E³A: Economics of Heating with Wood

STEP 5

Steps in the Wood Heat Series

E3A-WH.5
Printed April 2014

Heating with wood can reduce home heating costs – but accurately forecasting the cost reduction is a challenge. The major share of the lifecycle cost of a wood heating unit is the cost of a new unit, supplementary materials/tools, and installation. Potential cost savings arise when an inexpensive source of suitable wood fuel is available. However, there are factors that complicate the discussion of the economic benefits of wood heat installation. The following are a few of those complicating factors.

Local Regulations

Local ordinances influence the economics of wood heat in three ways. First, local emission standards may dictate the type of the unit allowed and the installation cost. Second, local ordinances may dictate when the unit can operate. This is especially true for new wood heating units (homes that had wood heat as a primary heating source prior to the ordinance may be exempt.) For example, an area prone to inversions may restrict burning for many days during the cold season, thus the economic discussion of wood heat must consider both the inability to use the unit during peak cold times and the cost of having a redundant fuel source (natural gas, electricity or propane) operating for that period. Third, local regulations in building codes may affect the cost of installation.

Fuel Cost

Wood is a renewable resource, though there are costs for obtaining wood fuel. Determining the actual cost of wood can vary based upon type of wood source, condition and storage. Here are some variables that influence the cost of the fuel:

Wood Availability

Wood can be gathered by the homeowner or a third party can deliver the wood. Third party delivery prices will vary based on distance to the wood resource, type of wood, costs of transportation, and the condition of the wood (split or round). In some areas, local saw mills will sell truckloads of "ends and pieces" or logs that are not saleable for the mill, but work well for burning in the home. These loads may cost less than cut and stacked wood that is gathered from the forest, but also may require additional processing such as cutting, splitting and stacking.

The cost of cutting your own firewood will depend on the homeowner. Someone who already possesses a saw and safety equipment, has the skill and physical ability to cut down trees, and has the ability to transport wood may find wood heat a reasonable option. Alternatively, buying equipment and learning how to use it safely may add thousands of dollars to the expense of using wood for heat.

Time and Physical Ability

The opportunity cost (you could be doing something else with your time) is also important to include in accurate assessments of economic viability. Gathering, splitting, and stacking firewood is a time consuming process. If you consider preparing your supply of wood as recreation, your opportunity cost may be quite low. If you would rather be fishing (or working overtime at your regular job), then it may be high. Your ability to conduct this type of hard physical labor may also change as you get older.

Some homeowners opt to pay a premium for delivered firewood to reduce the amount of physical labor required to burn wood. The cost per cord will increase if the wood is cut, split, and stacked.

While it is difficult to provide accurate average costs or return on investment information for wood, understanding the number of heating days and the amount of heating demand in the home can help in understanding the potential savings or cost.

Heating Degree-Days

Fuel demand for space heating varies according to the temperature outdoors. "Degree-day units" help in estimating the heat requirements and fuel costs for a building. Heating degree-days are a way to estimate heating costs. A heating degree-day is the demand for energy needed to heat a building for one day. When the outside air is above the base temperature of 65° F, no heat is required. To determine heating degree-days, the average daily temperature is subtracted from 65° F. Each degree accounts for one degree-day.

> Example: if a day's High temperature is 50° F and the Low is 30° F, the average daily temperature is 40° F. Subtracting 40° F from 65° F results in 25 degree-days for that day.

Heating demand is directly proportional to the number of degree-days in a year.

Example:

Here are some averages for Heating Degree Days from across Montana:

Heating Degree Days (Base 65)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Billings, MT	1,308	1,008	915	582	316	119	12	42	242	498	897	1,225	7,164
Glasgow, MT	1,686	1,330	1,104	621	322	121	19	71	267	586	1,074	1,544	8,745
Great Falls, MT	1,358	1,053	983	642	372	156	37	91	299	543	933	1,274	7,741
Havre, MT	1,546	1,201	999	613	324	113	33	49	270	622	1,067	1,410	8,247
Helena, MT	1,407	1,081	973	648	388	137	34	65	321	617	1,002	1,358	8,031
Kalispell, MT	1,380	1,075	970	654	425	235	97	128	367	716	1,020	1,311	8,378
Missoula, MT	1,311	1,002	905	624	409	179	65	81	303	645	978	1,290	7,792

Similar numbers for Wyoming include:

Heating Degree Days (Base 65)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Casper, WY	1,189	1,038	898	632	346	32	-	-	194	586	929	1,205	7,049
Cheyenne, WY	1,094	983	893	653	368	76	-	-	211	569	891	1,122	6,860
Jackson, WY	1,495	1,326	1,166	842	569	335	112	167	443	798	1,172	1,495	9,920
Rock Springs, WY	1,334	1,154	977	691	413	108	-	-	259	631	1,037	1,339	7,943
Sheridan, WY	1,250	1,048	904	589	324	43	-	-	189	591	972	1,256	7,166
Worland, WY	1,451	1,174	854	497	229	-	-	-	173	580	1,015	1,462	7,435

Wood Heat's Role in the Home

Economic discussions are further complicated based on the role that wood heat will play in the home. Some of the factors that make it difficult to provide an "average" economic benefit include: The floor plan of the home and where the stove will be located (i.e. – if the home has a basement, but the stove will be on the ground level, the heat may not be able to easily circulate to the lower level). In addition, consider if wood heat is a supplemental or primary source of heat, and the additional time required to use wood heat, as fuel needs to be constantly refilled and there is a "start-up" delay from when you start your unit and when it actually starts to heat the house.

Averages can be provided based on fuel substitutions. In North America, heat value (energy content) of fuels is commonly measured in BTU (British Thermal Units), which is roughly defined as the amount of energy needed to raise the temperature of 1 pound of water by 1°F, or in "therms", where 1 therm equals 100,000 BTU's. A Fuel Value Calculator, published in cooperation with the USDA Forest Service, Forest Products Laboratory, and the Pellet Fuels Institute in Arlington, Virginia, is a tool that can be used to compare typical unit costs of various fuels and is available online at http://goo.gl/wP8kR.

The following is an example for a Fuel Heating Cost Comparison for October 2013 in Montana, provided by NorthWestern Energy, a major utility. A similar cost structure and combustion efficiencies can be assumed for Wyoming.

Fuel Type	Heat Value (Therms/Unit)	Unit Cost	Unit Cost/Therm	Applicance Type	Appliance Efficiency (%, COP, or AFUE)		Cost/Therm
Wood	200/Cord	$150/Cord	$ 0.75	Fireplace	38%		$ 1.97
Wood	200/Cord	$150/Cord	$ 0.75	Stove	72%		$ 1.04
Electric	0.03413/kWh	$0.106/kWh	$ 3.11	Baseboard	100%		$ 3.11
Electric	0.0529/kWh	$0.106/kWh	$ 2.00	Air-Air Heat Pump	1.55	COP	$ 2.00
Electric	0.1024/kWh	$0.106/kWh	$ 1.04	Ground-Air Heat Pump	3	COP	$ 1.04
Propane	0.915/Gal	$2.05/Gal	$ 2.24	Furnace	80%	AFUE	$ 2.80
Propane	0.915/Gal	$2.05/Gal	$ 2.24	Furnace	90%	AFUE	$ 2.49
#2 Oil	1.39/Gal	$3.39/Gal	$ 2.44	Furnace	72%	AFUE	$ 3.39
Pellets	150/Ton	$240/Ton	$ 1.60	Stove	80%	AFUE	$ 2.00
Natural Gas	1/Therm	$0.739/Therm	$ 0.74	Furnace	64%	AFUE	$ 1.15
Natural Gas	1/Therm	$0.739/Therm	$ 0.74	Furnace	80%	AFUE	$ 0.92
Natural Gas	1/Therm	$0.739/Therm	$ 0.74	Furnace	90%	AFUE	$ 0.82

Cost per 100,000 Btus delivered as useable heat.

British Thermal Unit (Btu) is the amount of energy needed to raise the temperature of 1 pound of water 1° F.

Based on altitude and atmospheric pressure in Helena, MT

1,000 Btu	=	1 cubic foot
100,000 Btu	=	1 therm
1,000,000 Btu	=	1 dekatherm

The fuel comparisons shown are based on NorthWestern Energy's rates for electricity and natural gas and are subject to change. Monthly meter charges and/or tank rental charges are not included in the comparisons and need to be included if calculating a change in fuel sources. If you are comparing costs to other fuels or other energy providers, please adjust for fuel or rate cost difference applicable to your market area.

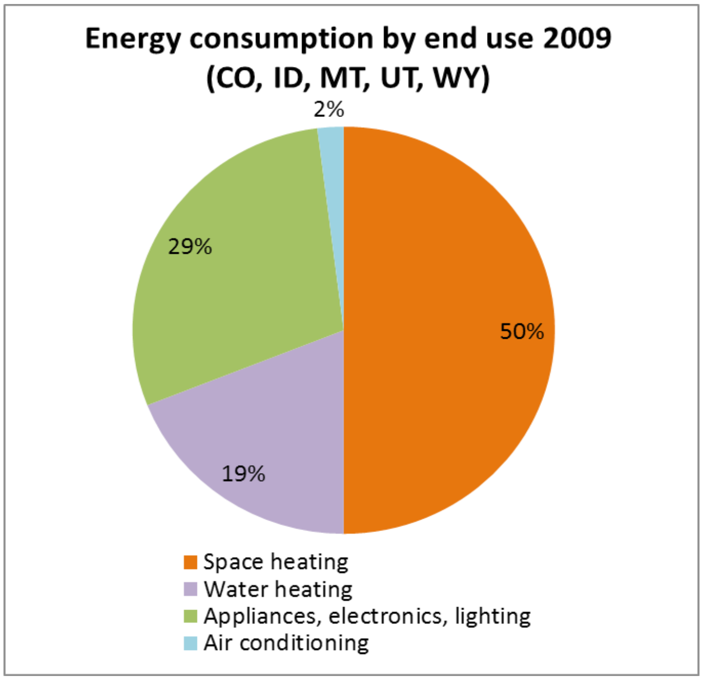

Figure 1: Adapted from EIA's 2009 Residential Energy Consumption Survey

Using some of the above numbers and assuming 50 Million BTU's/500 therms for annual home heating demand, a household in Montana or Wyoming would pay approximately $1,560 for fuel oil #2, or $480 for natural gas, or $1,550 for electric heat, or $1,320 for propane, or $640 for purchasing cordwood, or $1,000 for buying wood pellets. An online comparison calculator is available here: http://goo.gl/lhNmqC.

Space Heating Energy Consumption

An important step in evaluating the economic impact of a wood-fired heating system is the current space heating demand. The following steps will help you with this process (An online calculator is available as well: http://goo.gl/9PU0Q0.)

1. Obtain a 12-month fuel usage history. This information will come from different sources depending on the existing heating system. For example, if the home is currently heated with a propane-based forced air heating system, the information will be available from the propane supplier. Conversely, contact the electrical utility if the home is currently heated with electric baseboard.

My Heat Consumption

Month	Energy units	Cost ($)	$/unit of fuel	"Base Load" Units	Space Heating Units (Approx)	Cost for Space Heating
Example	96 therms	$80.02	$80.02/96=$0.83	8	96-8=88	88*$0.83=$73.04
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Total						

**The cost of fuel (per unit of fuel) is generally expressed as: $/gallon for heating oil, $/therm (or ccf) for natural gas, $/kWh for electricity, $/gallon for propane, $/ton for coal.*

Some utilities provide this history online or in monthly statements. The utility should be able to provide estimates based on energy usage for similar homes in the area if new construction is planned. Enter the amount used per month (this may require some division if the home is not billed monthly) in the table above.

2. Find the cost per energy unit. Use the table above to calculate the amount of energy used and the average cost per energy unit for the 12-month period.

3. Estimate the amount of the fuel used for space heating. Often, homes use one fuel for multiple purposes. For example, a home heated with propane may use the fuel in a cooking range, for domestic hot water heating, and for hot water-base board heating. To determine your space heating energy consumption, you need to approximate what percent of your total fuel is dedicated to space heating.

Things to consider:

a. If your home is all-electric, i.e. space heating is provided with electricity, assume that on average about 50% of the energy consumed in a Montana or Wyoming home annually is for space heating. So about half of your annual bill would be the demand and cost allocated to space heating.

b. Because most people don't meter their space heating separately from other end uses, a more involved calculation is necessary for a more accurate estimate. Assuming natural gas is used for heating, find a month (or the average of two) with the lowest natural gas consumption on the utility bill. This should be a summer month, when no or very little energy is required for space heating, and establishes a "base load" from water heating, cooking, etc. After subtracting this amount from the natural gas consumption of any other month the balance should provide a fairly good estimate of the amount consumed for space heating.

c. A general rule of thumb for annual consumption could be to assume 20% of natural gas consumption for domestic hot water heating.

Multiply both the total usage by month and the cost per month by the percentage used for space heating (see the example at left).

Once you understand your space heating costs and have discussed realistic estimates for the percentage of space heating demand you can offset with wood with a qualified installer, you can begin to assess both the total costs of the system and some simple return on investment calculations.

Incentives

A federal biomass heating tax incentive is available, which provides a tax credit up to $300 for the purchase of a biomass burning appliance, including pellet stoves, with a thermal efficiency rating of at least 75%. The Residential Energy Efficiency Tax Credit is for purchases/installations made in 2012, and 2013 (http://goo.gl/1x1s).

The State of Montana currently offers state incentives:

- Residential Alternative Energy System Tax Credit (personal tax credit), including for low-emission wood stoves, and biomass. Maximum Incentive is $500 per individual taxpayer or up to $1,000 per household.
- Renewable Energy Systems Exemption (property tax incentive), including low-emission wood or biomass combustion systems. May be claimed for 10 years after installation of the property; up to $20,000 (single-family residential)/$100,000 (multi-family residential dwellings or non-residential structures.)
- Alternative Energy Revolving Loan Program (state loan program). Maximum Incentive: $40,000, up to 10 years; 3.25% interest rate (for 2014). (Note: interest rate subject to change.)

The State of Wyoming does not offer any incentives for the use of wood for residential or commercial heating systems.

More and current information at DSIRE™ - http://dsireusa.org/

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