com/ije/article/42/6/1724/737113#12981961) of the literature found that children living in a home with gas cooking had a 42 percent increased risk of experiencing asthma symptoms. By switching to electric appliances, occupants can breathe healthier air and improve outdoor air quality as well. These upgrades are especially needed in the communities that face the worst pollution. In California alone, replacing gas with electric appliances would prevent [more than 350 premature deaths each year and produce $3.5 billion](https://coeh.ph.ucla.edu/2020/04/29/study-gas-powered-appliances-may-be-hazardous-for-your-health/) in annual health benefits from cleaner air. However, without prioritizing equity **(i.e**. ***offering electric appliances at low or no cost and targeting programs toward pollution-burdened communities), decarbonization initiatives risk only improving indoor air quality for families that can afford electric appliances and building upgrades, instead of families that would benefit most.[[11]](#footnote-11)***
	+ ***Decarbonization improvements on their own can grant health and comfort benefits if appropriately prioritized and included in the scope of work.*** For instance, the ability to add cooling to homes that don't already have it or are using expensive and inefficient systems like window units is a big potential health benefit. With increased temperatures and heat being the single deadliest type of event, cooling will become increasingly important and there are many places in the country where a decarbonization retrofit can introduce efficient and affordable cooling that will keep residents much safer and healthier. Additionally, opportunities like [supporting weatherization](https://healthybuilding.net/uploads/files/NRDC-HBN-EEFA%20Insulation%20Air%20Sealing%20Report%202022.pdf) (air sealing and insulation) upgrades can achieve some health co-benefits – including more comfortable indoor temperatures, noise reduction, and less infiltration of pollutants from the outside – while increasing energy efficiency for heating and cooling.
	+ ***In addition,*** ***the retrofit process presents further opportunity to pursue health and resiliency focused improvements concurrently in order to maximize holistic building improvements and tenant benefits while minimizing the inconveniences and added costs of undertaking two separate retrofit processes.*** Adding resiliency improvements (e.g. elevation of building systems; appropriate stormwater management; etc.) are particularly important, as many low-income and marginalized communities are on the front lines of climate-related hazards and disasters. Retrofits tackling decarbonization can also be layered with remediation for lead exposure, mold, asbestos, pests, and/or any other health and safety hazards, doubling down on the health-related benefits of decarbonization.
	+ ***Making investments in existing buildings that improve housing and air quality and deliver health benefits, ultimately can preserve key community assets that provide housing stability for millions of families.*** Failing to make such investments further increases transition risk these communities face as the economy transitions away from fossil fuels.
* ***Employment and Business Opportunities:***
	+ ***The growing demand for building decarbonization presents significant opportunities for both job seekers and businesses alike to capitalize on the transition toward a clean economy and a focus on building decarbonization.*** Particularly in the mission-based sectors, building decarbonization efforts that pair with high-road, prevailing wage local hiring, as well as small business support can deliver significant benefits to communities. For instance, [a 2020 ACEEE Report](https://www.aceee.org/sites/default/files/pdfs/efficiency-investments-analysis-sept-2020.pdf) that considered efficiency investments in low- and moderate-income multifamily housing, found that such investments would result in over 98,000 additional job-years, result in $15.8 billion in energy bill savings and other financial benefits, and reduce CO2 emissions by 54 million metric tons (equivalent to taking nearly 12 million cars and light trucks off the road).
* ***Displacement Risk:***
	+ ***Many times,*** ***building decarbonization carries high upfront costs, which pose a risk to renters and housing affordability if landlords pass these costs on as rent increases.*** This is particularly a risk in unregulated affordable housing (NOAH). Additional risks include eviction during the retrofit process and changes in metering that could cause renters to begin paying for heat, hot water, or other utilities post-retrofit, ultimately adding to their overall housing cost burden. The Building Electrification Institute (BEI) recommends that public funding should have basic tenant protections attached to prevent evictions and rent increases that may be a result of upgrades.[[12]](#footnote-12)

## Deal Economies

It is difficult to summarize “deal economics” for multifamily housing because investment structure varies depending on the size of the project, geographic area, local market economics, whether the project is subsidized or NOAH, and other factors. In some markets, affordable multifamily housing is big business, and the markets for the development, financing, and management of multifamily properties are mature. In other markets, “Mom and Pop” landlords scrape by. In all markets, many of the building components important for greenhouse gas reduction – including insulation, windows, HVAC systems, etc. – are specified and financed primarily when the property is first built and then again when it is sold or refinanced. Or, when an emergency repair or replacement is needed. There are two main strategies for decarbonizing multifamily housing: (1) transform the multifamily marketplace so that decarbonization is built into the day-to-day regular systems of housing development, finance, management, and repair; and (2) create mid-cycle products and programs that work alongside and around traditional market systems while incentivizing the decarbonization we seek. Typically, affordable multifamily properties are financed with private mortgages or special Federal financing programs, as described above. Many energy retrofits and renewable energy systems are incentivized with rebates, discounts, tax credits, and low-interest rates through Federal, state, utility, and private programs. Grants or other subsidies may be necessary for high-cost areas, or areas with low electricity prices. Home appliances are often financed through retailer installment payment plans or credit cards. Below, we cover key nuances of deal economics:

* **Decarbonization retrofit costs and payback periods vary widely from market to market,** **but generally speaking, owners of multifamily buildings will have to make large up-front capital investments to improve existing building performance and lower emissions.** Depending on the scope, deeper energy retrofits will likely require significant grant support.
* Because of local regulation and geographic energy mix and price variation, ***location is a critical factor in determining how much financial sense it makes to focus on energy efficiency improvement versus electrification.*** In some instances, decarbonization investments can result in underwritable energy savings (meaning that decarbonization investments can pay for themselves and thus be financed), and in others, electrification and/or efficiency upgrades will need to be incentivized with a combination of lower cost capital and grants.
* According to the [City of San Jose’s Framework for Existing Building Electrification](https://www.sanjoseca.gov/home/showpublisheddocument/90625/638017000335100000), estimated decarbonization retrofit costs are $24,000 and up per unit, which can result in modest annual operating cost savings if implemented with central AC. However, if those same investments included on-site solar to offset increased electricity bills, increased savings upwards of $600 per year can be achieved. More jurisdictions and NGO’s will be assembling cost data for holistic building decarbonization retrofits in multifamily buildings as more decarbonization policies for existing buildings emerge.
* Underscoring the regional variability of costs of operating all electric multifamily building, a [Chicago report conducted by Energy Futures Group](https://energyfuturesgroup.com/2022/11/electrification-of-gas-heated-homes-in-chicago/) found that full electrification of a home in a multifamily building would result in first year energy bill savings of $1,036, without any additional energy efficiency or on-site energy production or storage measures included.
* ***Decarbonized new construction projects do not pose the same up-front cost issues that decarbonization retrofits do*** – most projects see lower development costs as well as lower operational costs.[[13]](#footnote-13) For example, [one affordable multifamily housing development in San Francisco, CA](https://developingresilience.uli.org/case/maceo-may/) saved roughly $250,000 through decarbonization measures. The developer then put those savings toward an energy-recovery ventilation system that reduces HVAC electricity consumption and filters airborne debris, as well as toward energy resilience in the form of solar panels and battery storage that can provide lighting and power to essential needs.

## Barriers to Market Development, Deployment, and Impact

In this section, we describe the complicated set of economic, physical, regulatory, and social barriers to developing the energy retrofit market for this sector, getting investable deals, and achieving impact. The challenges are particularly acute in LMI and disadvantaged communities. While a number of barriers exist to decarbonize multifamily housing, particularly when considering retrofits of existing buildings, **there are proven financing and technical assistance strategies that can be deployed to scale affordable multifamily decarbonization, particularly when considering the role GGRF capital can play.**

* In some cases, electrification of buildings may actually increase current operational costs, and energy efficiency upgrades may not deliver enough cost savings to offset, particularly in the short term.[[14]](#footnote-14) A long list of excellent reports and research have documented these barriers, including work from the American Council for an Energy-Efficient Economy[[15]](#footnote-15), The State and Local Energy Efficiency Action Network[[16]](#footnote-16), Energy Programs Consortium[[17]](#footnote-17), and the US Department of Energy[[18]](#footnote-18).
* Overall, some of the most common barriers can be broken into the categories below. It is important to note however, ***many of these barriers can be overcome with a strategic approach to building decarbonization that pairs smart, flexible, and subsidized lending with high-quality technical assistance on the ground.***
	+ ***Owner Barriers:***
		- Split Incentive**:** Owners of multifamily buildings that are individually metered or receive utility allowances do not necessarily have an incentive to pay for energy efficiency upgrades since they will not receive the monetary benefits of such upgrades.
		- Limited cash flow for mid-cycle investments: Typically, owners of subsidized affordable housing have affordability covenants on their property, which limit their ability to increase rent to cover energy efficiency or electrification investments. Additionally, many soft/gap financing programs are repaid on a cash flow basis, which further limits the ability of owners to save for future decarbonization upgrades.
		- Dispersed and complex ownership structure: The varying ownership structures of multifamily housing mean that decision-making is diffuse, and many parties may not make the effort or have the capacity to understand the benefits of decarbonization investment.
		- Lack of capital planning**:** Many owners upgrade their systems reactively, typically when equipment breaks down or a unit turns over. When making these upgrades, owners may focus on like-for-like replacement rather than taking a longer-term retrofit planning approach to enhance their building with systems that are less expensive to operate and maintain.
		- Owner capacity: Many operators do not have the staff power, expertise, or time to track energy usage data and put together an energy efficiency and electrification strategy. Similarly, many smaller operators may not have the capacity to manage contractors to make sure work is appropriately executed.
	+ **Physical and Geographic Barriers:**
		- Diverse building stock and systems: The diversity of multifamily building type (garden-style; mid-rise; high-rise; etc.); the heating, cooling, and ventilation systems that they employ; and the existing capital stacks and lenders involved mean that there is no one-size-fits all financing solution for multifamily building decarbonization.
		- Building conditions and construction uncertainty: Many older multifamily affordable housing buildings require significant structural, pre-weatherization, health and safety, and electrical capacity upgrades beyond electrical system replacement in order to fully decarbonize, dramatically increasing costs. Additionally, uncertainty regarding construction scope of rehabs may result in higher contingencies and general conditions in contractor bids, increasing costs.
		- Physical disruption of tenants to make improvements: Many mission-oriented owners may not want to undergo significant retrofits that would require the displacement of current residents to make energy efficiency and electrification improvements. In addition, contractors who have not completed many occupied rehabs may assign significant risk to such projects, resulting in increased costs and potentially an unwillingness to even bid.
		- Geographic variation in utility mix and prices: When considered in combination with the energy source that building systems use, different scenarios can result in dramatically different payback periods for energy efficiency and electrification upgrades.
	+ ***Financing and Regulatory Barriers:***
		- Lender, investor, and government approvals: Restrictions on the amount of debt an owner can carry on one property, the ability to collateralize additional debt on that property, and lender/investor approval requirement, all represent significant barriers for multifamily property owners looking to make energy efficiency or electrification investments outside of a major recapitalization event.
		- Buildings standards and regulation: The diverse array of building standards across the country mean that some multifamily owners face fewer incentives than others to invest in energy efficiency and electrification. However more owners across the country will likely see increased incentives, as the Inflation Reduction Act (IRA) contains $1 billion for updating codes, on top of several hundred million from the Infrastructure Investment and Jobs Act (IIJA).[[19]](#footnote-19)
		- Legal and regulatory barriers to affordable housing programs: The structures of many housing programs necessary to build and operate affordable housing come with legal and regulatory requirements, as well as tax implications, that make decarbonization investments difficult to pursue.
	+ ***Information and Technical Expertise Barriers:***
		- Access to data and expertise to execute a plan: Multifamily owners may not have the technical expertise on staff, nor financial capacity to be able to easily access the complete picture of their building’s energy usage or put together a feasible and predictable energy efficiency improvement and/or electrification model.
		- Limited data and comps: Limited data and access to comps create significant uncertainty around potential operational savings (when applicable) from making investments.

## Recommendations for Deployment of GGRF Dollars

Below we lay out a set of recommendations for greenhouse gas reduction in this sector, through the equitable deployment of GGRF dollars and with consideration to the barriers outlined above. These recommendations are grounded in deep, hands-on expertise and were developed through relevant market participants and stakeholders who together explored the investment opportunity in this market sector, identified and discussed barriers to scaling this line of work, and considered potential solutions and funding priorities. Contributors considered how best to deploy GGRF funds into this space, with a focus on the highest priority strategies needed to turn on the spigot of creditworthy, impactful decarbonization projects in LI/DAC communities.

The GGRF represents a once-in-a-lifetime source of capital for mission lenders to integrate multifamily building decarbonization strategies into their operations and product offerings. ***To maximize this opportunity, lenders should have a clear theory of change and deployment strategy that considers the entire delivery ecosystem, informed by an understanding of the barriers listed above.***

* ***Technical assistance provision at both the lender, community, and project level will be critical in deploying GGRF into multifamily decarbonization.***
	+ Between housing finance agencies, CDFIs, community banks, and other lenders, there exists a vast affordable housing infrastructure that has yet to fully incorporate decarbonization into its daily work. Pairing technical assistance providers with lenders using business-as-usual approaches to financing and subsidy is unlikely to generate significant scaling of these projects. Given electrification may not result in operating cost savings for owners, technical assistance should be comprehensive and fully paid for, and subsidies will likely need to be high to achieve implementation success.
	+ In addition, convincing communities, and project owners to take the leap into decarbonization and helping them through the process are a few of the ways technical assistance can facilitate a healthy pipeline of projects. GGRF lenders should look to invest in and partner with organizations like [Elevate Energy](https://www.elevatenp.org/), [New Ecology](https://www.newecology.org/), [Southface](https://www.southface.org/), and others in alliances like the [Relay Network](https://relaynetwork.org/partners/), a network of mission-based energy efficiency implementers in the multifamily space. Other potential models include NYC Accelerator, Denver’s Building Electrification Incentive Program, and Boston’s planned Retrofit Resource Hub. Organizations like these can produce and execute portfolio-wide decarbonization strategies.
* ***Lender Deployment Considerations:***
	+ Understand your portfolio’s energy consumption and GHG emissions: If they haven’t done so already, all Lenders should track energy consumption in their portfolio and establish a proven methodology for calculating and tracking their portfolio’s greenhouse gas emissions. The GGRF program seeks to reduce GHG emissions, and in order to be competitive in securing GGRF capital, mission-based lenders will need to be able to measure baseline GHG emissions, as well as anticipated GHG reductions. The Lender will likely need to set minimum building performance standards related to GHG emissions and/or building energy performance (e.g. minimum 25% energy savings for existing buildings and higher for new construction) for GGRF-related investments.
	+ Carrots + Sticks Analysis: Lender could map their multifamily lending activity against the states, municipalities, and utility service territories with policy drivers and incentives for building efficiency and electrification. This could include areas with specific decarbonization commitments[[20]](#footnote-20) and another overlay that includes jurisdictions with building performance mandates (see map included in the policy discussion section). As discussed previously, sector-wide building decarbonization approaches are more likely to occur in areas with specific building performance standards in place. Additionally, having a thorough understanding of multifamily incentive programs at the state, local, and utility level could highlight key markets within a lender’s portfolio that are primed for multifamily decarbonization strategies.
	+ Technical Capacity and Borrower Support: Lender should partner with mission-based building science technical assistance providers (e.g. Elevate Energy; New Ecology; Southface; etc.) to establish an internal process to identify opportunities to help borrowers improve efficiency of buildings and consider electrification, and to comply with any upcoming regulation, starting at initial customer contact. In some markets – including New York City, Boston, Chicago, and Washington DC – there are “energy efficiency resource hubs” or “accelerators” to help borrowers obtain the help they need to move forward with projects – lenders can connect with these “hubs” and seek project referrals.
	+ General Financing Strategy: Lender should offer GGRF-associated loans (combined with other capital sources) to incentivize borrowers to invest in building electrification and energy efficiency improvements using a toolkit including:
		- Free technical assistance from vetted and certified third parties.
		- Reduced interest and other concessionary-termed loans (via credit enhancement or loan loss reserves), potentially on a sliding scale based on deeper GHG emission and resident co-benefits impact. GGRF grant funds should be blended into loan products and the lender will likely need to be able to demonstrate why grant funds are needed (e.g. grant funds cover additional costs associated with decarbonization that go above and beyond current building code; grant funds reduced overall interest rate to allow for deeper decarbonization to occur).
		- Soft loans or grants at the project level based on high-impact, qualifying projects that can’t pencil and for which such a grant is instrumental for a borrower to move forward.
	+ Ongoing Approach: Lender should regularly review its portfolio to better understand the impact of GGRF participation on reducing GHG emissions from portfolio properties and target future opportunities for investment in GHG reducing technologies and measures.
* In many cases, mission lenders do not necessarily need to create new products, rather they can modify existing loan products to accommodate and incentivize GHG-reducing investments. However, this does not mean that mission lenders can forgo making meaningful changes in how they operate. ***Intentional investments in modifying underwriting criteria, tracking energy use and GHG emission reductions and reporting, growing in-house underwriting and technical expertise in energy efficiency, electrification, and solar, among other operational investments, will be critical.***
* Decarbonization financing approaches and engagement with owners of more regulated affordable housing stock like LIHTC and HUD-assisted properties will likely differ from NOAH approaches. However, the technical work of building electrification and energy efficiency improvements while sophisticated and distributed, is scalable.
* ***Rehab for Existing Buildings:*** GGRF capital has the potential to address many of the significant hurdles currently faced in decarbonizing the existing multifamily building stock — a sector that is harder to decarbonize than new construction, and one that represents a large percentage of the GHG emissions we need to reduce to achieve our climate goals. More subsidy is needed in this space compared to new construction to achieve meaningful GHG emission reductions, as well as potential health and safety benefits.
	+ Predevelopment: low-interest loans, 0 percent recoverable grants, or grants to fund Integrated Physical Needs Assessments (IPNAs) that combine both property assessment with energy and water efficiency audits; solar modeling; and other feasibility studies that provide a detailed roadmap for building decarbonization.
		- An existing product that may serve as a model in this space is Inclusive Prosperity Capital’s Navigator Loan (IPC), which provides a standardized loan with a tech-enabled platform for intake and underwriting for owners to assess, plan, and design energy, health & safety, and resiliency improvements, as well as the work necessary to secure construction and term financing to implement the improvements. Since 2016, IPC has made 25 Navigator loans ranging from $5,000 to $390,000, totaling almost $2.5 million originated. Of the 25 loans, only one loan is non-performing.
		- Another potential model to consider is [LISC Boston’s Climate Ready Housing](https://www.lisc.org/boston/our-work/green-homes/climate-ready-housing-program/) approach, which provides owners with two potential decarbonization paths as they prepare for recapitalization or consider mid-cycle upgrades: “Deep Energy Retrofits” that achieve at least 50% reduction in carbon emissions, or “Zero Carbon Emissions Over Time (ZOT)” that assumes a less significant intervention but a long term plan to zero emissions by 2050.
	+ Acquisition: Blending in GGRF capital to cover incremental decarbonization costs and predevelopment, lenders could structure higher LTV, lower interest acquisition loans that fund both acquisition, initial decarbonization approaches, and the predevelopment feasibility studies needed for a full rehab.
* Construction and Permanent Products: Long-term, low-interest, subordinated (or unsecured) debt with pricing incentives for deeper efficiency, electrification, and/or resiliency work has the potential to make deeper energy retrofits and electrification possible for some existing multifamily buildings.
	+ Existing product offerings that share some of these characteristics include Community Preservation Corporation’s [Climate Friendly Homes Fund](https://communityp.com/climate-friendly-homes-fund/), and [Inclusive](https://www.inclusiveprosperitycapital.org/catalyst/#:~:text=The%20Catalyst%20Loan%20provides%20construction,any%20local%20building%20energy%20requirements.) Prosperity Capital’s (IPC) Catalyst Loan Product. IPC has closed 32 Catalyst loans ranging from $25,000 to $3.5 million and totaling $14.5 million. The Catalyst loan portfolio has experienced no delinquencies or defaults.
	+ Massachusetts Housing Partnership offers a [Green Building Certification Financing Program](https://www.mhp.net/rental-financing/green-healthy-financing) that provides interest rate discounts, reimbursement for commissioning costs, and 2 years of free energy benchmarking services for projects pursuing deeper green and healthy housing improvements. MHP has seen a significant uptake in this program and now finances over half of projects through this program, which demonstrates the potential incentive-based permanent financing can play in driving decarbonization.
	+ In addition to specific products, GGRF capital could be used for contingency pools on the portfolio or city-wide basis to address both perceived and real risk associated with existing building decarbonization.
* ***New Construction:***Many new construction projects could benefit from low-cost or incentivized financing for achieving much higher standards in energy efficiency and electrification than building code currently sets. Although all-electric new construction is typically lower cost to build than mixed fuel construction, many developers may need incentives to encourage them to deviate from the norm, especially when planning and soft costs may be higher than doing business as usual. Lower-cost financing in the new construction space could increase early adoption rates in areas of the country not currently under Building Performance Standards. Presumably, new construction projects will be longer-lived than existing building projects, and less scarce public capital is required to fill the decarbonization gap.
	+ Other “ecosystem” approaches to multifamily decarbonization that go beyond financing interventions should be prioritized, including investments in workforce development and small business training and support. Growing demand for electricians, heat pump installers, and architects and engineers equipped with deep technical knowledge, are just some examples of opportunities to increase local jobs and businesses. Partners who are organized around achieving social and racial equity outcomes in this work – for example, those that focused on addressing racial employment inequities, community ownership, and wealth-building – should be prioritized. Lenders receiving GGRF capital should consider parallel “ecosystem” investments that can address the barriers discussed above and help build a more sustainable pipeline of projects that also produce co-benefits for communities.
* As previously discussed, energy efficiency and electrification approaches may produce unintended consequences for residents in the form of potential displacement, eviction, and/or rent or utility increases. Lenders should seek to mitigate these potential outcomes upfront in their loan documents and as borrowers complete the predevelopment work associated with retrofit and electrification work.
	+ Organizations like the Institute for Market Transformation and Building Electrification Institute, heavily involved in the design and implementation of building decarbonization policies, [recommend that](https://www.imt.org/resources/understanding-the-housing-affordability-risk-posed-by-building-performance-policies/) loan programs catered to affordable multifamily housing be [deployed with conditions](https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/62dee63440f313694d2da211/1658775094884/BEI_Housing%2BAffordability%2Band%2BBuilding%2BElectrification_July%2B2022.pdf) that protect tenants, such as rent increase restrictions, eviction protections, and conditions for sale.

## Conclusion

Significant greenhouse gas reduction and improved health, economic, and resiliency outcomes are achievable through strategic investment with GGRF capital in the decarbonization of affordable multifamily buildings across the country.

Such outcomes will require coordination and collaboration by lenders, developers, installers, technical assistance providers, policy and advocacy groups, community groups, and other key players across the ecosystem. Successful investment strategies will address the complicated set of economic, physical, and regulatory barriers to developing the building decarbonization market for this sector, getting investable projects, and achieving impact – challenges that are particularly acute in low-income and marginalized communities. By taking an ecosystem-level approach to building decarbonization, we can work to drive significant quality-of-life improvements for millions and begin to structure investments to ensure that resilience and greenhouse gas reduction are engineered into every investment, every building, every business, every project, everywhere, for everyone.

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### Links to relevant Literature, Websites, and Case Studies

[Energy Star- Multifamily High Rise Program](https://www.energystar.gov/partner_resources/residential_new/program_reqs/mfhr)

[Energy Star- Multifamily New Building Construction Building Eligibility](https://www.energystar.gov/partner_resources/residential_new/program_reqs/mfnc_building_eligibility)

[Enterprise Green Communities Criteria & Certification](https://www.greencommunitiesonline.org/operating-energy)

[nrdc- Los Angeles Affordable Decarbonization Study Phase 2](https://www.nrdc.org/sites/default/files/la-affordable-housing-decarbonization-study-phase2-20211108.pdf)

[ACEEE- Building Decarbonized Solutions for Affordable Housing Sector](https://www.aceee.org/research-report/u2204)

* [Guide for Greener QAPs – International Living Future Institute, June 2020](https://universitysystemnh.sharepoint.com/teams/WellsFargoCleanEnergyJustice/Shared%20Documents/GHG%20Reduction%20Fund/sprint%20design%20labs%20by%20vertical/2%20-%20multifamily%20housing/2020-Guide-for-Greener-QAPs_reduced.pdf?CT=1667317389127&OR=ItemsView)
	+ Lessons learned on how to work with local HFAs to develop greener qualified allocation plans (QAPs) to fund healthy and sustainable projects.
* [Leading with Equity and Justice in the Clean Energy Transition: Getting to the Starting Line for Residential Building Electrification – Green & Healthy Homes Initiative, 2021](https://www.greenandhealthyhomes.org/wp-content/uploads/2021-GHHI-Leading-with-equity_wp_Final.pdf)
	+ Examines historical injustices, up through a case study of the COVID-19 vaccine rollout, within ESJ communities regarding health and wealth. GHHI provides policy and programmatic recommendations for equitable building electrification.
* [New York State Disadvantaged Communities Barriers and Opportunities Report – NYSERDA/NYS DEC/NYPA, December 2021](https://climate.ny.gov/-/media/Project/Climate/Files/21-35-NY-Disadvantaged-Communities-Barriers-and-Opportunities-Report.pdf)
	+ This report provides recommendations for New York State’s Climate Action Council’s Scoping Plan to increase equitable access to clean energy and its benefits. It also examines why this barrier exists in some communities and why those communities also face disproportionate impacts of climate change and air pollution.
* [Building Decarbonization Solutions for the Affordable Housing Sector – ACEEE, April 2022](https://www.aceee.org/research-report/u2204)
	+ Reducing and preventing inequities and supporting economic development whilst achieving decarbonization objectives, specifically in affordable housing. The research focuses on program and policy approaches for energy efficiency and electrification, with some renewable generation.
* [City Playbooks for the Equitable Electrification of Multifamily Buildings—BEI, July 2022](https://www.beicities.org/city-playbooks)
	+ [Playbook 1: Multifamily Electrification Background and Recommendations](https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/62f51465ca250848a4d2579f/1660228716471/BEI_CityPlaybook1_Updated_July%2B2022.pdf)
		- Explains why the electrification of existing buildings is critical. Provides recommendations for local governments to advance equitable electrification in multifamily buildings.
	+ [Playbook 2: Multifamily Electrification Retrofits and Considerations](https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/62f51525eadd6f661e434a1d/1660228905619/BEI_CityPlaybook2_Updated_July%2B2022.pdf)
		- Overview for policymakers on technical and equipment upgrades to achieve an all-electric building, categorized into the four MF building typologies: low-rise with furnaces, low-rise with boilers, mid-rise, and high-rise buildings.
	+ [Playbook 3: Multifamily Guidance for Building Decision-Makers](https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/62f518627d0dcc7f6ceb1dac/1660229733188/BEI_CityPlaybook3_Updated_July%2B2022.pdf)
		- Resources explaining the all-electric retrofit process for each of the four MF building typologies and on electrical needs of a building. Also explains how the process will impact tenants and provides recommendations.
* [The Building Decarbonization Practice Guide Vol. 3 – William J Worthen Foundation, March 2022](https://static1.squarespace.com/static/582a1176893fc0eadc79722d/t/62292c873d0e1a132bd229fb/1646865555270/Building-Decarb-Practice-Guide_vol_3_v4_2ND%2BEDITION.pdf)
	+ A guide to the design process and operational phase of decarbonization projects, including a recommended cost-benefit analysis approach and several short case studies. Primarily addresses low- and mid-rise multifamily housing but applicable to hotels, dormitories, and similar buildings.
* [The Impact of Fossil Fuels in Buildings: A Fact Base – RMI, December 2019](https://lpdd.org/wp-content/uploads/2020/03/Building-Electrification-fact-base-report.pdf)
	+ A compendium of charts presenting a landscape of direct building emissions—from where fuel is sourced, to the utilities and infrastructure that deliver gas, to the health implications.
* [Underwriting Efficiency – Community Preservation Corporation, May 2017](https://communityp.com/wp-content/uploads/2017/05/CPC_Underwriting_Efficiency_Handbook_Full_Interactive_FINAL.pdf)
	+ “This handbook provides professionals involved in the origination, underwriting, closing, and servicing of multifamily mortgages the information and tools necessary to finance energy and water efficiency measures as part of a first mortgage.”
* [LA Building Decarbonization: Tenant Impact and Recommendations – Strategic Actions for a Just Economy (SAJE), December 2021](https://www.saje.net/wp-content/uploads/2021/12/LA-Building-Decarb_Tenant-Impact-and-Recommendations_SAJE_December-2021-1.pdf)
	+ Draws out the negative impacts of decarbonization on marginalized tenants under current laws and makes policy recommendations to protect tenants from cost burdens and instead expand affordability.
* [Sustainable Affordable Housing: Strategies for Financing an Inclusive Energy Transition – NY Fed, October 2022](https://www.newyorkfed.org/outreach-and-education/climate/fed-affordable-housing-and-energy-transition)
	+ Recommendations from housing and finance working group, hosted by the Federal Reserve Bank of New York, on making compliance with the CLCPA and Local Law 97 easier and more affordable based on analysis of decarbonization programs serving affordable housing markets. Focus on early adoption strategies and developing financial tools for all to take part in the transition towards decarbonization.
1. (a) According to U.S. Energy Information Administration 2015 residential energy consumption and expenditures report, apartments with 5 or more units consumed ~724 trillion Btu total. [https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce1.1.pdf](https://www.eia.gov/consumption/residential/data/2015/c%26e/pdf/ce1.1.pdf). 724 tril btu converts 212183454804.688904 kwh

(b) Using epa's ghg calculator <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results> that converts to 91,789,354 metric tons of CO2

(c) EPA's 2015 GHG inventory calculated 6,586,000,000 metric tons of CO2e <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>. 91789354/6586000000= 13.9% [↑](#footnote-ref-1)
2. For instance, tangible benefits could include 1) The opportunity to add cooling as a health and climate resilience strategy; 2) The opportunity to improve indoor air quality and health, particularly for those living in neighborhoods and buildings with the worst current health outcomes (largely as a result of racist policies like redlining); (3) scaling deployment of electric heat pumps can bring air-conditioning to millions of people, a life-saving measure as global warming continues to intensify summer heat. [↑](#footnote-ref-2)
3. The discussion below includes estimates of market size for certain multifamily “types,” however it is important to point out that one building may fall into multiple categories below (e.g. a building could both be NOAH and have a Fannie Mae supported mortgage). [↑](#footnote-ref-3)
4. For an overview of the LIHTC program, see UC Berkeley’s Turner Center paper here: <https://ternercenter.berkeley.edu/wp-content/uploads/2021/04/LIHTC-Complexity-Final.pdf> [↑](#footnote-ref-4)
5. See Building Electrification Institute’s work key considerations and approaches for equitable BPS adoption: [https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/62dee651086dc41b0aae71d4/1658775123616/BEI\_Equitable+Building+Performance+Standards\_July+2022.pdf](https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/62dee651086dc41b0aae71d4/1658775123616/BEI_Equitable%2BBuilding%2BPerformance%2BStandards_July%2B2022.pdf) [↑](#footnote-ref-5)
6. For a more in-depth look at some of these different policies and regulations, see Building Electrification Institute’s analysis here: [https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/630e3d507db0cb4bd5a61849/1661877586266/BEI-Burlington\_Existing+Buildings+Policy+Review\_July+2022\_Final.pdf](https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/630e3d507db0cb4bd5a61849/1661877586266/BEI-Burlington_Existing%2BBuildings%2BPolicy%2BReview_July%2B2022_Final.pdf) [↑](#footnote-ref-6)
7. See, for instance, Building Electrification Institute’s analyses for DC, Salt Lake City, and Burlington (<https://www.beicities.org/city-resources>), as well as Energy+Environmental Economics’ analysis across all of Utah’s climate zones (<https://www.ethree.com/economics-of-all-electric-new-construction-in-utah/>). [↑](#footnote-ref-7)
8. See ACEEE’s State Energy Efficiency Scorecard for mapping of relevant programs: <https://www.aceee.org/research-report/u2011> [↑](#footnote-ref-8)
9. https://www.nrdc.org/experts/amulya-yerrapotu/case-equitable-building-decarb-midwest [↑](#footnote-ref-9)
10. A [2022 National Center for Healthy Housing report](https://nchh.org/resource-library/report_studying-the-optimal-ventilation-for-environmental-indoor-air-quality.pdf) found that while installing continuous mechanical ventilation systems significantly reduces some forms of indoor air pollution, ultimately no amount of ventilation can fully compensate for all the contaminants produced by indoor combustion systems like gas stoves. [↑](#footnote-ref-10)
11. See ACEEE’s 2022 review of energy efficiency programs targeting low-income households: https://www.aceee.org/research-report/u2205 [↑](#footnote-ref-11)
12. [https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/62dee63440f313694d2da211/1658775094884/BEI\_Housing+Affordability+and+Building+Electrification\_July+2022.pdf](https://static1.squarespace.com/static/5b6a482db27e39e8fcf65bbf/t/62dee63440f313694d2da211/1658775094884/BEI_Housing%2BAffordability%2Band%2BBuilding%2BElectrification_July%2B2022.pdf) [↑](#footnote-ref-12)
13. See, for instance, Building Electrification Institute’s analyses for DC, Salt Lake City, San Jose, and Burlington (<https://www.beicities.org/city-resources>), as well as Energy+Environmental Economics’ analysis across all of Utah’s climate zones (<https://www.ethree.com/economics-of-all-electric-new-construction-in-utah/>). [↑](#footnote-ref-13)
14. Encouragingly, BEI analysis (See, for instance, BEI’s analyses for DC, Salt Lake City, and Burlington (<https://www.beicities.org/city-resources>) finds that there are ways to avoid this in almost every climate in the US with the right retrofit strategies and technologies. However, those strategies and technologies may require additional subsidies, particularly for low-income households. [↑](#footnote-ref-14)
15. [Building Decarbonization Solutions for the Affordable Housing Sector, 2022](https://www.aceee.org/sites/default/files/pdfs/u2204.pdf) [↑](#footnote-ref-15)
16. [Energy Efficiency Financing for Low- and Moderate-Income Households: Current State of the Market, Issues, and Opportunities](https://emp.lbl.gov/sites/default/files/news/lmi-final0811.pdf) [↑](#footnote-ref-16)
17. [Multifamily Energy Efficiency: Reported Barriers and Emerging Practices, 2013](https://www.aceee.org/files/pdf/resource/epc_%20multifamily_housing_13.pdf) [↑](#footnote-ref-17)
18. [Better Buildings Financing Navigator](https://betterbuildingssolutioncenter.energy.gov/financing-navigator/primer/multifamily-energy-financing-primer) [↑](#footnote-ref-18)
19. https://www.nlc.org/article/2022/09/13/federal-funding-to-help-municipalities-implement-modern-energy-codes/ [↑](#footnote-ref-19)
20. For instance, see RMI’s Zero Emissions Building Ordinances Tracker here: <https://buildingdecarb.org/zeb-ordinances> [↑](#footnote-ref-20)