



# Household Energy Efficiency Analysis for Louisville, Kentucky

Many households in the City of Louisville, Kentucky, could save hundreds of dollars annually on their energy bills and reduce carbon emissions with energy efficiency retrofits and upgrades in their homes and apartments. As part of the U.S. Department of Energy’s (DOE) Communities LEAP (Local Energy Action Program) pilot, the National Renewable Energy Laboratory (NREL) analyzed energy efficiency and electrification upgrades for about 357,900 housing units in Louisville, Kentucky.

For more information about the Communities LEAP effort in Louisville, Kentucky, visit: <https://www.energy.gov/communitiesLEAP/city-louisville-kentucky>.

## Top End-Uses of Energy in Louisville

Heating is the dominant end-use for energy, and natural gas is the dominant fuel type.

Top 4 residential energy uses in Louisville:

- 45% for space heating using natural gas
- 11% for cooling using electricity
- 10% for space heating using electricity
- 9% for interior lighting using electricity

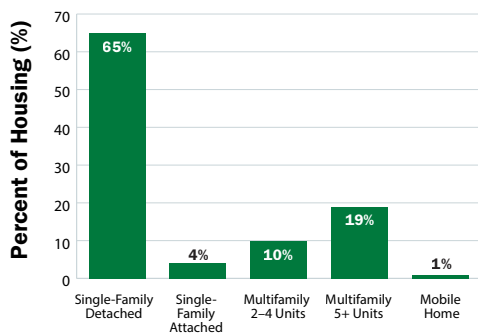
For more information on energy efficiency improvements, including smaller do-it-yourself projects, visit DOE’s Office of Energy Efficiency and Renewable Energy’s Energy Saver webpage: <https://www.energy.gov/energysaver/energy-saver>

## Energy Challenges of Louisville’s Housing Stock

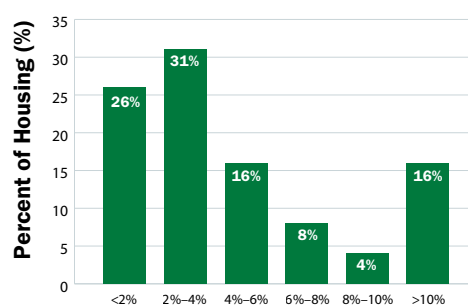
An estimated 70%+ of the homes and apartments analyzed in Louisville have poor building envelopes, meaning inadequate insulation and sealing allows air in and out of homes. Inadequate building envelopes increase the cost of heating and cooling homes, which requires residents to spend a higher share of their income on energy. Updating the building envelope could help lower the share of income residents must spend on energy, known as energy burden, and provide a more comfortable and safe indoor environment.

## Louisville, Kentucky Residential Housing Stock Summary

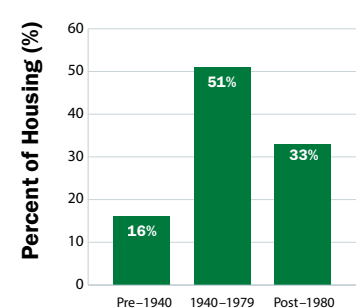
### Building Type



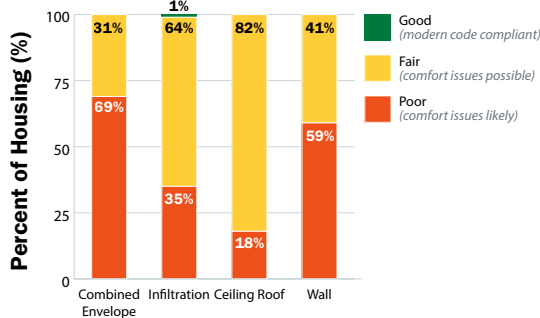
### Energy Burden



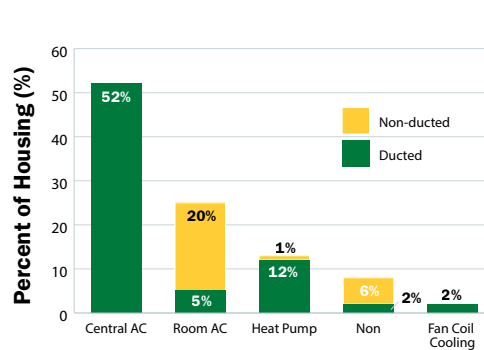
### Construction Year



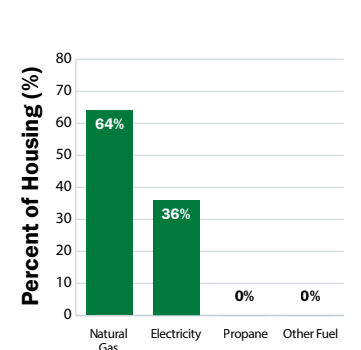
### Envelope Status for Buildings with Frame Wall



### Cooling Type



### Space Heating Fuel Type



# Annual Community-Wide Savings by Upgrade

The results below are the estimated average annual savings for all modeled household types located in Louisville.



**Energy Bill Reductions**

Million \$



**Emissions Reductions**

Equivalent to number of cars taken off the road



**Energy Savings**

Equivalent number of homes



**Upgrade Cost**

\$-\$\$\$

## Basic enclosure\*

139

142,000

81,580

\$

## Enhanced enclosure\*\*

167

170,000

96,930

\$\$

## Heat pump water heater

32

394,900

22,110

\$

## Enhanced enclosure and high-efficiency whole home electrification\*\*\*

373

394,600

239,290

\$\$\$

## Minimum-efficiency heat pump with existing backup

72

108,500

78,250

\$\$

\* Basic enclosure includes attic floor insulation, general air sealing, duct sealing, duct insulation, and wall insulation.

\*\* Enhanced enclosure includes basic enclosure with insulating foundation walls and rim joists, sealing crawlspace vent, and insulating finished attics and cathedral ceilings.

\*\*\* Enhanced enclosure with high-efficiency whole home electrification includes an enhanced enclosure, high-efficiency heat pump, heat pump water heater, ventless heat pump dryer, electric oven, and induction range.

## Average Annual Savings Per Household from Basic Enclosure and Enhanced Enclosure with Whole Home Electrification

Housing Type	Upgrade	Estimated Average Energy Bill Reductions*	Energy Bill Savings per Dollar of Project Cost	Impact of Energy Bill Reductions on Energy Burden (pre -> post)**	Emissions Reductions Equivalent to Number of Cars Taken Off of the Road
Single-family attached homes built between 1940 and 1979	Basic enclosure	\$313	0.06	17.6% → 15.4%	0.31
	Enhanced enclosure and whole home electrification	\$991	0.03	17.6% → 9.5%	0.87
Multifamily building with 2-4 units built between 1940 and 1979	Basic enclosure	\$286	0.12	12.8% → 10.8%	0.26
	Enhanced enclosure and whole home electrification	\$947	0.03	12.7% → 6.4%	0.75
Single-family detached home built between 1940 and 1979	Basic enclosure	\$531	0.08	14.4% → 1.6%	0.55
	Enhanced enclosure and whole home electrification	\$1,414	0.03	14.4% → 7.2%	1.36
Multifamily building with 5+ units built between 1940 and 1979	Basic enclosure	\$215	0.14	14.2% → 12.3%	0.18
	Enhanced enclosure and whole home electrification	\$826	0.03	14.3% → 7.5%	0.61

Actual site energy reductions, energy bill reductions, and changes to energy burden for any individual household will vary.

\* Results are average annual savings per household (per unit for multifamily buildings); actual savings for any individual household can vary.

\*\*Pre-upgrade energy burden may differ between upgrade packages because not all homes in the analysis require the same upgrades.

### The Most Impactful Upgrades

Based on NREL's analysis for Louisville, the basic enclosure was the upgrade on average that resulted in the most energy bill savings per upgrade cost for all housing types. Enhanced enclosure and whole home electrification had the most energy savings on average across all housing types. Actual costs and savings will vary depending on many factors, including the price of materials, contractor, size of the project, current incentive programs, and more.

### Approach Details

#### Information on Upgrade Packages

NREL analyzed a total of 16 energy efficiency upgrades for Louisville. Modeled energy burden and energy bill reductions vary by ownership (resident-owned or rented), housing type, and other factors. This analysis does not account for

federal, state, and local rebates or programs that may further lower energy burden, upgrade costs, and payback periods.

#### Modeling Assumptions

- Vacant housing was not included as part of this analysis per the community's request.
- Local equipment, labor costs, and utility costs were taken from a mixture of local and national data sources from 2023 or the most recently available data.
- The envelope status figure was based on 2023 International Energy Conservation Code (IECC) requirements for wall insulation, attic insulation, infiltration rates, and wall construction type.
- Upgrades did not consider new electric panel requirements.

To learn more about the modeled packages and upgrades in all building types, please visit <https://data.nrel.gov/submissions/224>.



This work presents energy efficiency and electrification modeling results for dwelling units using ResStock EUSS 2022.1, which is a statistical representation based on modeling predictions of energy use and savings, and actual results may vary. Scan the QR code to access the methodology document at <https://www.nrel.gov/docs/fy24osti/88058.pdf>.