



Energy Efficient Home Construction



TABLE OF CONTENTS

ENERGY SAVINGS - TWO PLANS 1

REQUIRED FEATURES CHART 2

THE ELECTRIC HEAT PUMP 4

ELECTRIC HEATING COST CHART 5

AIR SEALING 6

INSULATION 7

WINDOWS, DOORS AND SKYLIGHTS 9

LIGHTING AND APPLIANCES 10

ABOUT MOISTURE 11

HOME CONSTRUCTION TERMS 12

EQUIPMENT AND SIZING TERMS 13

EFFICIENCY RATINGS 14

INFORMATION RESOURCES 15

NOTES 17



CALL BEFORE YOU BUILD

Prior to construction, call your local electric power association to schedule a house plan evaluation. Planning ahead can save construction costs as well as energy dollars. Ask your representative to assist you in meeting Comfort Advantage requirements.

ENERGY SAVINGS - TWO PLANS

For the Comfort Advantage home, your electric cooperative representative and your builder must verify that standards have been met. Comfort Advantage Plus standards take energy efficiency a step further for those who want greater energy savings. A Comfort Advantage representative will offer energy management suggestions on proper application and installation of energy saving technologies. Inspections during construction will confirm that your new home meets all Comfort Advantage standards.



REQUIRED FEATURES	 Comfort Advantage	 Comfort Advantage Plus
HEATING AND COOLING EQUIPMENT		
14 SEER or higher Electric Heat Pump or an ARI-Rated Geothermal System	✓	
15 SEER or higher Electric Heat Pump or an ARI-Rated Geothermal System		✓
Programmable thermostat		✓
Ductwork sealed with mastic (no duct tape)	✓	✓
Duct Insulation: R-4 in conditioned space, R-6 in attic and crawl space	✓	✓
Heating and cooling equipment sized according to industry standards in Manual J	✓	✓
5% or less duct leakage found with pressure test by a third party (at cost to the member)		Optional
WATER HEATING		
Electric tank water heater with a 0.90 energy factor or higher; or a qualified outdoor gas tankless water heater.	✓	✓
Insulate pipes. Select unit with built-in heat traps or installed traps.	✓	✓
INSULATION		
R-38 Attic Insulation	✓	✓
R-20 Cathedralized Unvented Attic Insulation (Encapsulated Attic) - foam insulation between roof rafters on under side of roof decking and on attic sidewalls and gable ends.	✓	✓
R-13 Wall Insulation	✓	✓
R-19 Floor Insulation for crawl spaces	✓	✓
Insulation fills entire cavities. (Exceptions apply for some high R-value insulating materials); No compressed batts or gaps are allowed. Even coverage is required.	✓	✓
WINDOWS		
Double Pane Windows, thermal break recommended for metal windows	✓	
Double Pane low-e windows		✓
Glass area no more than 20% of floor area	✓	✓
Windows rated to .60 U-factor and 0.60 SHGC (or lower for each)	✓	
Windows rated to .40 U-factor and 0.35 SHGC (or lower for each)		✓
AIR RETARDERS		
All penetrations through exterior walls sealed	✓	✓
Sill insulation between slab and bottom plate	✓	✓
Housewrap or building paper covers exterior sheathing in wood framed houses	✓	✓
Canned lights rated as airtight and for insulated ceiling (ICAT)	✓	✓
Electrical boxes on exterior walls caulked or gasketed	✓	✓
Holes into attic sealed	✓	✓
Air leakage determined with blower door test by a third party (at cost to the member)		Optional
ADDITIONAL FEATURES	Choose 2	Choose 3
Radon vent pipe installed		
Exhaust System in kitchen and baths		
ENERGY STAR qualified windows, doors and skylights		
Duct system in conditioned space		
Compact fluorescent lighting (hard wired on 25% of fixtures)		
ENERGY STAR Refrigerator		
Supply and return air vents in each room		
Air handler in conditioned space		
Mechanical ventilation system (for extremely tight houses)		
Continuous ridge vent		
Radiant barrier in attic		
Light color roof		
Polyethylene (plastic) vapor barrier below gravel		
Perimeter Slab Insulation with termite shield		

THE ELECTRIC HEAT PUMP

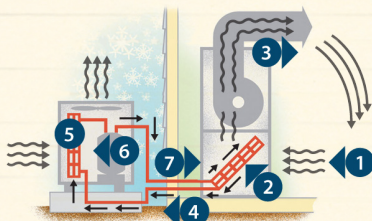
Heat Pumps Provide

- Lowest operating cost
- Superior home comfort

Types of heat pumps

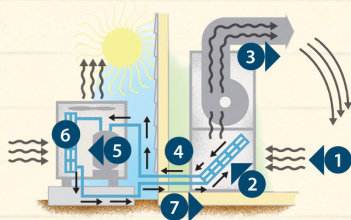
- An air source heat pump in summer works just like a central air conditioner. For heating in winter, it works in reverse. Even when it's very cold outside, the air source heat pump can harvest outdoor heat and "concentrate" it, raising the temperature for heating your home.

How a heat pump heats your home



1. Indoor air flows into indoor air filter grille (return).
2. Hot refrigerant inside coil heats indoor air.
3. Heated indoor air from inside unit returns to home.
4. Refrigerant flows to outdoor unit.
5. Refrigerant in coil absorbs available heat from cold winter air.
6. Compressor squeezes refrigerant to make it hotter.
7. Hot refrigerant flows to indoor unit.

How a heat pump cools your house



1. Indoor air flows into indoor air filter grille (return).
2. Cool refrigerant inside coil absorbs heat from blowing air.
3. Cooled indoor air is returned to the home.
4. Heated refrigerant flows to outside unit.
5. Compressor squeezes refrigerant to make it hotter.
6. Fan uses outside air to cool the hot refrigerant in coil.
7. Cooled refrigerant returns to indoor unit.

- A geothermal heat pump works in much the same way as an air-source heat pump. The difference is that the geothermal unit harvests heat and releases heat to a water loop of polyethylene pipe buried underground. Geothermal systems have a higher initial cost but a lower operating cost.

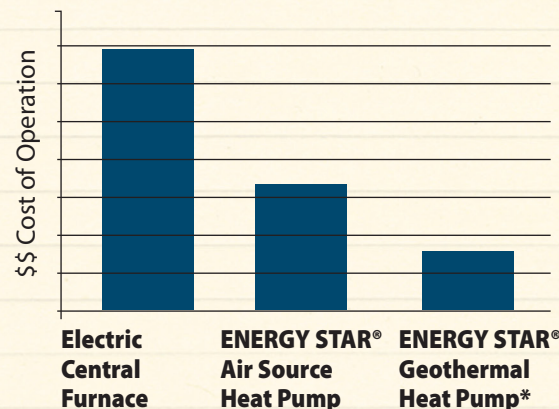
Efficiency and ENERGY STAR

- Select a heat pump with the ENERGY STAR® label for efficiency. Higher efficiency ratings mean lower operating cost.
- Ask your heating/cooling contractor for a Manual J load calculation to size your heat pump. Over sizing can cause comfort and condensation problems.
- See the page labeled Construction Terms for definitions of efficiency ratings such as SEER, HSPF, EER and COP.

Why should I avoid an electric furnace?

An electric furnace or strip heat uses more electricity and therefore is much more costly to operate. This form of electric heat is NOT recommended. Install a heat pump instead. Heat pump operating cost savings will provide quick payback to cover additional upfront cost.

ELECTRIC HEATING COST



**Significant additional water heating savings for geothermal should be considered. Savings and cost of operation for all systems will vary.*

AIR SEALING

Air sealing the home “envelope” and sealing air distribution ducts are two important measures for energy efficiency and indoor air quality. The greatest air leakage paths are at the perimeter of the floor line and in air distribution ducts/returns. Air leakage also occurs at penetrations for plumbing, lighting, wiring and around chimney chases. Conditioned air leaking from ducts into the attic or crawl space can cause the entire house to draw outside air. This replacement air must be conditioned on a continuing basis, increasing energy use.

Products for sealing air leakage in home construction include foam sealant for wiring holes in the top plates of walls; caulk for cracks and crevices; weather-stripping for doors and attic hatches; and backer rod or rope caulk for filling window/door shim spaces. Use of some high expansion foam sealants around windows and doors will void the warranty. Read carefully. Sole plate sealers, rolled products to place where the foundation meets the perimeter framing, are now widely available. Metal flashing and fire-rated caulk can be used to seal the chase area around the chimney flue at the attic floor. Outlet/switch plate sealers on exterior walls also help control leakage.

If you want to plan ahead for air leakage testing after construction of your new home, contact a third party home energy rater or auditor. See the Building Performance Institute and the Residential Energy Services Network listed under *Online Resources*.



INSULATION

Where to Insulate

The entire barrier between the outside air and the inside conditioned air should contain insulation. The wall area behind a bath tub or shower enclosure on an exterior wall is most often neglected. That wall must be insulated prior to the arrival of the insulation crew and prior to installation of the tub enclosure.

Some insulation products perform double duty by air sealing and insulating in places where they are applied. As the thickness of an insulating material increases, so does effectiveness or R-value. However, if air flows through the insulation, or finds a pathway around the insulation, the insulating effect is greatly reduced. That's why air sealing the building envelope before insulating is important.

Types of Insulation

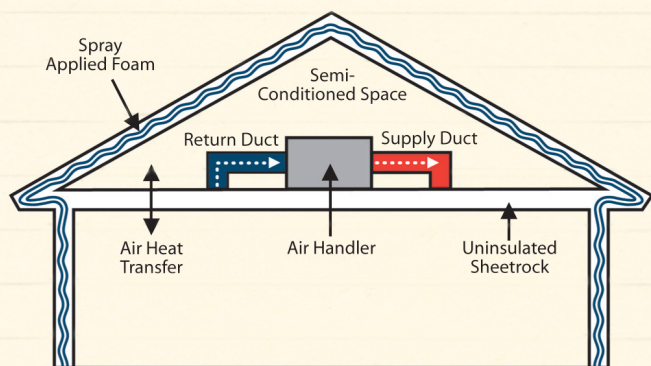
Cellulose: R-value is approximately 3.4 to 3.8 per inch. Cellulose, which is made from recycled newspaper, is blown damp into open wall cavities and sometimes blown dry in the attic. Boric acid, an additive in cellulose insulation, increases fire resistance, repels insects, and helps prevent mold growth. Cellulose should be blown at a density of around 3 to 3.2 pounds per cubic foot to help prevent settling and for enhanced air sealing. Refer to the coverage chart on each bag and know how many bags are installed.

Fiberglass: R-value for batts is approximately 3.1 to 4.3 per inch. Manufacturer installation instructions must be followed because compression of batts will cause a reduction in R-value. For blown insulation, see the R-value charts on insulation bags. Be sure to measure R-value by the number of bags installed per 1000 square feet of attic because blown insulation can fluff and settle.

Fiberglass insulation provides little reduction in air leakage, but when combined with extensive air sealing practices can be very effective. Some new methods of installing fiberglass include a more dense high R-value application using an adhesive binding agent and a nonwoven fabric for retention.

Spray-in-place foam: R-Value ranges around 3 to 4 for open cell foam and around 6 to 7 per inch for closed cell foam. Foams have high R-values for insulating and have excellent air sealing properties. However, spray-in-place foam has a higher initial cost. An emerging construction practice approved by the International Code Council is to install spray foam insulation between roof rafters overhead in the attic and on attic walls. This creates a conditioned, unvented attic space called an encapsulated attic. The Comfort Advantage requirement for encapsulated attics has been reduced to R-20 (actual R value). When attics are encapsulated with foam, there is no need for insulation on the attic floor. Flammability and combustion characteristics of foam products vary according to the chemical formulation, combustion temperature, and available air. See applicable building codes.

Unvented Encapsulated Attic



Unvented Encapsulated Attic (or cathedralized attic): This building practice allows efficient placement of heating/cooling air handling equipment in the attic. The equipment in this conditioned attic operates more efficiently than equipment in an unconditioned vented attic.



WINDOWS, DOORS AND SKYLIGHTS

For energy efficiency and comfort, select ENERGY STAR windows, doors, and skylights labeled for your climate zone. The southern most part of Mississippi is in the southern climate zone. Areas around and north of Hattiesburg, Mississippi approach the south central climate zone.

To qualify for the extra benefits of Comfort Advantage Plus, select a window with a Solar Heat Gain Coefficient (SHGC) of .35 or lower. This ensures additional protection from solar heat entering the home. See the page labeled Construction Terms for definitions of window efficiency ratings. See Online Resources for more information.

Thermal breaks in the frame and warm edge technology for the glass both help prevent condensation in winter. Chronic condensation can damage sills, damage insulation, and cause paint to crack, encouraging mold growth. Metal window frames without thermal breaks are most prone to condensation.

LIGHTING AND APPLIANCES

ENERGY STAR qualified lighting provides warm bright light but uses 75 percent less energy and produces 75 percent less heat. Both bulbs and lighting fixtures displaying the ENERGY STAR label can be found at retail building supply stores. Approved fixtures will come packaged with the appropriate bulb, so that consumers will know which products to purchase for replacement.

ENERGY STAR appliances meet rigid efficiency requirements saving 10 percent to 50 percent on energy used. ENERGY STAR clothes washers and dishwashers use less water. Washers with this label remove more water from clothes, so that drying time is reduced. ENERGY STAR refrigerators use 40 percent less energy than the ones sold as recently as 2001.

The most efficient water heating is provided as a benefit of a geothermal heat pump used for heating and cooling your home. Electric storage tank water heaters should have an energy factor of .90 or above and should have heat traps. For more information, see the *Online Resources* listing here for water heater directory. Electric tankless water heaters are not recommended and do not qualify for the Comfort Advantage home program except for very small units in seldom used remote locations such as utility buildings.



ABOUT MOISTURE

Moisture penetration of walls and other building components is the most common cause of failed construction. Wet insulation is worse than no insulation at all. For further information, see *Online Resources - Building Science Consortium*.

For moisture management, pay attention to

- Properly applied flashing on windows and doors
- Proper application of house wrap (See manufacturer instructions)
- Efficient window selection and installation according to manufacturer specifications
- Sizing of heat pumps according to Manual J load calculation (Over-sizing creates high humidity.)
- Avoidance of vinyl wall paper (to prevent trapped moisture)
- Avoidance of polyethylene sheeting except as ground cover in crawl spaces
- Avoidance of foil backed gypsum (sheetrock) for the interior
- Proper drainage around foundation

HOME CONSTRUCTION TERMS

ENERGY STAR® is a United States government-backed symbol for energy efficiency. Look for the ENERGY STAR label on construction products, appliances and heating/cooling equipment.

ICAT (Insulated Ceiling Air Tight) is a rating for recessed can light fixtures. ICAT indicates air-tight fixture design for insulation contact.

R-Value is a rating for insulation efficiency. Higher ratings are better.

Low E is a window coating that reduces radiant heat flow for energy efficiency.

SHGC (Solar Heat Gain Coefficient), a window rating, tells how much solar heat enters through the window. Lower ratings mean less heat.

Thermal break is an insulating section between the inner and outer sections of a metal window frame. Thermal breaks help prevent condensation on window frame surfaces.

U-Factor is a window rating which indicates how well it prevents heat from escaping, ranging from poor at 1.2 to excellent at .20. Look for the lower number.



EQUIPMENT AND SIZING TERMS

Air-Source Heat Pump is an energy efficient, electric heating/cooling system that transfers heat between the house and the outside air.

Geothermal Heat Pump System is the most efficient heating/cooling and water heating system that transfers heat between the house and a water loop buried in the earth.

Heat Traps are valves or loops of pipe designed to reduce heat flow out of the water heater tank, when not in use.

Manual J is an Air Conditioning Contractors of America (ACCA) procedure performed by equipment contractors for sizing heating/cooling loads in homes.

Programmable thermostats can be set to automatically adjust heating/cooling temperatures while you are away or while you are sleeping.

NOTE: Electric whole-house tankless water heaters do not qualify for the Comfort Advantage Program. Small point-of-use tankless units may be used for remote sinks, such as pool houses or utility sheds.





EFFICIENCY RATINGS

Energy Factor is an efficiency rating for water heaters. Higher ratings are better.

HSPF is a measure of a heat pump unit's average heating efficiency throughout the heating season. Range is 8.2 to around 13 with higher being better.

SEER is a measure of the heat pump unit's average cooling efficiency throughout a cooling season. Range is from 14 to around 25. Higher numbers mean greater energy savings.

EER and COP are the primary efficiency ratings for geothermal heat pumps. The approximate range for closed-loop geothermal system cooling efficiency is less than 14 to 40 or greater. The COP for closed loop heating efficiency ranges approximately from 2.5 to 5 or more. Higher numbers mean more energy savings.

ONLINE RESOURCES

- **Home Energy Magazine**
www.homeenergy.org
- **Journal of Light Construction**
www.jlconline.com
- **Check out your local electric power association's website** for more information on constructing an energy efficient home.
- **Building Science Corporation**
www.buildingscience.com
See Bookstore (Controlling Moisture and Builder's Guides).
- **Doug Rye**
www.dougyrye.com
www.philliprye.com
Architect; Energy efficient house plans or energy analysis of your house plans.
- **ENERGY STAR®**
www.energystar.gov
Click "Energy Efficient New Homes."
- **Geothermal Heat Pump Consortium**
www.geoexchange.org
Learn about the most efficient form of heating, cooling and water heating available.
- **Lawrence Berkley Lab whole house calculator**
www.homeenergysaver.lbl.gov

- **Building Performance Institute**
www.bpihomeowner.org
- **Residential Energy Services Network**
www.resnet.us/
- **Southface Energy**
www.southface.org
See Green Building Services.
- **Tax Incentives for energy efficiency purchases and homes**
www.energytaxincentives.org
- **Water heater and heat pump ratings directory**
www.ahridirectory.org/
- **Window overhang analysis calculator**
www.susdesign.com/overhang_annual
- **Window selection**
www.efficientwindows.org
- **Windows listing with ratings - National Fenestration Rating Council**
www.nfrc.org

NOTES

