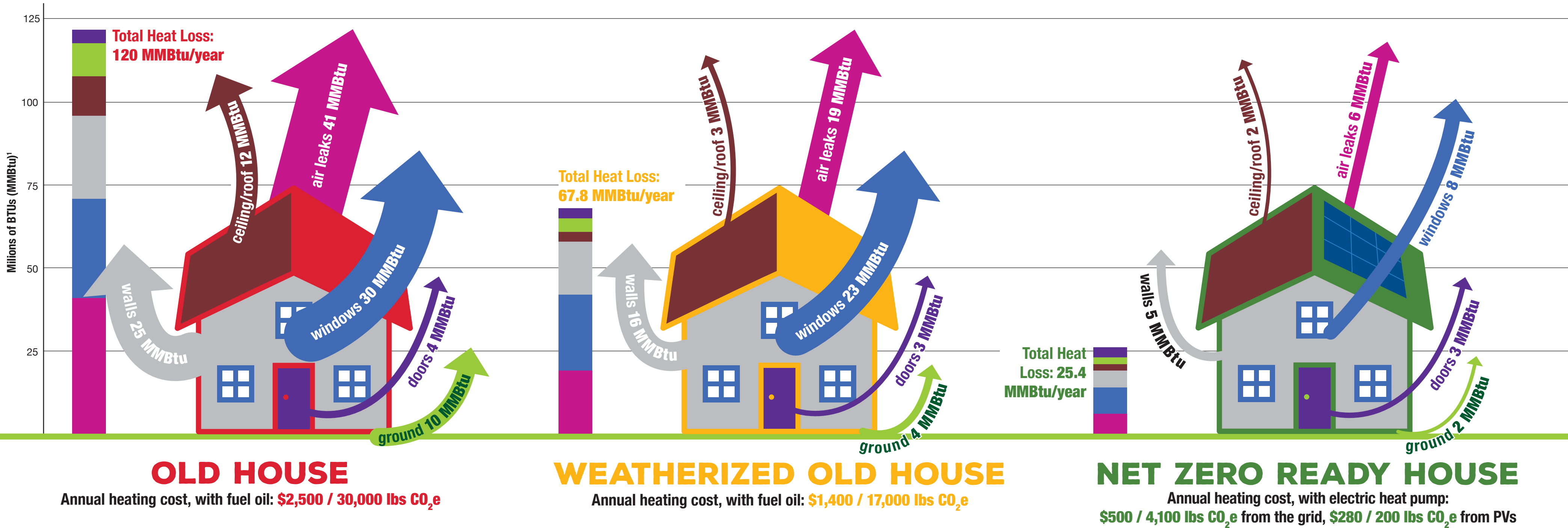


HEATING VT HOMES

Where is heat leaving our homes?²



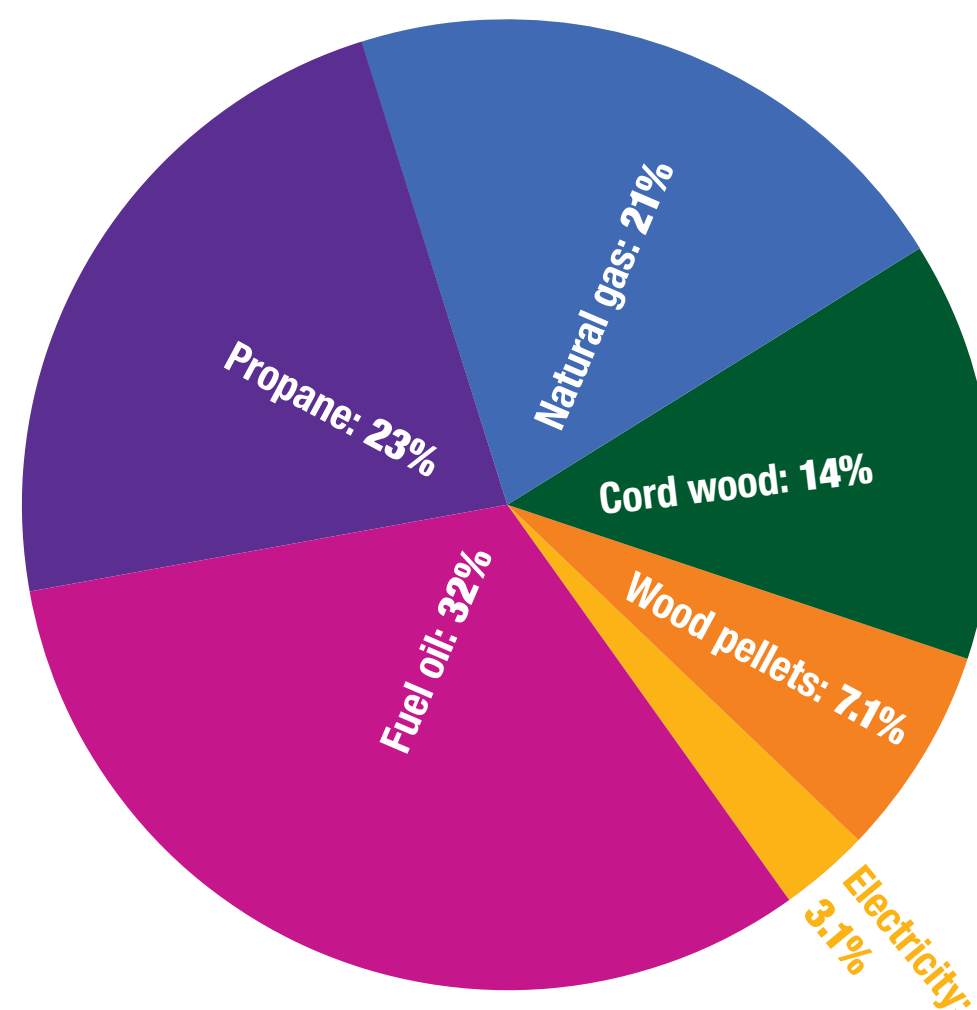
poster produced by the
VERMONT ENERGY EDUCATION PROGRAM
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OUR MISSION is to build a deep understanding of energy through education, encouraging choices that result in sustainability in our communities, economy and environment.

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- NOTES**
1. A British thermal unit (Btu) is a measure of energy. If you completely burn up a large wooden match, it gives off about 1 Btu of energy. A Btu is defined as the amount of heat required to raise one pound of water 1 degree F. One million Btus (1 MMBtu) is the amount of heat delivered to a house from about 7 gallons of fuel oil.
 2. Based on a two-story, 2,300 sq.ft. home, 29 feet wide by 40 feet long. The old house has some insulation and is quite leaky to air movement; the weatherized old home has been tightened up and insulated and storm windows have been repaired. Both have typical oil boilers. The net zero ready home is very highly insulated and very air tight, with heat recovery ventilation and an air source heat pump.
 3. Data from U.S. Energy Information Agency: www.eia.gov/state/seds/seds-data-fuel.php?sid=VT#DataFiles. These data may undercount cord-wood, because it is often cut by the user or bought on the informal market, not tracked by US EIA.
 4. What is the cost of each source? Cost of fuels are tracked by the state of Vermont: publicservice.vermont.gov/publications-resources/publications/fuel_report. Cost per million BTUs (MMBtu) is based on typical efficiencies for new heating systems used in homes. See note 7 for solar costs. Carbon dioxide equivalent (CO₂e) emissions refers to the CO₂ emitted from burning the fuel plus the equivalent CO₂ global warming potential caused by gases other than CO₂ being emitted in the process of exploration, extraction, transport, refinement and distribution of the fuel. CO₂e is expressed in terms of the amount of CO₂ that would have an equivalent global warming effect over the next 20 years. Methane, for example, has a CO₂e of 86 when considered over 20 years, meaning a pound of methane has 86 times the global warming effect of CO₂. For further detail on these calculations, email info@veep.org.
 5. Many tallies of CO₂ emissions discount wood emissions partially or totally because trees will regrow and absorb that CO₂ within some period of time, often cited as 30 years, sometimes more. We include a range of emissions here because 1) Burning wood pellets releases as much or more carbon dioxide per unit of energy as burning coal, 2) We don't know whether the trees are harvested sustainably, 3) We are concerned about near-term CO₂ additions to the atmosphere because of the rapid rise of atmospheric CO₂, and 4) Perhaps most importantly, to engage you in this important conversation about wood burning. The larger value represents total emissions from harvesting, transporting and burning the wood. The lowest figure assumes almost all the wood is harvested sustainably.
 6. How can efficiency be more than 100%? Even in very cold climates, a modern air source heat pump will deliver, on average over the winter, about 2.3 units of heat for every unit of electricity it uses. It does this by extracting heat from the outside air, even at very low outdoor temperatures.
 7. Isn't the cost of solar-powered electricity \$0? The energy from the sun is free, but it costs money to install a photovoltaic (PV) system. The cost of electricity from PVs is estimated here at \$0.09/kWh, figured by dividing the installed cost of the PV system by its lifetime kWh output.

What energy sources heat our homes?³



What is the cost of each source?⁴

Heating Fuel	Typical delivery efficiency	CO ₂ e emissions per MMBtu of heat delivered	Cost per MMBtu of heat delivered to the house
Fuel oil	85%	240 lbs	\$21
Propane	90%	210 lbs	\$30
Natural gas	90%	260 lbs	\$15
Cord wood	65%	30–300 lbs ⁵	\$17
Wood pellets	85%	23–230 lbs ⁵	\$19
Electricity from the grid with resistance heat	100%	360 lbs	\$47
Electricity from the grid with air source heat pump	230% ⁶	160 lbs	\$20
Electricity from solar with air source heat pump	230%	8 lbs	\$12 ⁷