COMMUNITIES LEAP
U.S. DEPARTMENT OF ENERGY

Household Energy Efficiency Analysis for Duluth, Minnesota

Many households in the Duluth, Minnesota, 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 39,000 housing units in Duluth.

For more information about the Communities LEAP effort in Duluth, visit: https://www.energy.gov/communitiesLEAP/duluth-minnesota

Top End-Uses of Energy in Duluth

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

Top 4 residential energy uses in the Duluth:

- 60% for space heating using natural gas
- 7% for hot water heating using natural gas
- 7% for space heating using fuel oil
- 6% for space heating using electricity

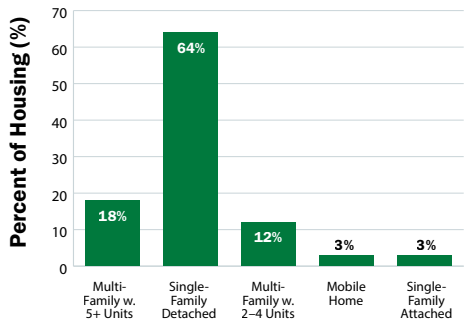
For information on energy efficiency improvements, including smaller do-it-yourself projects, visit DOE's Office of Energy Efficiency and Renewable Energy's Energy Saver webpage: https://www.energy.gov/energysaver/energy-saver

Energy Challenges of Duluth's Housing Stock

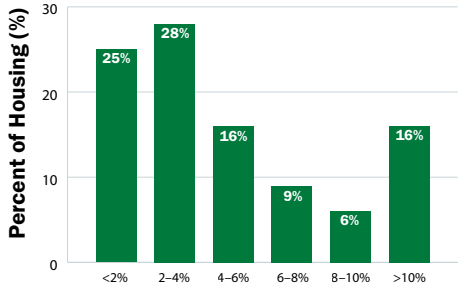
An estimated 70% or more of the homes and apartments analyzed in Duluth have poor building envelopes, meaning inadequate insulation and sealing allows air in and out of homes. Inadequate building envelopes increase the cost of heating and cooling homes, which requires residents to spend a higher share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

Duluth, Minnesota Residential Housing Stock Summary

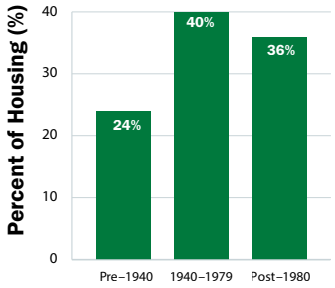
Building Type



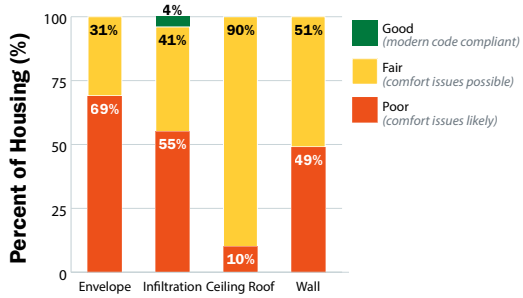
Energy Burden



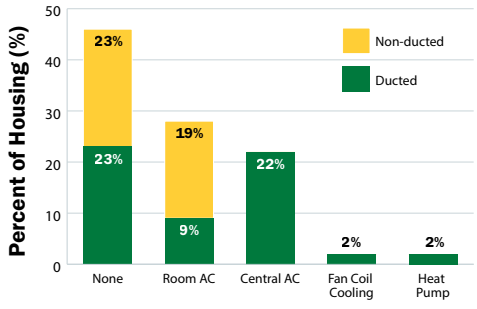
Construction Year



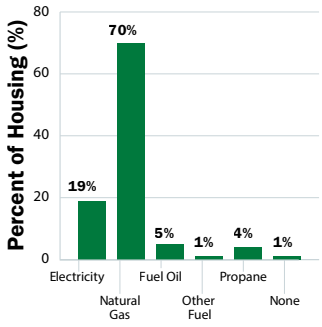
Envelope Status



Cooling Type



Space Heating Fuel Type



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

Annual Community-Wide Savings by Upgrade

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

	Energy Bill Reductions *Million $*	**Emissions Reductions** *Equivalent to number of cars taken off the road*	**Energy Savings** *Equivalent number of homes*	**Upgrade Cost** *$–$$$*
Basic enclosure*	8	13,300	6,040	$
Enhanced enclosure**	11	17,800	1,570	$$
Heat pump water heater	2	3,600	1,570	$
High-efficiency whole home electrification***	5	60,100	22,400	$$$

** 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.*

**** High-efficiency whole home electrification includes a 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 Upgrade

Housing Type	Area Median Income	Estimated Annual Energy Bill Reductions	Impact of Energy Bill Reductions on Energy Burden (pre -> post)	Average Site Energy Reduction (%)
Single-family detached home built before 1940 with renters	All	$464	11.9% → 9.5%	25%
	0%–80%	$360	19.5% → 15.3%	27%
Single-family detached home built before 1940 and owner occupied	All	$405	6.5% → 5.7%	20%
	0%–80%	$368	17.0% → 15.1%	21%
Multifamily building with 2-4 units built between 1940 and 1979*	All	$186	8.4% → 7.6%	12%
	0%–80%	$208	9.9% → 8.9%	12%
Multifamily building with 5+ units built between 1940 and 1970*	All	$169	10.6% → 9.4%	14%
	0%–80%	$170	11.3% → 10.0%	14%

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 Duluth 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 Duluth. 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.

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

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