U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
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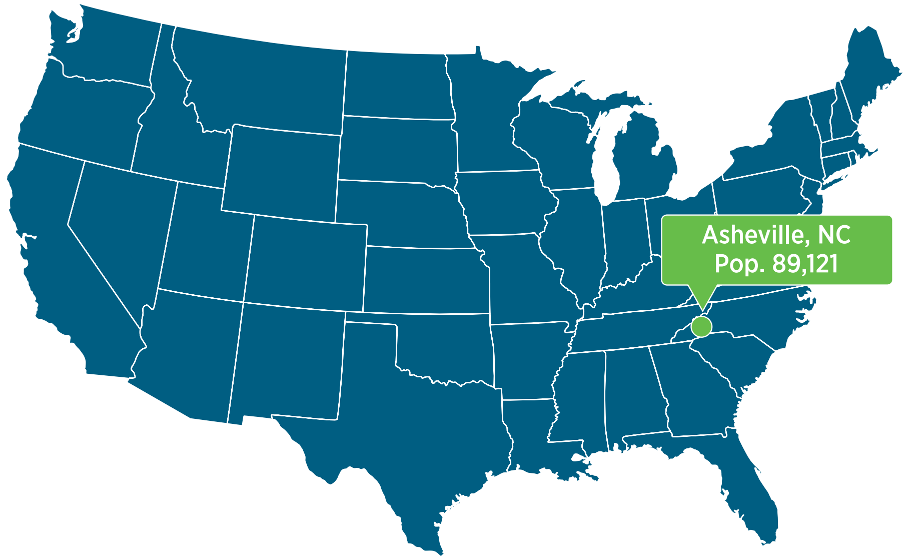
CITY ENERGY: FROM DATA TO DECISIONS



Asheville, North Carolina: Reducing Electricity Demand through Building Programs & Policies

The City of Asheville 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 City Energy Profiles on the State and Local Energy Data (SLED) website (*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.

City Energy Question

The City of Asheville, North Carolina, is seeking to reduce peak electricity demand in order to eliminate the need for a new fossil fuel generation plant.

Current utility plans call for a gas-fired generation plant that runs only during peak load times to be constructed in 2023. The community is seeking to avoid the need for a new plant and avoid the associated air quality and energy cost impacts.

To this end, the city asked the following question: What data and analysis can help target programs and policies that can increase the electricity efficiency of buildings?

"Cities-LEAP and SLED helped Asheville advance our efforts to avoid the construction of a natural gas peak power plant. The data was valuable in the development of a joint city and county low-income weatherization program specifically designed to alleviate the county's peak demand, and will contribute to our annual 4% carbon reduction goal."

— Bridget Herring, Energy Program Coordinator, City of Asheville

Data and Analysis

The foundation for this analysis comes from estimated city energy data available on SLED, supplemental data from publicly available sources (including the U.S. Census Bureau), and data inputs obtained directly from the City of Asheville.

Targeting Residential Building Energy Efficiency

Residential buildings comprise an estimated 62% of the total building stock area in Asheville. Approximately 31% of the building stock area is commercial and 6% is industrial (see Figure 1). Within the subset of residential buildings, single-family dwellings constitute an estimated 73% of the housing stock by total area (see Figure 2).

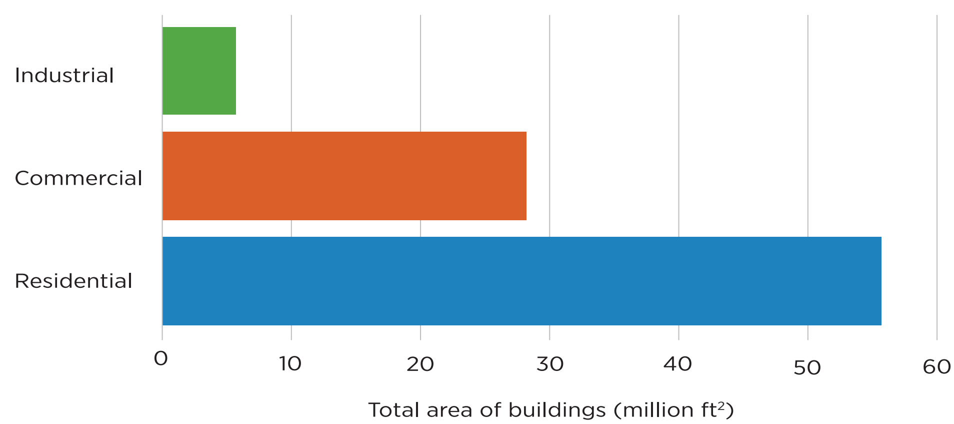


Figure 1. Total area of building stock by sector (2013) in Asheville, North Carolina (Source: SLED)

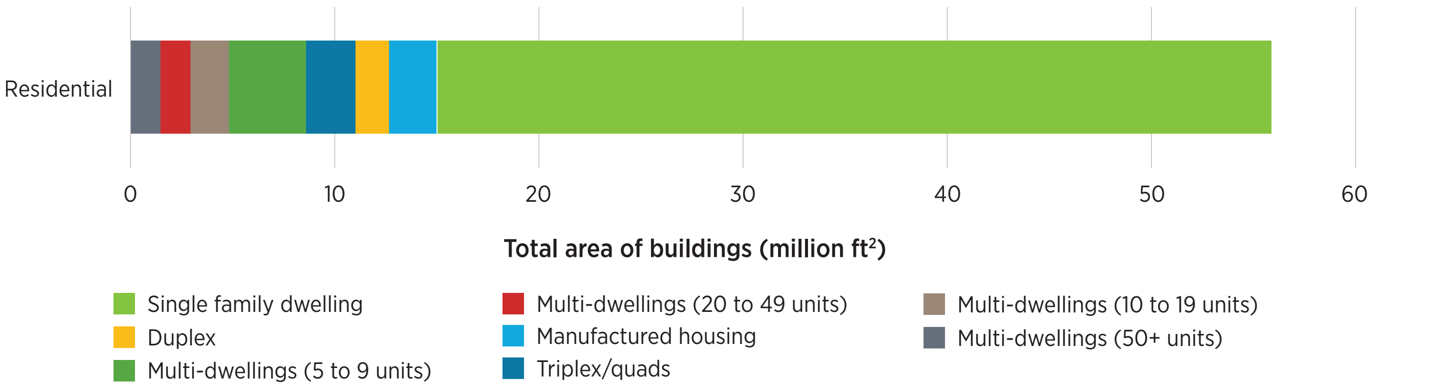


Figure 2. Total area of residential building stock by type (2013) in Asheville, North Carolina (Source: SLED)

An NREL analysis of electricity cost-savings potential in single-family detached homes in each state, based on a detailed modeling of 350,000 representative individual houses, found that these are the most cost-effective measures in North Carolina (see also Figure 3):

1. Adding R-5 wall sheathing insulation
2. Drilling into exterior walls and filling with insulation
3. Installing smart thermostats
4. Adding foundation R-10 crawlspace wall insulation
5. Increasing attic insulation to R-39/49/60.

Another measure, replacing electric furnaces with variable-speed heat pumps (VSHP) at wear-out, provides the greatest cumulative electricity savings potential for single-family detached homes in North Carolina.

Nearly half of the occupied housing units in Asheville are renter-occupied (49%), and poverty levels are slightly higher than the national average (see Table 1). The Asheville residential sector also has higher total and per-capita estimated electricity usage and expenditures than both national averages and cities with similar populations and climate zones (cohort cities).

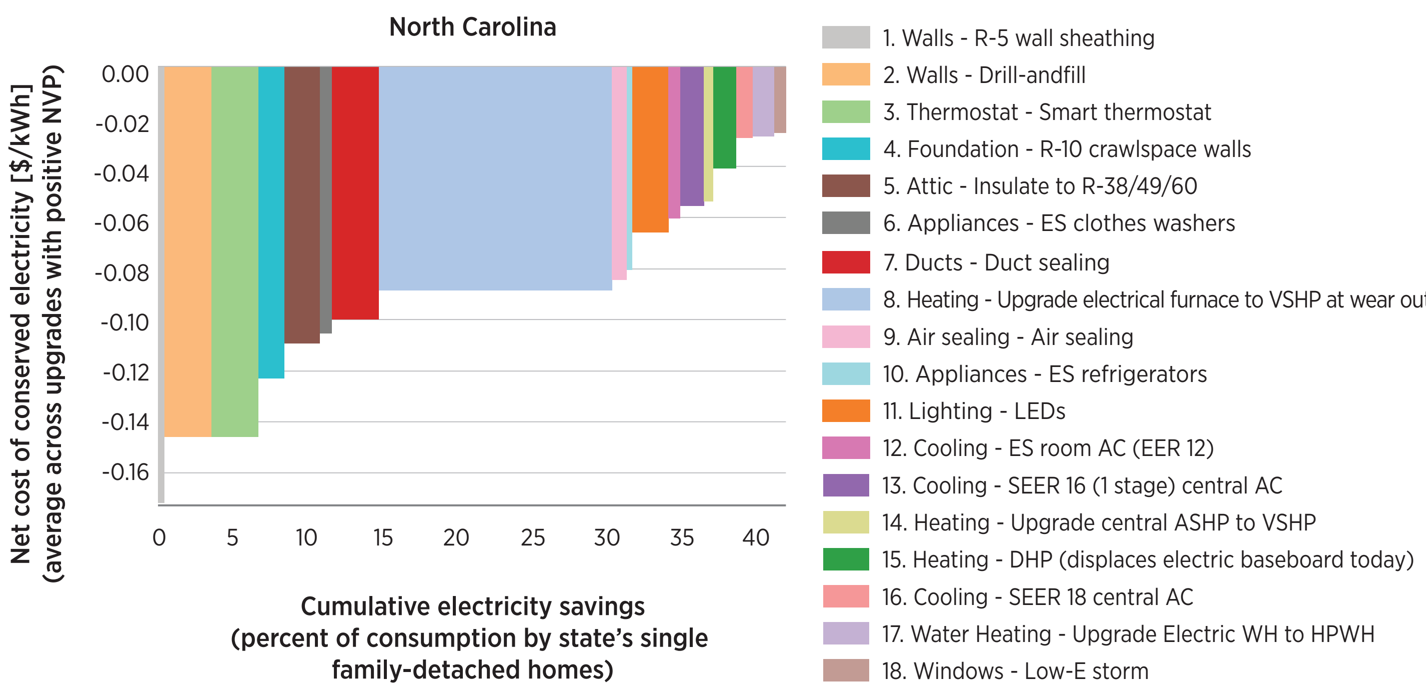


Figure 3. Electric efficiency supply curve for North Carolina (Source: E. Wilson et al., *Electric End-Use Energy Efficiency Potential in the U.S. Single-Family Housing Stock*, NREL [2017], p. 95, *http://www.nrel.gov/docs/fy17osti/65667.pdf*). *VSHP = variable-speed heat pump; ASHP = air-source heat pump; DHP = ductless heat pump; WH = water heater; HPWH = heat pump water heater.*

Table 1. Demographic Factors for Asheville, North Carolina, Compared to State and U.S. Averages

	Asheville	North Carolina	United States
Percent renter-occupied	49.3%	34.9%	36.1%
Median household income	$43,334	$46,868	$53,889
Individuals below poverty level	17.3%	17.4%	15.5%

Source: Data from the U.S. Census Bureau, 2015 American Community Survey: *https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml*.

According to SLED, average annual per-capita residential energy expenditures are approximately $790 in Asheville compared to $520 nationally. Significant residential energy reductions may be achieved by targeting efficiency programs to relieve this higher energy cost burden and reach renter-occupied households.

Asheville was interested in estimating the potential reductions in carbon emissions based on residential energy efficiency program participant rates of both a literature-based average of 8% and a stretch goal of 16%. Results from the Cities-LEAP policy analysis suggest that an 8% residential and commercial building participation rate could reduce emissions by approximately 8,700 tons of carbon dioxide (tCO_2) annually. Increasing residential participation to 16% results in a reduction of approximately 13,800 tCO_2 per year.[3]

Targeting Energy Efficiency in Commercial Buildings

While residential buildings comprise the highest percentage of Asheville's total built area, the commercial sector consumes more electricity. According to city-provided data, the Asheville commercial sector consumed 765,000 megawatt-hours (MWh) in 2016, compared to the residential sector, which consumed 635,000 MWh. Energy efficiency programs targeted at the commercial sector may therefore achieve significant reductions in electricity consumption with a lower participation rate due to the higher consumption per facility. Efficiency programs may be most effective if targeted to the highest electricity-consuming industries.

Hospitals, warehousing and storage facilities, museums, and accommodation facilities (e.g., hotels, dormitories) rank high in terms of electricity consumption among Asheville industries (see Table 2).

Options for Building Energy Codes

Even where building codes are set at the state level, like in North Carolina, local governments have options to achieve energy savings by increasing code compliance and adopting beyond-code measures where possible, i.e., measures that surpass the currently applicable state or local code requirements. These actions support code compliance:

- Provide education and training opportunities for building developers, architects, contractors, maintenance personnel, and third-party reviewers
- Increase resources available for compliance activities and training for code enforcement officials
- Conduct periodic compliance reviews
- Examine which beyond-code measures, if any, would promote compliance.[4]

Options for Building Energy Incentives

Building energy incentives refer to policies that "indirectly reduce building energy use by supporting investment in more energy efficient technology or building practices."[5] These incentives have differing approaches for the residential and commercial sectors. Some common options for city-level action include the following:

- Planning mechanisms, such as zoning and development approval for new

Table 2. Estimated Annual Electricity Consumption by Commercial Activity in Asheville, North Carolina

Commercial Activities: Top 5 Electricity-Consuming Industries	Number of Establishments	Electricity Use (MWh)	Rank
Hospitals	3	28,831	1
Museums, historical sites, and similar institutions	7	17,130	2
Warehousing and storage	1	12,498	3
Accommodation	73	12,459	4
General merchandise stores	24	11,611	5

Source: SLED.

[3] Analysis based on O'Shaughnessy et al., *Estimating the National Carbon Abatement Potential of City Policies: A Data-Driven Approach*, NREL (2016), NREL-67101, http://www.nrel.gov/docs/fy17osti/67101.pdf and https://energy.gov/eere/study-shows-carbon-emission-reductions-city-energy-actions.
[4] For more on beyond-code measures, see "Going Beyond Code" (https://www.energycodes.gov/sites/default/files/documents/GoingBeyondCode.pdf) and the Building Codes Assistance Project "Beyond Code Portal" http://bcapcodes.org/beyond-code-portal.
[5] O'Shaughnessy et al., *Estimating the National Carbon Abatement Potential of City Policies: A Data-Driven Approach*, NREL (2016).

Table 3. Commercial Properties in Asheville, North Carolina (with areas at or above 10,000 ft^2)

Property Type	Property Count	Aggregate Area (ft^2)
Flex	79	1,828,000
General retail	329	12,348,000
Health care	14	817,000
Hospitality	58	5,347,000
Industrial	140	7,257,000
Multi-family	110	12,292,000
Office	236	6,908,000
Specialty	50	2,026,000
Sports & entertainment	5	446,000
Sum	1,021	49,269,000

Source: CoStar Realty Information, Inc. (*www.costar.com*); similar data forthcoming on SLED for other cities.

buildings, can incorporate density bonuses, incentives for LEED (Leadership in Energy and Environmental Design)-certifiable buildings,[6] reduced parking requirements, and a host of other measures designed to improve building efficiency.

- Financial incentives for home weatherization, energy audits, HVAC (heating, ventilation, and air conditioning) upgrades, and energy efficient appliances
- Benchmarking policies to increase transparency in commercial building energy use, which literature suggests can alter energy use behavior.[7]

An analysis of Asheville's commercial buildings in the CoStar Realty database indicates a benchmarking policy addressing commercial properties with areas at or above 10,000 ft^2 would apply to 1,021 properties and a total of 49 million ft^2 (see Table 3).

If such a policy included commercial properties of 50,000 ft^2 or more, it would address approximately 240 properties and a total of 33 million ft^2.

Resources

The following resources may be useful to guide further research and action steps:

Residential Buildings

- Better Buildings Guide for Benchmarking Residential Energy Efficiency Program Progress: *http://energy.gov/eere/better-buildings-residential-network/downloads/guide-benchmarking-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/sites/production/files/2015-08/documents/affordable_housing.pdf*

Commercial Buildings

- Commercial Building Energy Rating and Disclosure Policies: *http://www.imt.org/resources/detail/commercial-building-energy-rating-and-disclosure-policies*
- Commercial Buildings Advanced Energy Retrofit Guides: *http://energy.gov/eere/buildings/advanced-energy-retrofit-guides*.
- State and Local Energy Efficiency Action Network, Greater Energy Savings through Building Energy Performance Policy: Four Leading Policy and Program Options: *https://www4.eere.energy.gov/seeaction/system/files/documents/building_energy.pdf*

The Buildings & Efficiencies categorization of the SLED Local Energy Action Toolbox provides additional catalogued resources: *https://apps1.eere.energy.gov/sled/cleap.html*.

Cities-LEAP is a project funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). It is part of an effort by EERE's Strategic Priorities and Impact Analysis Team to empower state and local decision makers with data-driven analysis. ■

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

DOE/EE-1620 • September 2017

[6] The City of Boston's Article 37 requires newly constructed buildings that are more than 50,000 square feet to be LEED certifiable. Certification is not required, but building developers must demonstrate to the city that certification criteria are met (https://www.cityofboston.gov/images_documents/Article%2037%20Green%20Buildings%20LEED_tcm3-2760.pdf).

[7] A summary of this literature is provided on page 14 of O'Shaughnessy, et al.