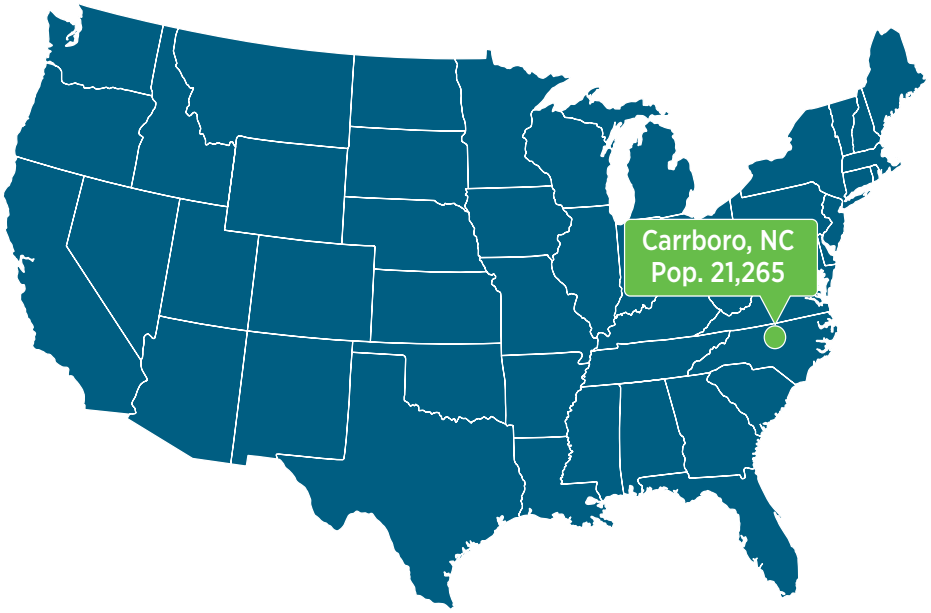
U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY



# Carrboro, North Carolina: Achieving Building Efficiencies for Low-Income Households

The Town of Carrboro partnered with the Energy Department and the National Renewable Energy Laboratory (NREL) to demonstrate how data and analysis can inform more strategic energy decisions. NREL based its analysis in-part on the State and Local Energy Data (SLED) website's City Energy Profiles (*eere.energy.gov/sled*). The profiles contain data compiled by SLED and the Cities Leading through Energy Analysis and Planning (Cities-LEAP) program. Cities across the country can follow the same approach and use data-driven analysis in their own energy planning.




> "The Cities-LEAP analysis provided data not readily or easily accessible for me, drilled down with some more sophisticated analyses than we would be able to pursue locally, provided a more national context, and highlighted options and resources to consider as Carrboro begins to move from a phase of developing a local climate action plan to implementing the plan."
>
> *— Randy Dodd, Environmental Planner, Town of Carrboro*

## City Energy Goal

The Town of Carrboro, North Carolina, is prioritizing actions to achieve its community climate action plan's ambitious recommendation to reduce greenhouse gas emissions 50% by 2025.[1] In particular, Carrboro is seeking to achieve greater building efficiencies without passing along costs to low-income renters. To meet this goal, Carrboro officials asked for data and analysis to help target building energy actions and policies that can benefit low-income households.

Carrboro is a "bedroom community," housing many students from the nearby University of North Carolina at Chapel Hill. Rental units comprise 60% of the housing stock. More than 85% of the total building area in Carrboro is composed of residential units (see Figure 1).

## Data and Analysis

To conduct the analysis, NREL evaluated the estimated city energy data available on SLED, supplemental data from publicly available sources, and data inputs obtained directly from Carrboro.

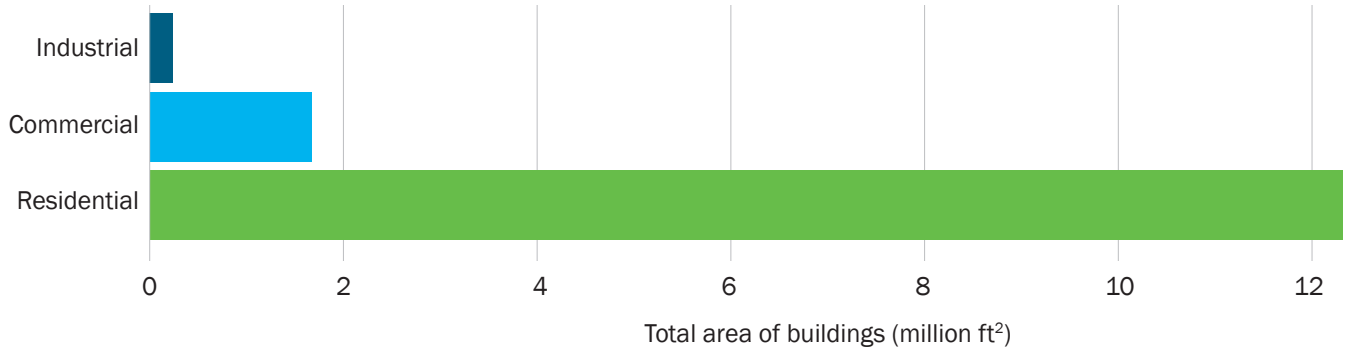



**Figure 1.** Total estimated building area by sector (2013) in Carrboro, North Carolina (Source: SLED)

[1] *Community Climate Action Plan*: http://www.townofcarrboro.org/928/Community-Climate-Action-Plan.

## Reducing Building Energy Consumption

Single-family dwellings account for approximately 61% of the residential building area and 85% of the number of residential buildings (see Figure 2).

Given the prominence of the residential sector in Carrboro's building stock, the town was particularly interested in energy efficiency measures for single-family homes. However, this analysis shows that rental units and low- and moderate-income residents are more likely to be located in multifamily dwellings.

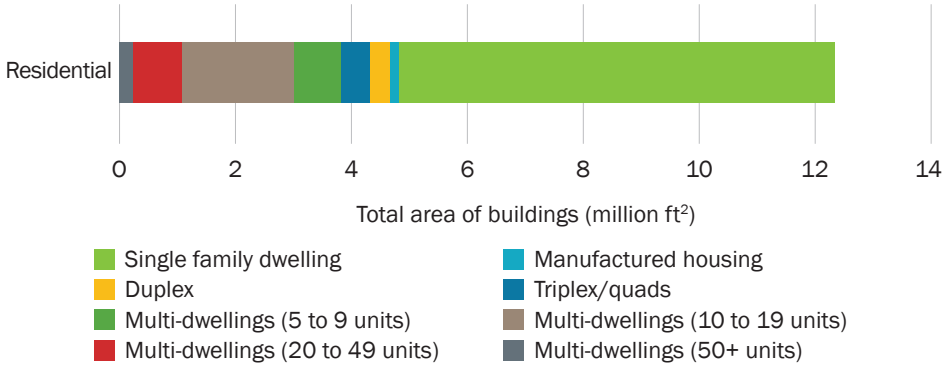



**Figure 2.** Residential building stock area by building type (2013) in Carrboro, North Carolina (Source: SLED)

## Achieving Low-Income Household Energy Savings

Of the 8,723 occupied housing units in Carrboro, an estimated 60% are renter occupied, which is nearly twice the percentage of renter-occupied units in both North Carolina (34.9%) and the United States (36.1%).[2] Carrboro's residential per capita electricity usage is more than twice the national average. Per capita annual residential electricity expenditures are an estimated $270 higher than the national average.[3]

The U.S. Department of Housing and Urban Development (HUD) determines low-income status as a percentage of area median income (AMI) for a given location. HUD defines "very low income" as households earning 50% or less of AMI.[4] Based on an analysis of HUD and U.S. Census data, approximately 34% of renter-occupied units are occupied by very low-income renters (see Figure 3). Renters in Carrboro are more likely to fall into lower income brackets than their homeowner counterparts.

Renters in Carrboro are also likely to live in multifamily buildings; 71% of all renter-occupied units are in buildings of three or more units.

Energy burden (the ratio of energy expenditures to household income) is a metric commonly used to evaluate the relative cost burden of energy expenditures on households. Renter-occupied households have lower energy burdens than owner-occupied households in corresponding AMI categories in Carrboro (see Figure 4).

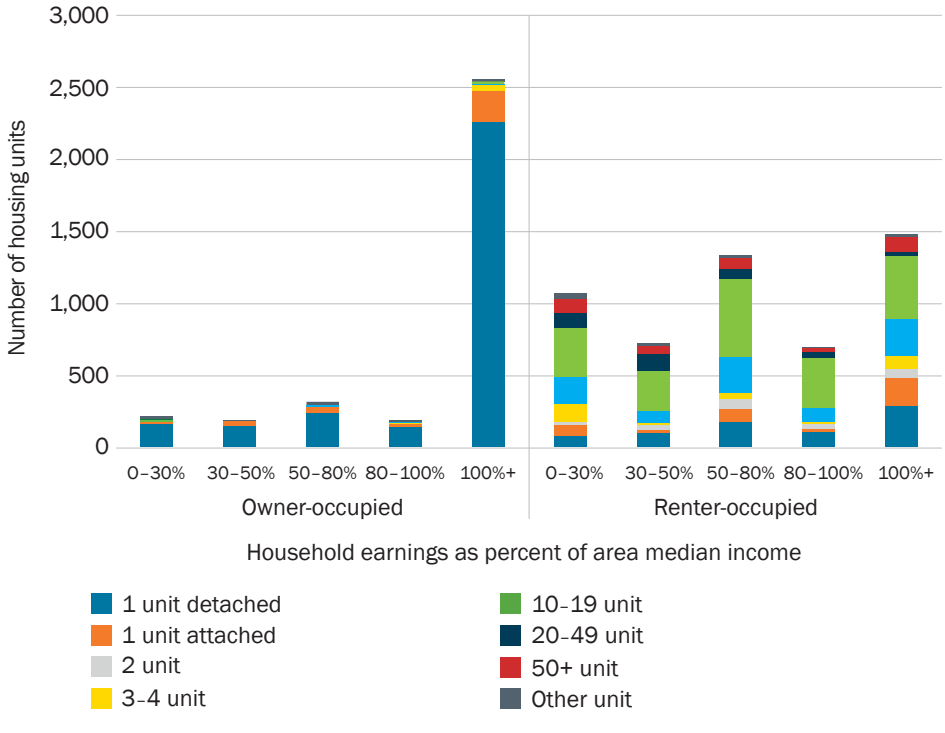



**Figure 3.** Number of housing units by housing type and area median income (2015) in Carrboro, North Carolina (Source: U.S. Census, U.S. Housing and Urban Development, and Energy Information Administration data[5])

[2] U.S. Census Bureau, American Fact Finder: Selected Housing Characteristics, 2011–2015 American Community Survey 5-Year Estimates.
[3] From data and estimates available for all cities on SLED (http://eere.energy.gov/sled).
[4] State and county-level income limits are updated every fiscal year and are based on the number of people per household. Income limit documentation is available at https://www.huduser.gov/portal/datasets/il.html.
[5] Figure based on an NREL residential household disaggregation and cross-tabulation of the U.S. Census, U.S. Housing and Urban Development, and Energy Information Administration data. Similar data and the associated methodology will be available for all cities in SLED.

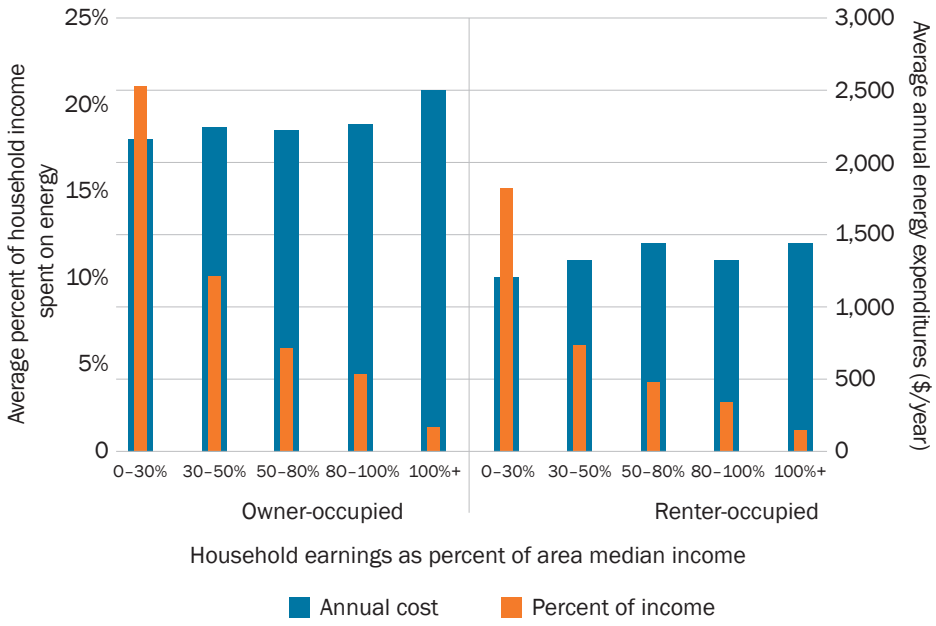



**Figure 4.** Average energy expenditures and energy burden for residential sector (2015) for Carrboro, North Carolina (Source: U.S. Census, U.S. Housing and Urban Development, and Energy Information Administration data[6])

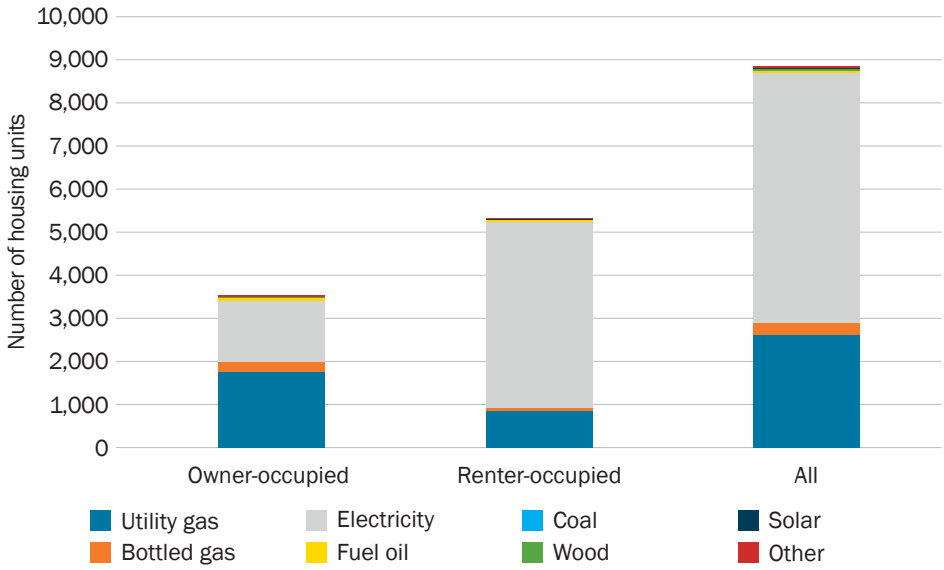



**Figure 5.** Number of housing units by heating fuel type and ownership status (2015) in Carrboro, North Carolina (Source: Data from U.S. Census Bureau, American Fact Finder: Selected Housing Characteristics, 2011–2015 American Community Survey 5-Year Estimates)

Renter households across all AMI categories in Carrboro, and most communities, have lower total annual energy costs than owner-occupied households. This situation may correlate with factors such as differences in unit area and household size, as well as shared walls and rental units that do not have separately metered utilities.

An estimated 81% of rental units are electrically heated compared to approximately 41% of owner-occupied units (see Figure 5). The slightly lower energy burden among renters may also be correlated with the increased likelihood that rental units are electrically heated, as average monthly expenditures on electricity are lower than other forms of heating in Carrboro (see Figure 6).

An analysis[7] of potential energy cost savings in single-family detached homes in each state, based on a detailed modeling of 350,000 representative individual houses found that the following are the most cost effective measures in North Carolina:

1. Installing smart thermostats
2. Replacing propane furnaces with variable-speed heat pumps
3. Adding 1-inch (R-5) insulated sheathing at siding wear out
4. Upgrading to ENERGY STAR® clothes washers
5. Drilling into exterior walls and filling with insulation.

One example of a state taking action to increase upgrades to ENERGY STAR® clothes washers is Oregon State's energy efficiency appliance rebate program for low-income families.[8]

[6] Figure based on an NREL residential household disaggregation and cross-tabulation of U.S. Census, U.S. Housing and Urban Development, and Energy Information Administration data.

[7] E. Wilson et al., Electric End-Use Energy Efficiency Potential in the U.S. Single-Family Housing Stock, National Renewable Energy Laboratory (2017), p. 95, http://www.nrel.gov/docs/fy17osti/65667.pdf.

[8] "EERE Success Story: Oregon State Energy-Efficiency Appliance Rebate Program Helps Low-Income Families," U.S. Department of Energy, http://energy.gov/eere/success-stories/articles/eere-success-story-oregon-state-energy-efficiency-appliance-rebate.

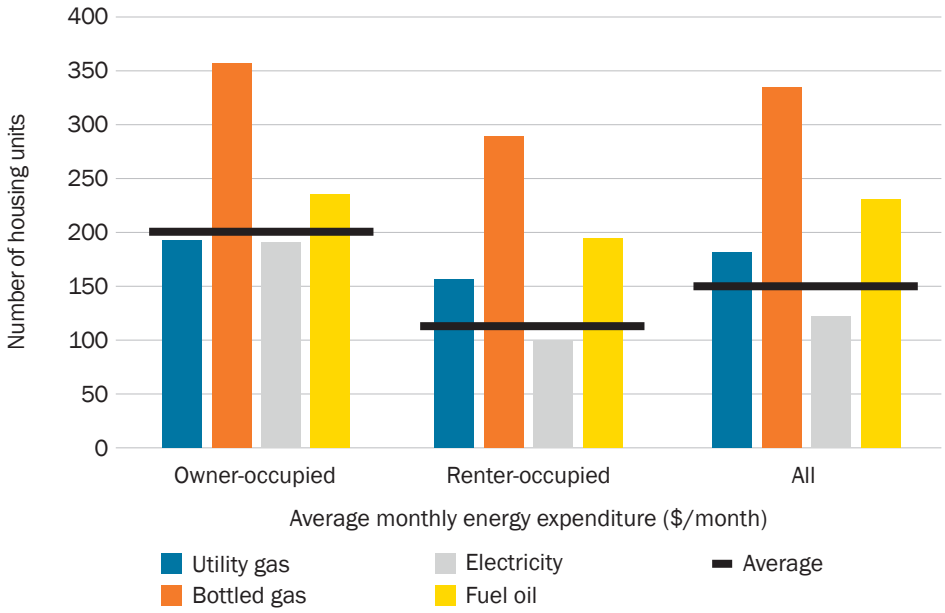



**Figure 6.** Estimated average monthly expenditures by heating fuel type (2015) in Carrboro, North Carolina (Source: U.S. Census, U.S. Housing and Urban Development, and Energy Information Administration data[10])

### Approaches to Reduce Energy Burden & Increase Energy Efficiency

In Carrboro, programs that target energy efficiency upgrades in multifamily buildings may have a greater impact on the low-income population. Additionally, because rental units in Carrboro are already more likely to use electricity as a heating source, and because average monthly electricity expenditures are low relative to other heating fuels, converting rental properties from bottled gas (generally propane) to variable-speed heat pumps may target units with occupants that experience a higher energy burden.

Additional measures to increase the efficiency of low-income and rental properties include the following:

- Time-of-sale efficiency requirements
- Rental and low-income weatherization programs
- Mechanisms to disclose anticipated utility bills to potential renters and buyers
- Requiring renovations to meet code
- Improving code compliance rates
- Adopting beyond-code measures (i.e., city policies that go beyond state-level or the latest vintage of building codes, such as the International Energy Conservation Code[11])
- Requiring new multi-family developments to meet efficiency standards in order to receive zoning and development approvals.

## Resources

The following resources may be useful:

### Low-Income Residential Energy Efficiency

- Better Buildings Clean Energy for Low Income Communities Accelerator: *https://betterbuildingsinitiative.energy.gov/accelerators/clean-energy-low-income-communities*
- Energy Efficiency in Affordable Housing, a U.S. Environmental Protection Agency guide for local governments: *https://19january2017snapshot.epa.gov/statelocalclimate/energy-efficiency-affordable-housing_.html*

### Multifamily Residential Energy Efficiency

- North Carolina's Multifamily Energy Efficiency Collaborative: *http://blog.cleanenergy.org/2017/01/12/reducing-the-energy-burden-in-the-southeast-tackling-energy-efficiency-in-multifamily-housing/*
- Energy Efficiency for All: Resources for design of multifamily efficiency programs and budgets: *http://energyefficiencyforall.org/issues/program-design-and-budgets*

### Renter-Owner Split Incentives

- Policy options for the split incentive: Increasing energy efficiency for low-income renters: *http://www.sciencedirect.com/science/article/pii/S0301421512004661*
- Report from the Rental Housing Energy Efficiency Work Group in Minnesota: *http://www.cleanenergyresourceteams.org/files/*
- Case study on rental housing policy in Boulder, Colorado: *http://aceee.org/files/proceedings/2012/data/papers/0193-000251.pdf*.

Find a catalogued, searchable list of more than 500 resources on the SLED Local Energy Action Toolbox: *https://apps1.eere.energy.gov/sled/cleap.html*.

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**For more information, visit:**
energy.gov/eere/cities

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[10] Figure based on an NREL residential household disaggregation and cross-tabulation of U.S. Census, U.S. Housing and Urban Development, and Energy Information Administration data.

[11] International Energy Conservation Code Resource Page, International Code Council, https://www.iccsafe.org/about-icc/government-relations/international-energy-conservation-code-resource-page.