



BUILDING IN ALASKA

Tips on Insulating an Existing House

EEM-04452

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As a "first cut" evaluation in deciding what items are most worthy for energy efficient retrofits, start with the "**Low-Energy Retrofit-Priority Checklist**" which is adapted from the Environmental Building News (July 2007.)

This checklist assumes that you are starting with a fairly standard existing house relative to energy features: for example, an uninsulated basement: 2x4 walls insulated with R-11 fiberglass; a flat ceiling insulated with R-19 fiberglass; insulated-glass windows or single-pane windows with storm windows; a relatively leaky 5-7 air changes per hour at 50 pascals (ACH50), and an atmospherically vented furnace or boiler. Within each category, the checklist starts with easy, low-cost measures, and includes progressively more costly or difficult measures. Note that some later measures obviate the need for earlier measures, so this should not be considered a step-by-step action list. When the starting conditions are different—a better-insulated house or a house with no insulation at all—the cost-effectiveness of different measures will differ, but many of the strategies will still be applicable.



HOUSE ENVELOPE	
Air-seal foundations and attic	Identify and seal major holes in the foundation and attic; patch holes in ducts through unconditioned spaces.
Fix moisture problems and insulate basement walls	Identify and repair any moisture problems (including drainage and site-moisture problems) in the basement or crawl space and, insulate walls (R-15 to R-20) if walls are suitably flat, with high-density EPS or XPS board insulation. Cover insulation with non-paper-faced drywall if the basement space is being finished, or other durable protective surface.
Air-seal the house	Hire a weatherization contractor or energy auditor to locate (using a <i>blower door</i>) and seal cracks and leaks in the house envelope, especially at floors and ceilings. Weatherstrip windows and doors. Note that tightening a house often causes higher moisture levels indoors that may have to be dealt with. Radon levels should also be closely monitored.

Add insulation in attic	Air-seal the attic first! Install additional insulation (e.g., cellulose) on top of existing insulation in the attic floor. Depending on existing conditions, it may be necessary to remove the attic floor to expose joist cavities to fill with insulation. In general, it is cost-effective to add more insulation than can fit in the joist cavity; additional insulation can be added on top of the floor, or the floor can be raised using cross joists to increase cavity thickness. If existing insulation is removed prior to installing new insulation, air-seal the exposed ceiling from above prior to insulating.
Upgrade windows	Replace existing windows with tight-sealing, double- or preferably triple-glazed, low-e windows or storm windows on either the interior or the exterior of the prime windows. When upgrading windows or adding storm panels, address moisture control and drainage. Consider different glazings for different orientations to exclude some of the unwanted solar gain.
MECHANICAL SYSTEMS	
Tune heating and air conditioning systems	Tune up equipment and inspect controls to ensure that mechanical systems are working at top efficiency. Replace air filters in furnaces and heat pumps.
Insulate water heater	Insulate storage-type water heaters, even newer models, with an insulation blanket. Electric water heaters can be covered more completely; gas water heaters require that areas be left uninsulated to provide for combustion air supply. Also insulate hot-water pipes to slow the cooling of hot water in the pipes.
Reduce hot water demand	Install low-flow showerheads and faucet aerators to reduce hot water demand. When there are long hot-water piping runs, install on-demand recirculation systems to reduce losses.
Replace furnace or boiler	Replace atmospheric-venting furnaces or boilers with new, sealed-combustion (or power-vented) high-efficiency models.
Install mechanical ventilation	Many energy retrofit measures will increase airtightness to the extent that poor air quality and condensation problems from excessive indoor humidity may occur. To remedy this, install a mechanical ventilation system or a heat-recovery ventilator to capture heat from the exhaust air stream.
HOUSE INTERIOR	
Replace incandescent lights	Install fluorescent or LED lighting as an energy-saving alternative to incandescent. Compact fluorescent lamps (CFLs) easily replace incandescent light bulbs; linear fluorescent fixtures (specify electronic ballasts and T-5 or T-8 lamps) can provide indirect lighting. Lighting energy savings can also be achieved with better controls, including occupancy sensors, and task lighting that replaces area lighting.
Upgrade appliances	Buy a plug-in energy-use meter to judge the efficiency of appliances, and replace inefficient equipment. A new refrigerator, for example, may use just a third as much electricity as one from the 1980s. Recycle old refrigerators rather than keeping them for back-up use. Some utilities in Alaska make these energy use meters available to customers.
Turn off the TV	Really turn it off. Many—but not all—televisions and other entertainment equipment continue to use power even when "turned off." To be sure that the equipment is really off, put it on a power strip and get in the habit of switching that off when equipment is not being used. When buying a new TV, consider both the standby and the operating power consumption. Be aware that digital recording devices, such as TiVo, tend to draw significant power (25-35 watts) even when not recording, and they are typically left on 24/7 to be ready for reset recording.

Turn off cable modems and routers	Internet connection equipment, including cable modems and wireless routers are significant electricity users in many homes—often surpassing even televisions. If doing so will not interrupt crucial services like phone service, plug these devices into power strips and switch them off at night and when the house is unoccupied.
Practice a low-energy lifestyle	Homeowners should be encouraged to alter their lifestyles in ways that reduce energy use by limiting water use, turning off lights when not in the room, making use of task lighting, etc. Also, carefully consider the need for any proposed addition and its impact on the occupants' total energy consumption.

Once you have selected those items from the priority list, you may want to seek a professional energy audit to get a better idea of the energy use at present and the value of the energy savings. A list of energy raters is available at the Alaska Housing Finance Corporation Web site: www.ahfc.state.ak

Before proceeding to do energy efficient retrofits, carefully review the following sections by building element to be sure you understand the necessary details required to do a "best practices" job. Sequencing of vapor barriers, placement, careful installation of insulation to eliminate voids, use of appropriate caulks and sealants, selection of materials, and material compatibility are all crucial details which when done right ensure a very satisfactory energy efficient result.

Understanding of the house as a system is very important to taking the correct and effective steps in a retrofit. A good review of building science concepts describing how a house works can be found in Chapter 2 "Building Science" of the *Alaska Residential Housing Manual* (© 2007 AHFC), which is available in either hard copy or CD from the Cooperative Extension Service 474-5211. Important cautions are knowing where to place vapor barriers to prevent moisture problems, understanding heat flow, and properties of various insulations. All these concepts and properties are covered well in the *Alaska Residential Housing Manual*.

Ceiling

Lack of ventilation and vapor barrier in the ceiling is often evident by moisture stains and water leaking out of electrical outlets during the spring thaw. Glaciering at the eaves is another sign that warm air is leaking into the roof cavity or that it is inadequately insulated.

The following steps should be taken if additional insulation is installed in the ceiling.

1. Lift the existing insulation and check for the existence of a vapor barrier. The vapor barrier usually consists of a clear sheet of polyethylene (Visqueen). Older houses may have a double sheet of rosin paper cemented to an asphalt coating. Sometimes the rosin paper may be coated on one side with a thin sheet of aluminum foil. The vapor barrier must be securely fastened under the ceiling joists to be effective. The aluminum foil cemented onto a rock lath is not adequate because the joints are not sealed. All air sealing should be completed BEFORE any new insulation is added to the attic.
2. If there is no vapor barrier evident, then a vapor barrier must be installed before placing any type of insulation. Vapor barriers may be installed using the following guidelines.
 - a. There is no satisfactory technique for installing and sealing a polyethylene sheet between the joists. If urethane is used without an additional vapor barrier, specification of water vapor permeability of the urethane should be provided by the applicator in writing. It is best to use a polyethylene vapor barrier for urethane foam applications.
 - b. If any loose fill (cellulose, mineral wool, fiberglass) insulation is used, a 6-mil polyethylene sheet must be installed on the underside of the ceiling and sealed along the seams and edges with non-hardening caulking compound. Then, 1 inch x 2 inch nailers should be installed under the vapor barrier. These may be covered with acoustical tile or sheet rock.

- c. Where possible, all openings around plumbing vent stacks, plumbing walls, electrical wiring, lighting fixtures and chimneys should be tightly sealed against water vapor and air migration into the roof cavity. Recessed lighting fixtures should be removed and the opening tightly sealed against warm air and water vapor leakage. Inspect exhaust fans located in the attic before installing insulation. Replace if needed (very likely).
- d. All access openings and stair wells from the interior of the house into a cold roof cavity or attic should be tightly sealed against migration of warm air and water vapor. Access openings into a cold attic should be placed in the gable ends of the roof rather than in the ceiling.
- e. When placing additional insulation in the roof cavity, special precautions must be taken not to restrict air movement over the insulation at the eaves, particularly with trusses constructed of 2 inch x 4 inch top and bottom chords. It may be desirable to place a 2 inch x 24 inch strip of rigid urethane under the eaves instead of blanket, batt or fill insulation. New products are available for this purpose, also.
- f. The plate (top) of interior partitions should be vapor proofed with vapor resistant paint and the edges sealed with caulking, when no other vapor protection has been provided.

Stud Frame Wall

Lack of insulation in a wall may be evident by blistering of paint on exterior siding, frost or condensation behind furniture and drapes, or staining of sheet rock nailheads.

Follow the steps listed below to insulate an existing wall.

1. Remove a section of exterior siding and sheathing in several locations and determine if the wall is insulated and/or vapor proofed. No insulation should be blown into the wall until it is properly vapor proofed.
2. The wall may be vapor proofed by installing a 6-mil polyethylene sheet over the existing interior wall covering. The vapor barrier should be sealed at all edges and seams. The polyethylene may be covered with sheetrock or paneling.

Cont'd on page 5.



Figure 1. This photo shows several aspects of a house, which is poorly insulated at the studs such that you see condensation and mold not only at the top of the wall where the wall plate is, but also in the corner and at each stud. This is an extreme example of a phenomenon called "ghosting of the studs" where the surface of the wall on the inside of the stud is cooler and therefore condenses out moisture and other vapors on the cool surface first. In the case shown, the problem is fairly horrible with the resulting mold on every cool surface of the inside of the building. Retrofit would solve this by insulating on the exterior or the interior and using good vapor barrier sealing to keep moisture from getting to cold surfaces. The existing condition may also be a result of a fairly tight air seal causing exceedingly high relative humidity levels in the building. Photo by Scott Waterman.



Figure 2. A photo by the author of his own house retrofit showing both the exterior wall being framed in and a new superinsulated window being installed in the rough opening of the old wall. Both of these are examples of how to retrofit both windows and walls with more insulation and a better performance window. The superwindow is described in the Fall 2005 issue of the *Alaska Building Science News*. It is a fiberglass framed quad-pane, krypton-fill window, 10 feet wide and 5 feet high with a measured R-value at approximately -20°F of 13.25 over a 36-hour period.



Figure 3. Shows another detail of the author's home in the final retrofit stages. The wall is being covered on the exterior with Tyvek® homewrap and the siding then installed such that cellulose insulation can be sprayed in the wall cavities and below the windows as the siding is attached. The finished wall is then sealed and the insulation is contained by the Tyvek® on the exterior. This system worked extremely well but it only worked well because the new window openings were sealed with foam sealant and the vapor barrier caulked to the inside of the window frame. The vapor barrier itself was of good quality, and had the confidence of the retrofit team that it did indeed stop most of the moisture at the inside wall. These two photographs (Figures 2 and 3) are indications of one way to amply retrofit a wall of a house to achieve a good result. The wall shown in Figure 3 resulted in approximately an R-27 wall when it was originally about R-11. This nearly tripled the insulating value of the wall.

3. The interior of the wall may also be vapor proofed by a vapor resistant wallpaper. Regular vinyl wallpaper may be waterproof and washable, but not necessarily vapor proof. The permeability should be specified by the manufacturer and not be greater than 0.750 perms.
4. After the wall has been properly vapor proofed, mineral wool or cellulose may be blown into the wall through 1 ½ -inch to 2-inch plugs cut through the exterior siding and sheathing in every cavity between the studs. Cavities under windows should also be insulated.
5. A more expensive and drastic method is to remove all interior wall covering, place 3½ inches of insulation between the studs, cover with 6 mil polyethylene and then install new gypsum board or paneling.

Basement

An uninsulated basement can cause a large portion of the heat loss in a house. Heat loss may be evident by melting of snow along the foundation wall.

The following steps may be taken to insulate a basement of an existing house.

1. It is always more effective and less likely to cause basement moisture problems if the basement is, and can be insulated on the outside of the wall, and below grade (below the soil surface). There are excellent extruded polystyrene rigid board insulations which are ideal for this application. Insulating basements and heated crawlspaces from the outside prevents moisture problems, and keeps inside wall surfaces warmer and dry. It is highly preferable to any interior insulation on basement walls, and should be the preferred option whenever possible. Always protect the outside surface from physical damage and insects with a permanent protective sheathing.
2. The basement of an existing house may be insulated from within by installing 2 inch x 4 inch nailers at 16-inch centers on the wall. Place 2 or 3½ inches insulation between the nailers. Over this place a 6 mil polyethylene vapor barrier. The vapor barrier may be covered with gypsum board and suitable paneling.
3. Foamed plastic may be sprayed between the nailers. However, a polyethylene vapor barrier should be placed over the insulation and nailers. Also, rigid foam plastic insulation board may be used.

Closed Crawl Spaces

A masonry crawl space of a home can account for 45 per cent of the heat loss depending on the temperature required to maintain a warm floor surface temperature. Heat loss is often evident by melting of snow along the foundation wall.

The guidelines below may be used to insulate a closed crawl space.

1. Excavate a trench along the wall to the depth of the footer for placement of insulation. Attach 2 or perhaps 3 inches of rigid polystyrene or urethane board on the interior of the masonry or concrete foundation wall depending on the severity of the climate. Sprayed-on urethane may also be used on the exterior of the foundation, as can extruded

polystyrene. Spray on foams need durable protective sheathing to keep from damaging the foam.

2. The foundation vents should be replaced with permanent closures.
3. For additional comfort and fuel savings, the floor of the crawl space may be covered with a 2 inch layer of rigid polystyrene. A 6 mil polyethylene vapor barrier should be placed under the insulation. The insulation should be covered with 4-to 6-inches of sand and gravel. This system also can aid in reducing radon induction into a crawlspace or basement.

Floors Over Unheated Crawl Spaces

A floor over an unheated crawl space should be provided with as much or greater insulation than the ceiling, since it is the closest surface upon which we work, play and relax during waking hours. However, it is still not possible to attain an ideal floor temperature without installing insulated skirting around the foundation, which must be done with extreme caution in permafrost zones.

Slab-On-Grade

Slab-on-grade is not recommended for Alaska except in a basement. Insulating the floors and foundations of a house with a concrete floor is difficult at best. Ideally, in a new home, the perimeter of the floor area should be insulated with at least 2 inches of polystyrene or urethane, with a 48 inch strip laid around the perimeter. It is very costly to provide sufficient heat to raise the floor surface temperature comparable to room air temperature. A cold floor results in stratification of air such that the thermostat must be set at 75° F to maintain a comfortable temperature at the floor. This can result in temperatures near the ceiling as high as 85° F. (See also the *Manual on Frost Protected Shallow Foundation Systems* noted on page 4.)

The following steps may be taken to insulate the foundation wall of a slab-on-grade house.

1. Excavate a trench around the perimeter of the house and install 2 inches vapor resistant extruded polystyrene high density board. The insulation should extend at least 32 inches below the surface. Foamed-in-place urethane is excellent, but it necessitates excavating a 4

foot wide trench to assure uniform foaming of insulation by the applicator. A rigid urethane or polystyrene board only requires a 1 foot wide trench to place the insulation. The foam plastic insulation above grade should be plastered or in some way protected against deterioration by ultraviolet light of the sun and mechanical damage by rodents, dogs and other pests.

2. A floating slab should be insulated by placing rigid insulation along the edges.

To insulate an existing concrete slab-on-grade, the following steps may be taken.

1. Install 2 inch x 3 inch or 2 inch x 4 inch treated (all weather wood) sleepers over the existing slab. A ¾ inch space should be left at the ends of sleepers to allow for possible expansion due to moisture adsorption.
2. The space between the sleepers may be insulated with 2 inches of polystyrene or urethane rigid board or foamed-in-place urethane.
3. A wood subfloor and/or finish flooring should be placed over the nailers. A ¾ inch clear space should be left around the perimeter of the subfloor and finish flooring to allow for possible expansion. A ¼ inch opening should be left behind or under the base molding to facilitate natural removal of water vapor that may condense out under the floor, particularly during summer when the heat may be turned off.

Exterior Retrofit of Vapor-Sealed Insulation

Insulation products with low water-vapor permeability are used for exterior retrofit of insulation. These insulations include closed-cell polystyrene foams and foil-faced plastic foams which are usually available in 2 foot x 8 foot or 4 foot x 8 foot sheets. Both types of insulation are excellent vapor barriers and, therefore, must be applied with special precautions to the exterior of structures. Otherwise, moisture could accumulate in the wall and be trapped by this new exterior vapor barrier.

Refer to manufacturer's recommended installation procedures whenever you use these types of insulation, and contact the Cooperative Extension Service at 1-800 478-8324 for further information.

The following Cooperative Extension Service publications are suggested:

EEM-00258, *Heat Loss Coefficients of Building Material*

HCM-00559, *Attics & Roofs for Northern Residential Construction*

HCM-00952, *Special Considerations for Building in Alaska*

HCM-01552, *Retrofit Insulation in Wood Roofs*

HCM-01553, *Retrofit Insulation in Concrete and Masonry Walls*

HCM-01554, *Retrofit Insulation in Existing Wood Walls*

EEM-01252, *Caulks and Sealants*

Reference

Environmental Building News, Vol. 16, Number 7, pp.18-19. July 2007.

See also Chapter 10, "Retrofit," of the latest Alaska Housing Manual, copyright AHFC, 2006.

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