HOME HEATING INDEX (HHI)

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There is a simple way for homeowners to estimate how weather tight and efficient their house is regarding winter heating. The Home Heating Index (HHI) compares a house winter heating history to a standard model, relative to house size, weather, and inhabitant habits. This HHI is appropriate for houses with significant winters, like those in Northern Nevada.

To estimate the HHI for your house, you will need to know how much fuel you consumed heating your house last winter. If you can average consumption over several winters so much the better, providing there have been no recent major changes. If you took a long winter vacation and lowered the thermostat, the estimated HHI will be lower than realistic. If you used several energy modes to heat your house (other than solar or other renewable energy), each source must be estimated; this will be illustrated in the real-life sample calculations below.

If you discarded last winter's propane, natural gas, heating oil, or electric bills, you can call your local supplier and recover the quantities consumed. The cost is not important, just the amount of fuel used.

If you use fuel for multiple purposes, such as natural gas or electricity for winter space heating, cooking and domestic hot water heating, then you should determine how much energy you use in an average summer non-heating month (as a baseline), multiply that number by 12, and subtract the result from your annual fuel usage. However, if you run an air conditioner, then this technique is not adequate for estimating winter electric heating.

After the fuel quantity(ies) are known, you will estimate the amount of heat input available to the house from the fuel(s) The heat content for various fuels are indicated in Table 1. The source of Table 1 is
http://www.hrt.msu.edu/Energy/pdf/Heating%20Value%20of%20Common%20Fuels.pdf

You also need to know how many Heating Degree Days (HDD) your climate manifests. A HDD for a given day is the average daily temperature (below 65^{o}F) subtracted from 65^{o}F, and all days are added for the heating season. Thus, the HDD is a measure of winter climate severity. HDDs are sensitive to elevation. For Nevada and parts of California use Table 2. For other locations consult
http://www.worldclimate.com/cgi-bin/grid.pl?gr=N39W119 for the proper latitude and longitude.

The HHI has dimensions of BTU/[squarefoot*HDD], which clearly normalizes the house winter heating energy on an area basis and also to climate. Therefore the HHI is a useful comparator throughout the United States where winter comes with some authority. HHI guidelines given below are somewhat arbitrary.

Home Heating Index (HHI)

HHI	Comments
0-2	Excellent! House consumes very little energy for its size, climate and user habits
2-4	Very Good! Some improvements could likely be found. House is well insulated and sealed against infiltration. Efficient heating system.
4-8	Moderate to Average. Improvements could be made
8-12	Low Average. You could save money by improving the house
12-18	Poor! There are many opportunities to improve the house
> 18	Paying a fortune to heat a drafty house with an inefficient heating system!

TABLE 1

Approximate Heating Value of Common Fuels

Natural Gas 1,030 Btu/cu ft
Propane 2,500 Btu/cu ft 92,500 Btu/gal
Methane 1,000 Btu/cu ft
Methanol 57,000 Btu/gal
Ethanol 76,000 Btu/gal
Fuel Oil #2 138,500 Btu/gal
Kerosene 135,000 Btu/gal
Softwood 2-3,000 lb/cord 10–15,000,000 Btu/cord
Hardwood 4-5,000 lb/cord 18–24,000,000 Btu/cord
Sawdust – green 10-13 lb/cu ft 8-10,000,000 Btu/ton
Sawdust – kiln dry 8-10 lb/cu ft 14-18,000,000 Btu/ton
Chips – 45% moisture 10-30 lb/cu ft 7,600,000 Btu/ton
Wood pellets – 10% moisture 40-50 lb/cu ft 16,000,000 Btu/ton
Hard Coal (anthracite) 13,000 Btu/lb 26,000,000 Btu/ton
Soft Coal (bituminous) 12,000 Btu/lb 24,000,000 Btu/ton
Electricity 3412 Btu/kilowatt hour
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TABLE 2
Winter Heating Degree Days (HDD)
Source: http://www.worldclimate.com/cgi-bin/grid.pl?gr=N39W119

LOCATION	HDD ~ ^{O}F
Carson City, NV	5690
Elko, NV	7076
Ely, NV	7619
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Fallon, NV	5690
Incline Village, NV	6818
Las Vegas, NV	2425
Lovelock, NV	5868
Reno, NV	5674
Virginia City, NV	6637
Winnemucca, NV	6314
Yerington, NV	5364
Portola, CA	7036
Tahoe City, CA	7855
Truckee, CA	8185

The HHI calculation will be illustrated by three actual cases taken from DRI home energy audit case files. Since the index is normalized to a unitized standard, the habitable space area is also needed. The formula for HHI is

HHI = Total Winter Fuel Energy / (House Area * HHD)

SAMPLE CALCULATIONS TO ESTIMATE HHI

Case 1: Solar House in Reno, NV

A 1900 square foot (sf) house in Reno is occupied by a retired couple. In the winter of 2008-9 the owner estimates the winter consumption at:

(1) 120 gallons of propane;
(2) 6/10 cord of pine wood;
(3) 800 kW-hr of electricity used for spot space heating.

HHI = [(120 gal)(92,500 BTU/gal) + (0.6 cord)(12,500,000 BTU/cord) + (800 kW-hr)(3412 BTU/kW-hr)] / [(1900 sf)*(5674 HDD)]

Propane Wood Electricity

HHI = [(11.1 + 7.5 + 2.7)x 10^6 BTU] / [1900sf * 5674HDD] = **1.98 BTU/sf-HDD**

This admirably low HHI is due to several factors.

(1) The house is well built and has 2x6 stud walls with R-19 insulation and R-39 in the attic. Excellent windows are used throughout.

(2) The occupants keep the thermostat set low (60°F at night and 65°F during waking hours). They dress warmly in winter. They do not heat the master bedroom, but do use an electric blanket at night, and the guest bedroom is sealed off. In their offices they each have a small electric heater below their desks for spot heating, so the air can be colder while they are comfortable. Occupant habits impact on the HHI!

(3) The house is solar heated throughout the winter. Although Reno gets quite cold (January high temperature averages 45°F and the low is 18°F), sunny Reno annually receives over 300 days with some sun, and is an excellent location for solar space heating. The house features a 230 sf vertical south-facing site-built solar air heater which provides winter space heating (and is not used in summer). The solar collector and system was built by the owner from basic materials and is shown in Figure 1. He estimates the simple payback period for the solar system is 3 years, derived from obviated fuel purchases. Since the solar contribution is free and non-polluting, solar drives down the HHI.

FIGURE 1 Solar air heater on the south side of a garage. Approximately 450 cfm of cool air is drawn into the solar collector, heated, and then blown into the house at approximately 120°F at noon on a sunny winter day when the ambient temperature might be 45°F.

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Case 2: Large House in Reno, NV

A 2800 sf house in Reno is occupied by a mature couple. In the winter of 2008-9 the owner estimates the winter consumption at:

(1) 700 gallons of heating oil;
(2) 2400 pounds of wood pellets.
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HHI = [(700 gal)(138,500 BTU/gal) + (1.2 ton pellets)(16,000,000 BTU/ton)] / [(2800 sf)*(5674 HDD)]

Oil Pellets

HHI = [(9.7 + 19.2)x 10^6 BTU] / [2800sf * 5674HDD] = **1.8 BTU/sf-HDD**

This house has a low winter heating consumption for its size and location. The owner has a professional furnace tune-up every 2-3 years, and changes the air filters twice a year. The windows and doors are generally well sealed, and the house is well insulated. It is not known if electric space heaters are used.

Case 3: House in Sparks, NV

A 1650 sf house in Sparks is heated exclusively by natural gas. The annual gas consumption, as read from 12 months of bills, was 584 Therms (note 1 Therm = 100,000 BTU). During the summer months June through September, when no gas was used for heating, the average monthly consumption was 13 Therms, which accounted for cooking and domestic hot water heating. This value of 13 Therms/month is taken as the base non-heating gas consumption. Therefore, the annual non-heating gas consumption is estimated to be (13 Therm/mo)(12 mo/year) = 156 Therms, and so the gas needed for winter heating is [584 – 156 =] 428 Therms. Thus the HHI is

HHI = Total Winter Fuel Energy / (House Area * HHD)
= (428 x 10^5 BTU) / [(1650 sf)(5674 DD)
HHI = 4.57 BTU/sf-DD

The two occupants of this house maintain the winter temperature around 64^oF and dress warmly, and so the HHI = 4.57 BTU/sf-DD would have been greater if the temperature were maintained higher. This indicates how the HHI is somewhat reflective of occupant habits. Thus the HHI normalizes winter energy consumption relative to: (1) habitable living area (sf); climate (DD); and (3) occupant habits relative to thermostat control.

A HHI = 4.57 BTU/sf-DD indicates an average house where energy conservation improvements could reduce heating bills and/or improve winter comfort. When a full energy audit was conducted on the house, several improvement opportunities were identified which will reduce the HHI.