COMMUNITIES LEAP
U.S. DEPARTMENT OF ENERGY

Household Energy Efficiency Analysis for Lawrence, Massachusetts

Many households in Lawrence, Massachusetts, 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 31,400 housing units in Lawrence.

For more information about the Communities LEAP effort in Lawrence, visit: https://www.energy.gov/communitiesLEAP/lawrence-massachusetts

Managing Energy Efficiency Costs

The upfront costs of energy efficiency upgrades can be reduced if they are coordinated with certain home upgrades. For instance, it is worth considering adding insulation when a home's siding requires replacement, or upgrading to a heat pump when the space heating or cooling system needs to be updated.

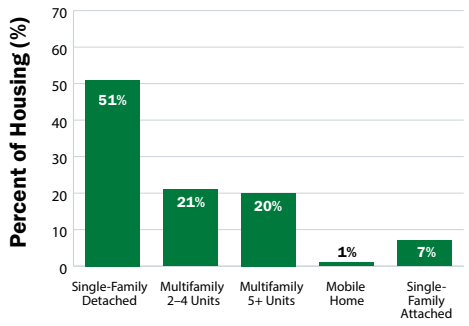
For information on energy efficiency improvements, including smaller do-it-yourself projects, visit DOE's Office of Energy Efficiency and Renewable Energy's Energy Saver webpage: https://www.energy.gov/energysaver/energy-saver

Energy Challenges of Lawrence's Housing Stock

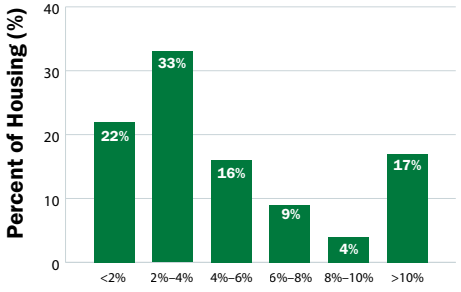
An estimated 70%+ of the homes and apartments analyzed in Lawrence have poor building envelopes, meaning inadequate insulation and sealing allows air in and out of homes. Inadequate building envelopes increase the cost of heating and cooling homes, which requires residents to spend a higher share of 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.

Lawrence, Massachusetts Residential Housing Stock Summary

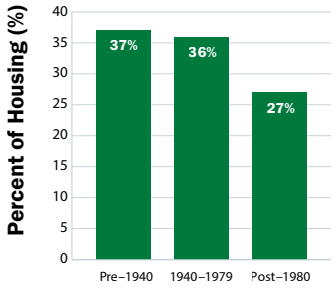
Building Type



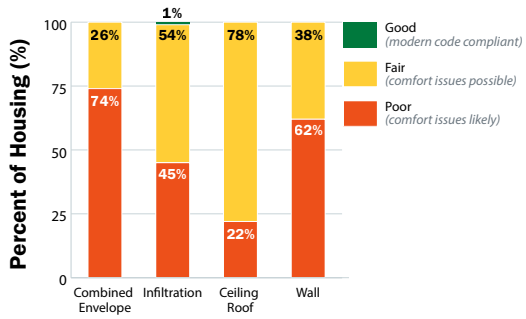
Energy Burden



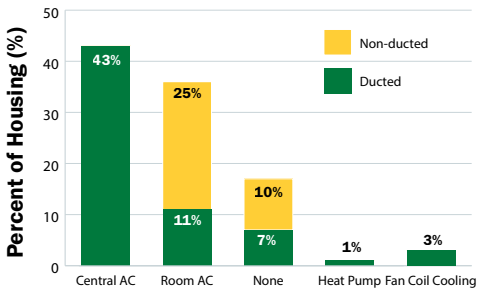
Construction Year



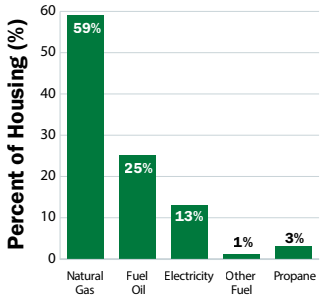
Envelope Status for Buildings with Frame Wall



Cooling Type



Space Heating Fuel Type



Source: ResStock-modeled data and results, https://data.nrel.gov/submissions/224

Annual Savings by Upgrade

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

	Energy Bill Reductions per Household *In $*	**Emissions Reductions per Household** *Equivalent to number of cars taken off the road*	**Upgrade Cost** *$–$$$*
Basic enclosure*	524	0.45	$
Enhanced enclosure**	627	0.52	$
Heat pump water heater	31	0.12	$
Enhanced enclosure and high-efficiency whole home electrification***	153	1.36	$$$

** 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.*

Energy efficiency upgrades can reduce the amount of energy and on-site fossil fuels required to power a home. Depending on the local conditions, combining single upgrades into one project can reduce home energy use, emissions, utility costs, and create a healthier living environment. Some upgrades increase the amount of electricity used. This is because they replace or reduce the use of other energy sources such as natural gas or fuel oil or they add a new service, such as air conditioning. Utility bill reductions from these upgrades strongly depend on current energy prices. NREL's analysis for Lawrence showed that if certain upgrades are applied alone, they may not lead to utility bill reductions. However, pairing energy efficiency upgrades that decrease the amount of energy needed, such as basic or enhanced enclosures measures, with other upgrades that increase energy use, such as heat pumps, can combine for utility bill reductions.

Average Annual Home Savings from Basic Enclosure Upgrade

Housing Type	Area Median Income	Range of Energy Bill Reductions	Impact of Energy Bill Reductions on Energy Burden (pre -> post)	Site Energy Reduction (%)
Multifamily building with 2-4 units built before 1940*	All	$123–$522	8.7% → 7.6%	23%
	0%–80%	$103–$414	11.5% → 12.2%	22%
Multifamily building with 5+ units built before 1940*	All	$90–$478	12.5% → 10.4%	19%
	0%–80%	$90–$410	14.9% → 12.5%	19%
Mobile home built between 1940 and 1979	All	$36–$72	8.8% → 8.6%	22%
	0%–80%	$36–$72	8.8% → 8.6%	22%
Single-family homes built before 1940	All	$123–$1,307	7.4% → 6.0%	28%
	0%–80%	$88–$892	15.0% → 12.1%	26%

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 may vary.*

Basic Enclosure Upgrade

NREL's analysis for Lawrence showed that on average, the most cost-effective option for upgrading energy efficiency is the basic enclosure, which includes adding insulation to exterior walls, the attic, and sealing openings around vents, doors, windows, and crawlspaces. Actual costs 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 Lawrence. The most cost-effective upgrade was defined as the energy efficiency and retrofit package that resulted in the most energy bill reductions per upgrade cost. All four housing types identified in this fact sheet had the same most cost-effective package. 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.

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For more information about Communities LEAP, visit:
energy.gov/communitiesLEAP

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