



Please add your name to the sign-in sheet



Button Up 201: An In-Depth Workshop for Controlling Energy Costs





CLEAN
AIR



COOL
PLANET



Thanks to:



Made possible by a grant from the NH Office of Energy and Planning, with funding from the American Recovery and Reinvestment Act of 2009



A special thanks to the creators of the Button-Up Vermont Model produced by Central Vermont Community Action Council in partnership with Efficiency VT & the VT Energy and Climate Action Network (please refer to presentation handouts for additional credits)



Presentation and Demonstrations

- Home Energy Principles
- Buttoning Up: Finding and Reducing Air Leaks
- Buttoning Up: Insulating
- Buttoning Up: Other Techniques
- Button Up and Other Resources

Disclaimer: *This workshop is only designed to provide general information about residential energy efficiency. It is the responsibility of workshop attendees, not of Button Up, to determine the applicability of these energy saving activities. Any activities conducted outside this actual workshop are the sole responsibility of the individuals engaged in the activity. Button Up strongly encourages attendees to seek the advice of a professional before engaging in any activity that can impact the building system and/or its occupants.*

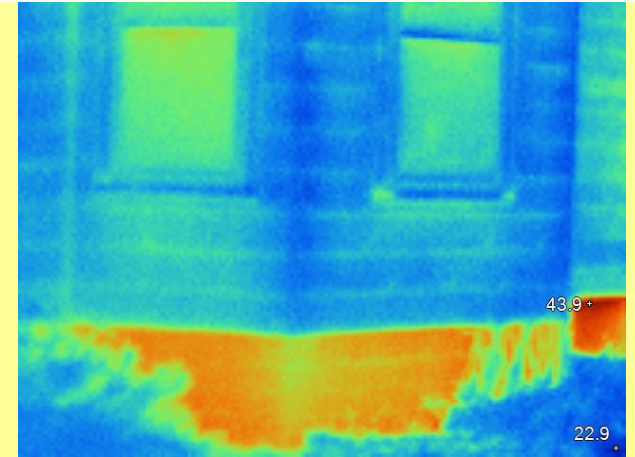


- **Simple Steps**
- **Boost Your Home Energy IQ**
- **Next Steps**
- **Utilize Button Up Resources**



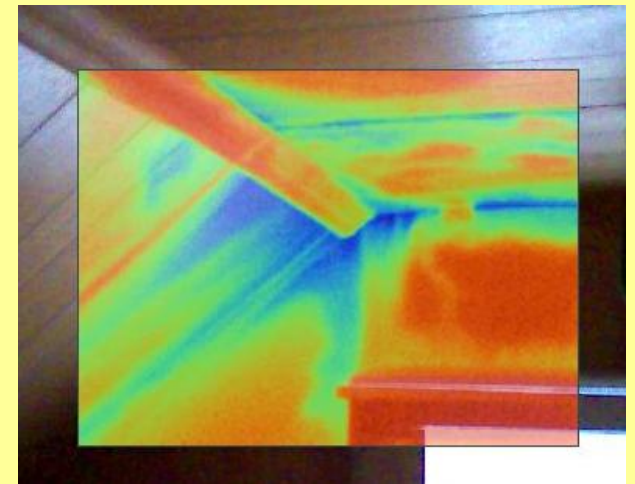
By Conduction

- Heat loss through materials -- from warm to cold
- Poor insulation = more conductive heat loss



And by Convection (Air leakage)

- Heat loss by warm air escaping high in the building,
- Pulls cold air in openings low in the building



The Building Envelope

- Energy efficient homes are wrapped in a continuous “building envelope” that connects two barriers:
- **Air Barrier** – stops air leaks that are coming through the attic and basement – “The Shell”
- **Thermal Barrier** – resists conductive heat loss – “The Sweater” – but is less effective if air flows through it
- The Building Envelope:



Energy Principles- Insulation Creates a Thermal Barrier

Loose Insulation Only \approx A Sweater

- Helps insulate
- Works well *IF* air can't move through it

- Insulation is *NOT* effective when air flows through it





Energy Principles- Houses Also Need an Air Barrier

Insulation & Air Barrier \approx A Winter Jacket

- Warm air doesn't escape
- Warmer than a sweater

Air seal *before* insulating!

- Stop heating the outdoors
- And increase insulation effectiveness



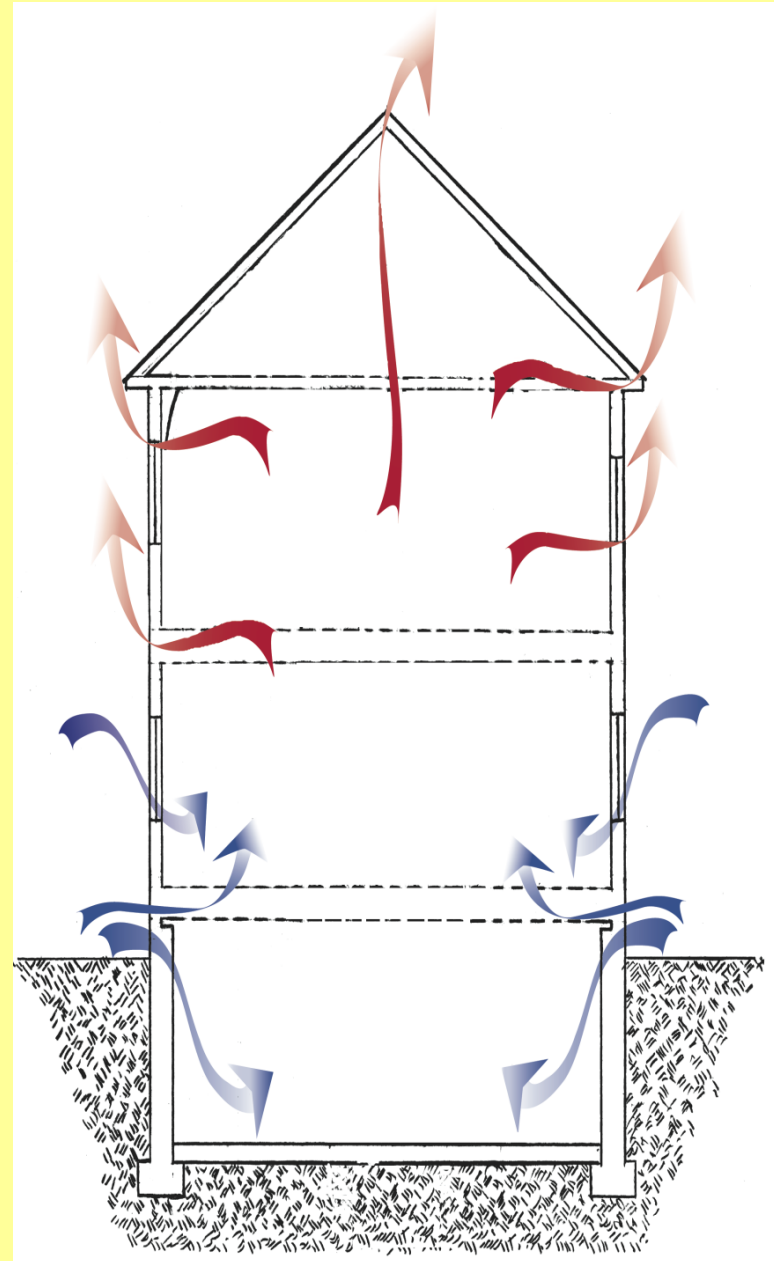
■ *Air barrier \neq Vapor barrier*

Air Leakage drives heat loss through Convection

- Buoyant warm air pushes upward and out near the top of house
- Sucks in cold air near the bottom
- Wind also adds to leakage

Stackolator Prop Demonstration

- Shows this “stack effect”



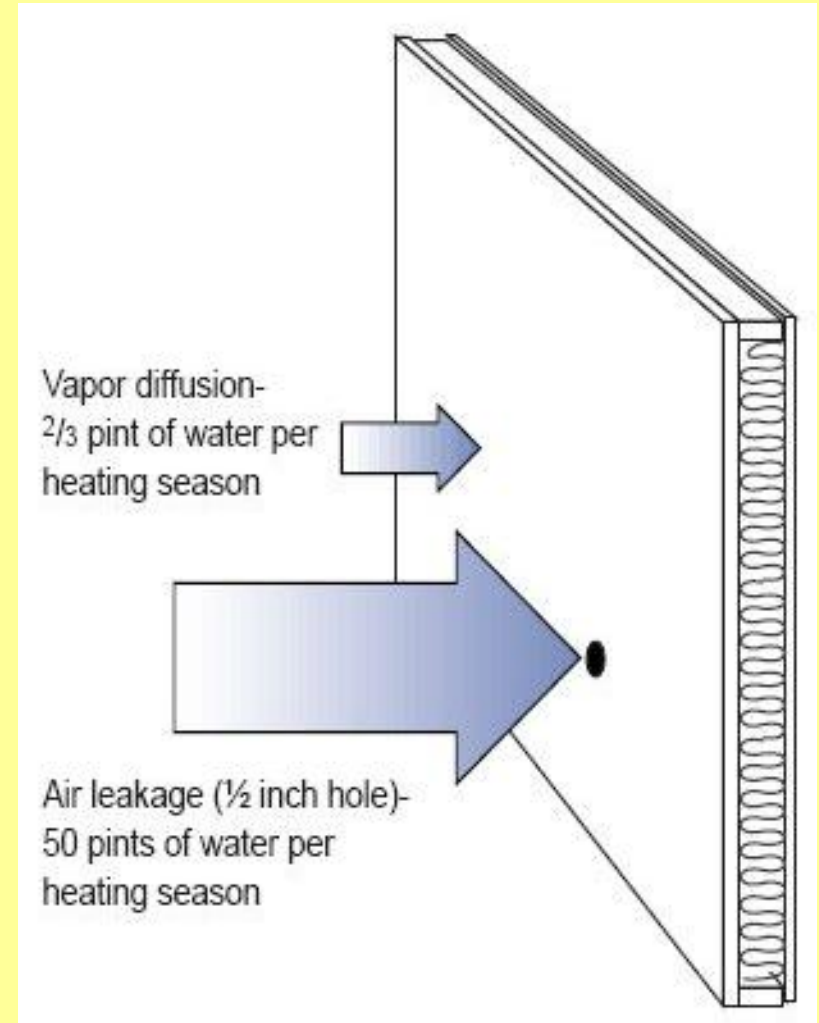
Energy Principles: Moisture and Vapor Barriers vs. Air Barriers

Focus on AIR BARRIERS

- **FACT:** In a 100-square-foot, air-sealed, unpainted drywall, over the course of a year...
- Only **2/3 PINT** of water diffused through drywall without a Vapor Barrier

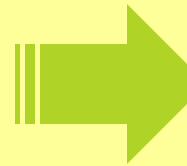
BUT...

- **50 PINTS** of water entered through a 1/2-inch-round hole



Energy Principles: Air Leakage & Internal Moisture Problems

Air exfiltration can lead to condensation



Warm air can hold more water vapor than cold air
Air leaking into attic cools and gives up moisture...

...and the moisture may condense in the attic
NOT a leaky roof
An (air) leaky ceiling!



Review- Home Energy Principles

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- The sweater and the jacket...
- Stack effect
- Air barrier and thermal barrier – what's the big deal?
- Air leakage and moldy attics...
- Demonstrations
 - The Stackolator
 - Insulation Air Display (ping-pong balls)



Button Up!

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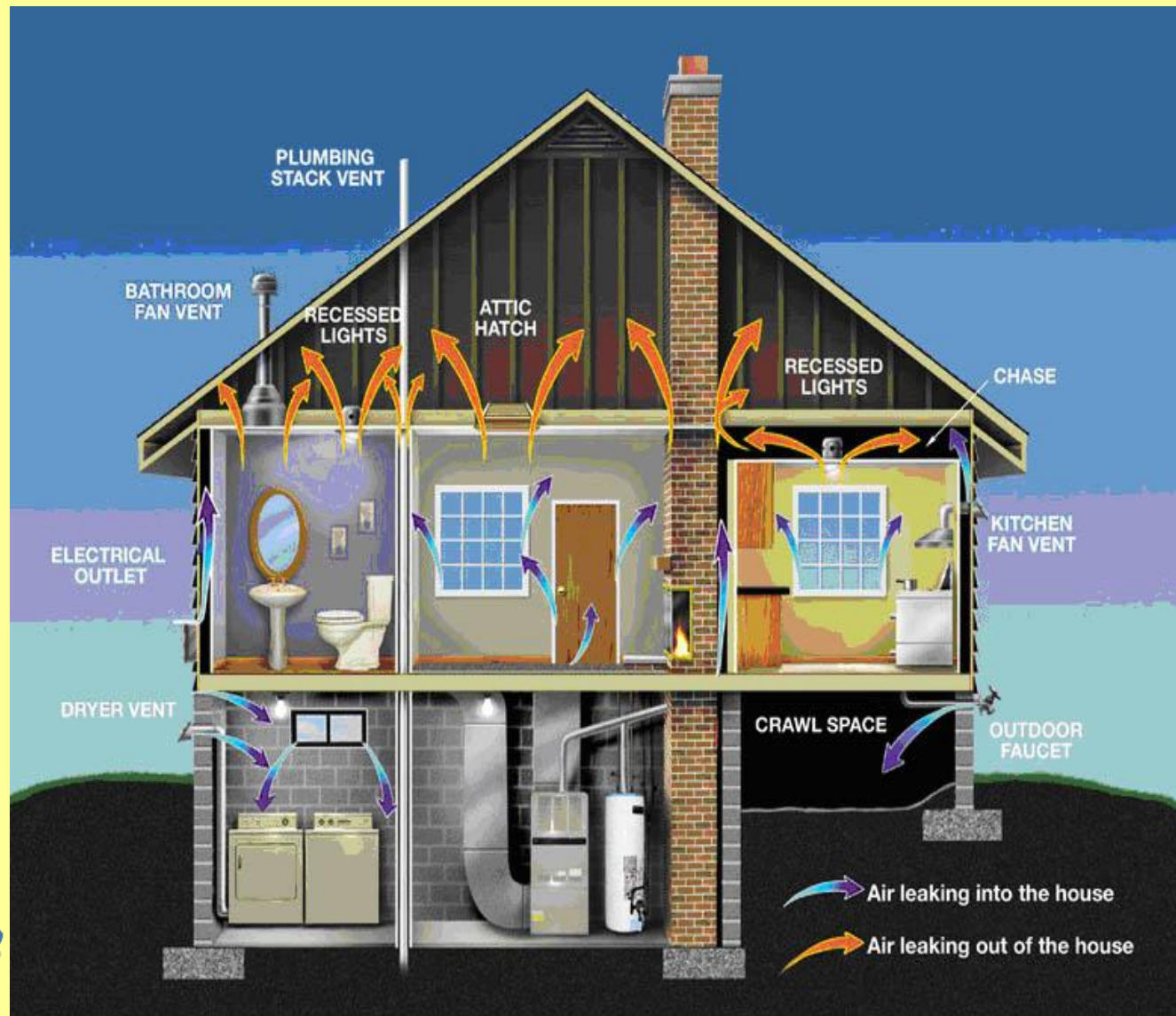
- Find Air Leaks
- Button Up in the Attic
- Button Up Elsewhere
- Insulating
- Other Techniques



Buttoning Up- Air Sealing Priorities

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Common Leaks in New Hampshire Homes



Priorities

Attic

Basement

Center



Image courtesy of US EPA



Buttoning Up- Attic Air Leakage 1

Common Leaks into the Attic #1



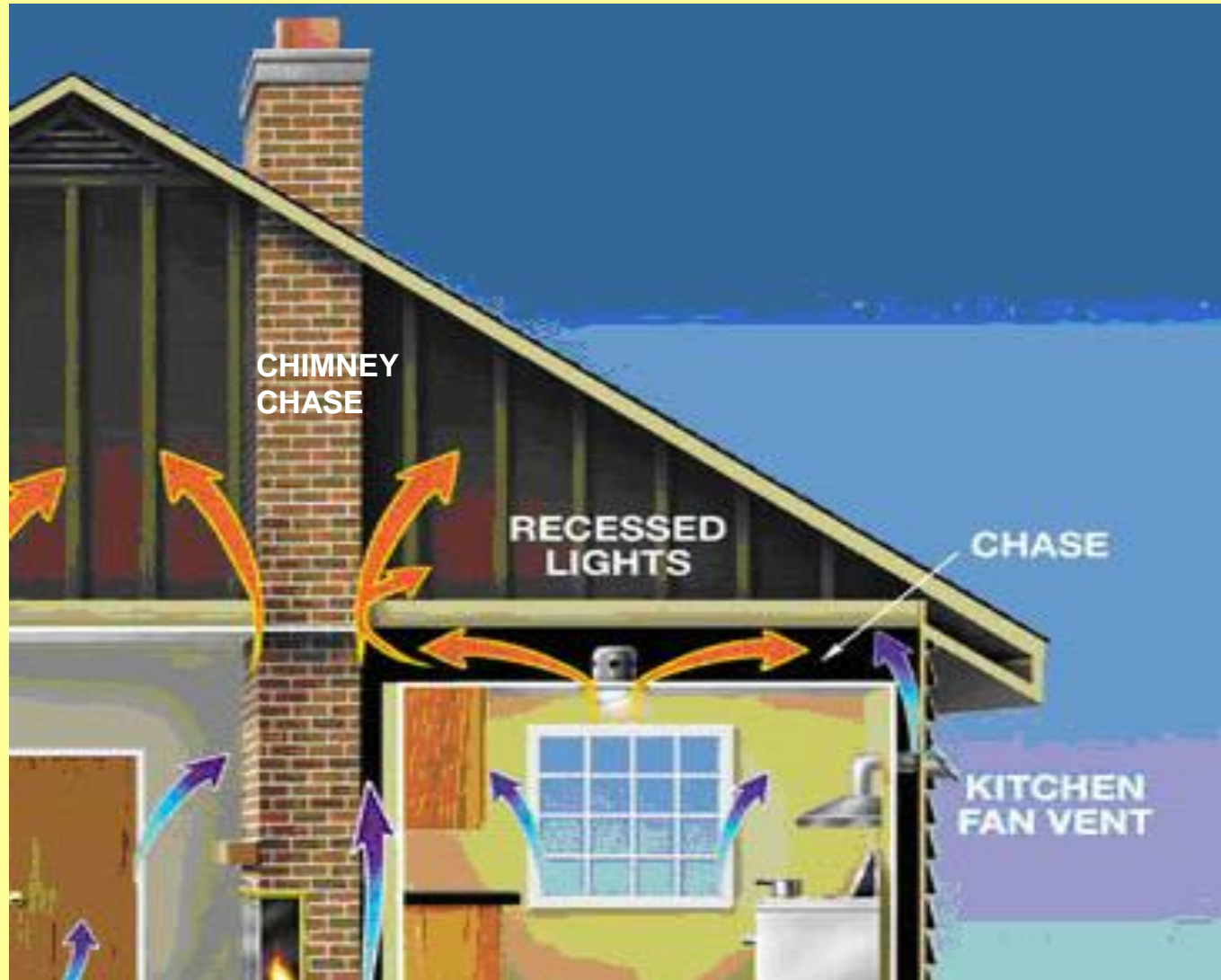
Image courtesy of US EPA





Buttoning Up- Attic Air Leakage 2

Common Leaks





Common Leaks



Finding Leaks Yourself (easier in winter)

- Look for hidden cracks and holes to outside
- On the bottom floor, feel for cool air leaking in
- On the top floor, observe incense smoke escaping out
- Look for sources of drafts near cobwebs
- Look for dirty (dust-stained) fiberglass
- Basement frozen pipes are often caused by cold air leakage



How Professionals Find Air Leaks

- The blower door test is primary tool
 - Quantifies air leakage -- “CFM₅₀”
 - Prioritizes air sealing opportunities
 - Also used to confirm air sealing
- Infrared imaging (thermography)
 - Can be used with a blower door
 - Also finds insulation voids
- Compare CFM₅₀ results with “Building Tightness Limit”
 - *Seal tight and ventilate right!*



© The Energy Conservatory

Images courtesy Patullo Consulting, Inc.

Buttoning Up- Infrared Thermography with a Blower Door

Using Infrared (IR) Thermography to Find Air Leaks



Digital Image



Infrared Image

IR image: light shades = warm; dark shades = cold
Cold air leakage at top of wall, corner and recessed light



Buttoning Up- Air Sealing

Some of the following are projects – you can do yourself. Other projects will require a professional or additional instruction. Even if you are doing it yourself, an audit can help you pinpoint your efforts.

For more advice, contact Button Up partners, learn from others, and use the resources.



BASIC

Do-it-yourself projects – possible projects for homeowners and renters



ADVANCED

Additional instruction needed or professional assistance required

Basic Air Sealing Materials



- Foam gun (with single part foam)
- Caulk (tube goo or rope type)
- Weather stripping
- Rigid foam board, sheetrock (edges fully sealed)





Buttoning Up – Attic Air Sealing

Electrical Penetrations



BASIC

Before



After



Images courtesy of Efficiency Vermont





Buttoning Up – Attic Air Sealing



BASIC

Plumbing & Wiring Penetrations / Top Plates



Cracks in top plates should also be sealed



Images courtesy of Efficiency Vermont





Buttoning Up- Attic Air Sealing

Attic Hatch



BASIC

Weather strip to create an effective seal and insulate the hatch – very cost-effective. Build a plywood dam around opening to keep insulation from falling



Images courtesy of EnergySmart of Vermont



Sealing a Pull-Down Stairs

- Needs a well-sealed and insulated box in attic
 - 4-8” of foam board (R-30+)
 - Weatherstripping and method to keep box sealed
- “Thermodome” and other ready-made options
 - Easier but...
 - May not fit perfectly
 - Still needs a flat platform to seal onto



ADVANCED

This approach doesn't work well *Why?*



Stained insulation from air leakage



Buttoning Up- Attic Air Sealing

Sealing a Chimney Chase



ADVANCED



Images courtesy of Efficiency Vermont



Sheet metal or flashing

Sealed with non-combustible caulk

Non-combustible insulation dam at least 2" from chimney



Buttoning Up- Attic Air Sealing

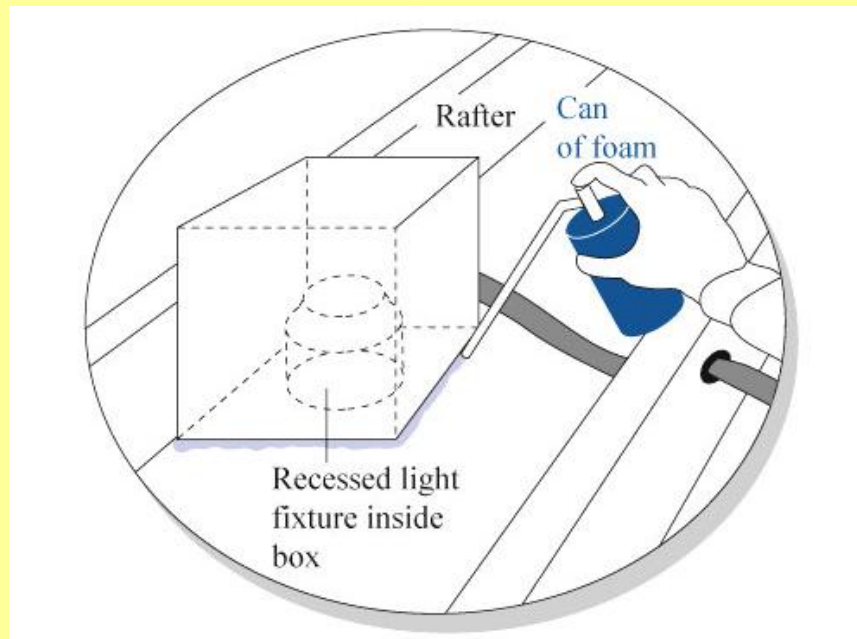
- Many older **ceiling can lights** are NOT rated for insulation contact (e.g., “Non-IC”)
- Must be either replaced with IC-AT can
- Or boxed with 3+” clearance on all sides
- Air-sealed custom drywall box



ADVANCED



Non-IC cans often are very leaky!





Bulkhead Door Air Sealing



BASIC

Highly cost effective

“Q-Lon” style weatherstrip

May require carpentry skills to seal effectively



Image courtesy of EnergySmart of Vermont



Box Sill and Foundation



- Junction of framing and foundation -- leaky
- Seal with gun foam around rigid foam
- Other basement opportunities:
 - Foundation windows
 - Plumbing and wiring penetrations
 - Miles of small cracks of the foundation



Fireplace



BASIC



ADVANCED

- Fireplaces lose more heat than they generate (in cold weather)
 - Sucks in cold outside combustion air
 - Warm air leaks out the chimney
- Close off a fireplace to create a tight seal during cold weather
- Insert inflatable “chimney balloon” when not in use
- Consider installing a fireplace insert with sealed doors



Windows



BASIC



ADVANCED

- Replacing windows – one of the least cost-effective strategies
- Many good reasons to replace windows, but energy savings is rarely one of them
- Sealing most windows costs far less than new replacements:
 - Caulk sash and trim (tube goo or rope type)
 - Air seal & insulate counter-weight cavities
 - V-seal between sashes and frames
- Window treatments options:
 - Interior storms, cellular shades, window quilts, plastic film, etc.





Air Sealing Action Plan:

- Find air leaks first – blower door very helpful
- **A**: Attic air sealing
- **B**: Basement air sealing
- **C**: Air sealing in the center

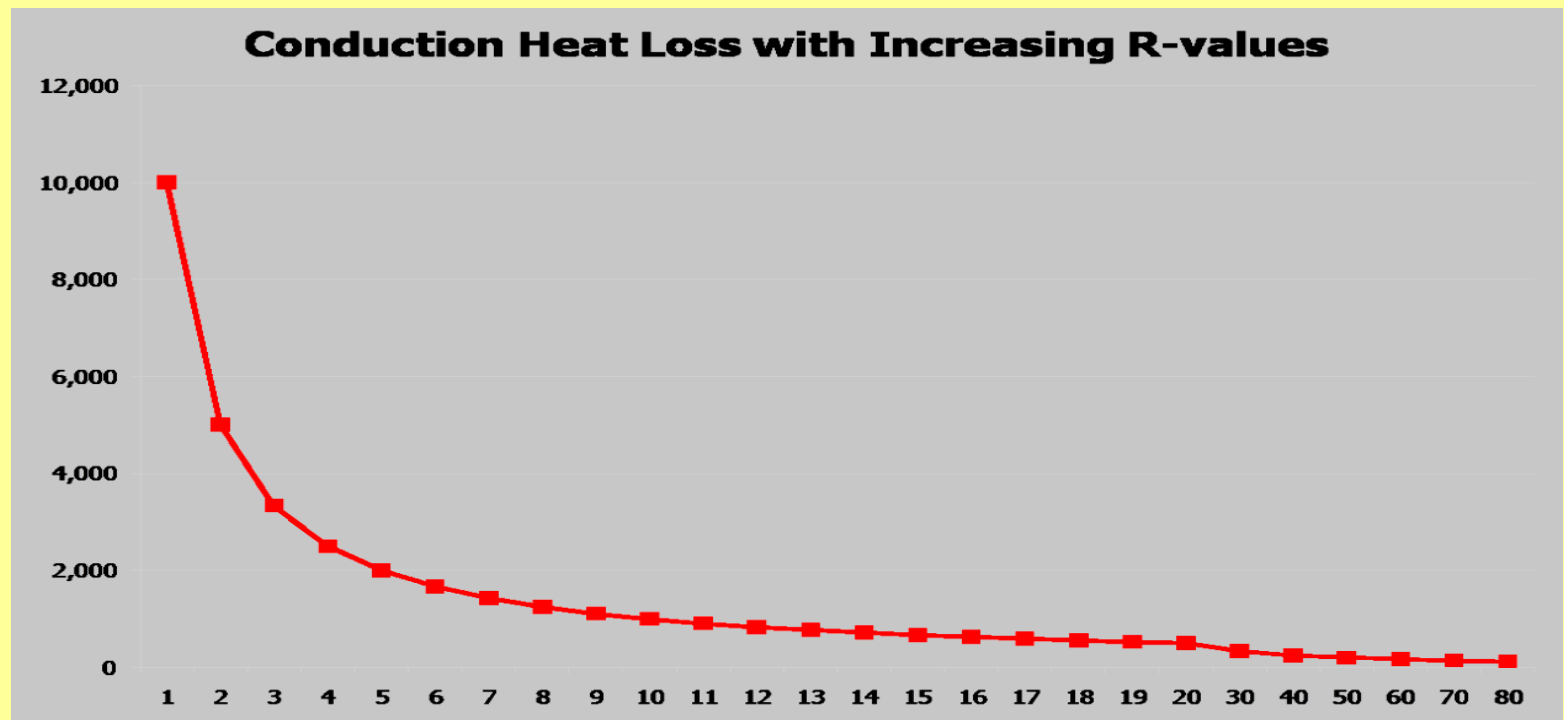
Save energy, help the planet and have fun!





Buttoning Up- Insulating

- **Conduction** is the movement of heat through a material
- **R-values** measure a material's resistance to conductive heat transfer
 - Materials with lower resistance to heat transfer have low R-values, such as glass, steel, concrete, wood, and wallboard
 - Materials with higher resistance to heat transfer have higher R-values (commonly called "insulation")





Installing Batt Insulation

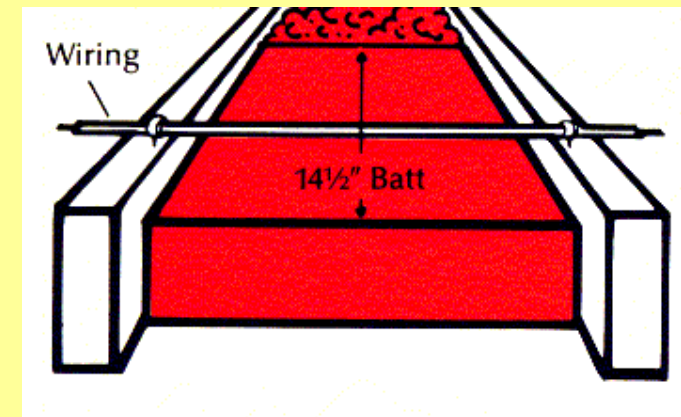
- Kraft vapor retarder on warm side
- Needs good contact with air barrier
- Fit around obstructions
- Careful installation is key – no gaps



BASIC



ADVANCED



*Scenario: Attic 95% covered with
R-38 insulation & 5% R-1 gaps*
What is the average attic R-value?

R-36 R-29 R-20 or R-13?

Tricky!

Lesson: Small areas with low
R-values can have a big impact



AFTER Air Sealing...



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- Installing **Loose Fill Insulation** in the Attic
 - Address conductive heat loss by adding insulation to achieve recommended R-values, where feasible
 - Loose fill insulation creates a uniform insulating layer

Attic blown-in
cellulose



Photo courtesy of Efficiency Vermont

Buttoning Up- Insulating

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- **Dense packing cellulose fiber** in closed cavities (wall, slope, floor) stops air movement and adds insulation in one step
- **Dense packing uninsulated walls and attics** – very cost-effective
- **Must be a minimum density:** 3.5 lbs./cubic ft.
- **Fiberglass can also be dense packed**



ADVANCED



Image courtesy of Vermont Dept. of Children and Families



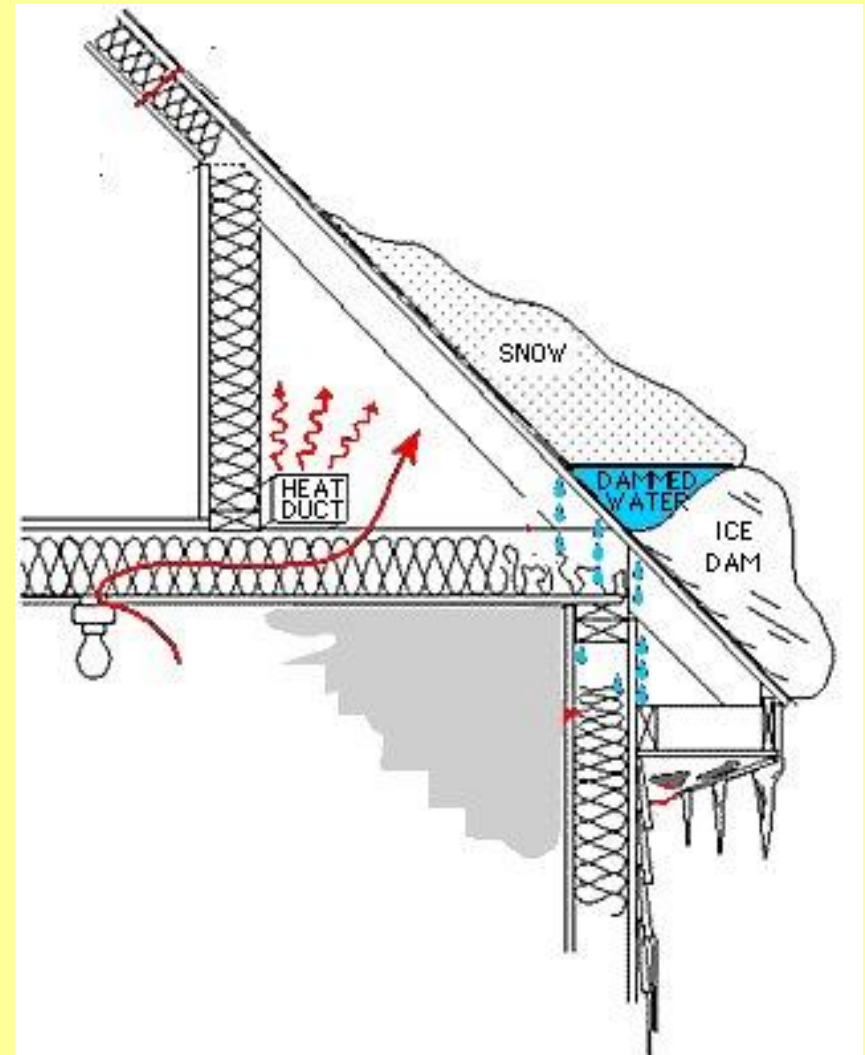
**Dense Pack Air Display
prop demo**

Knee Walls

- A thermal weak link in many cape-style houses
- Address air leakage and conductive heat loss
- Professional assistance recommended



ADVANCED





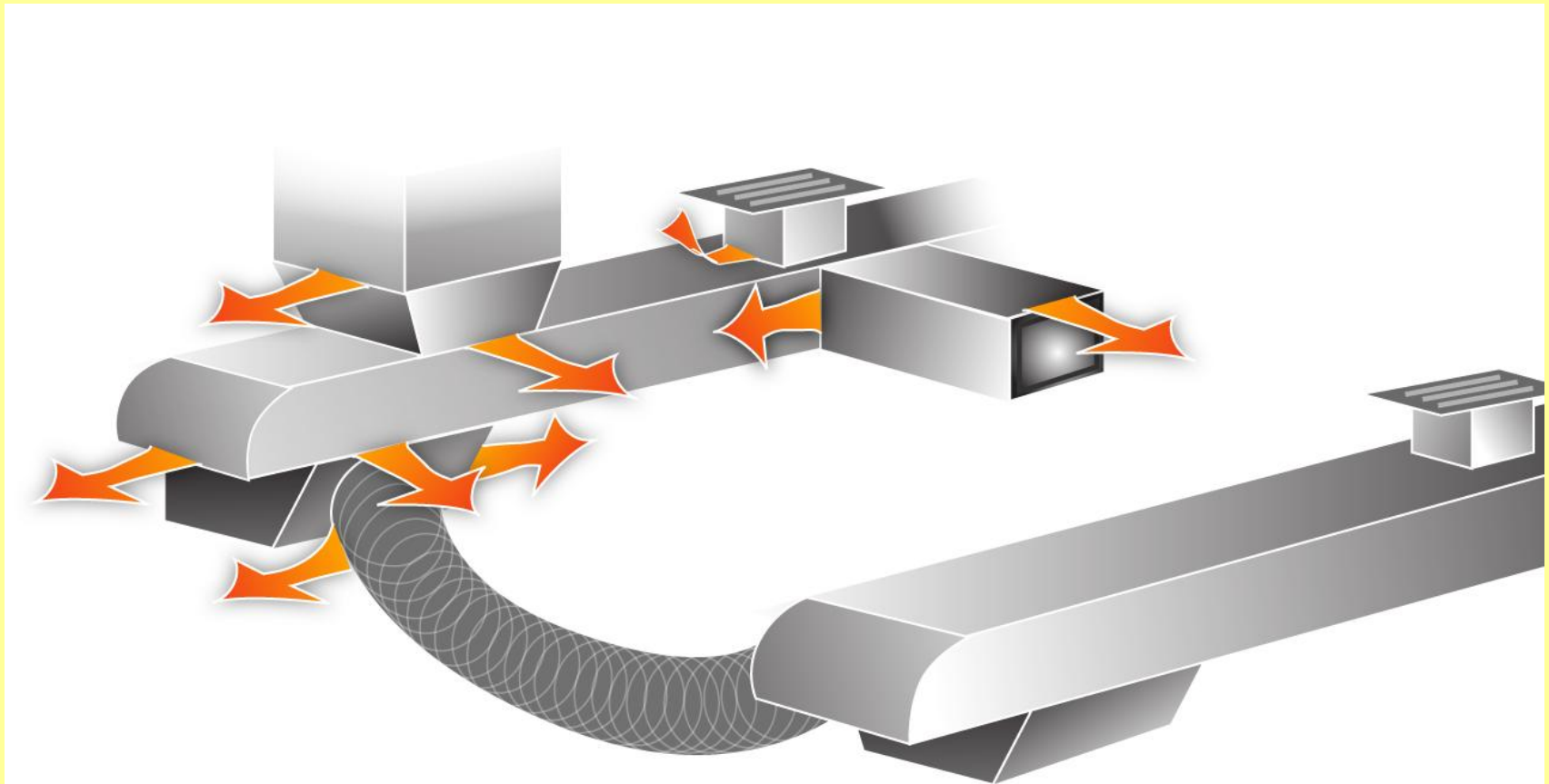
Other Tips to Button Up

- Duct sealing
- Clothes dryer venting
- Mechanical ventilation
- Health & safety issues
- Working with professionals



Common Spots for Duct Leakage

- Ducts need sealing *and* insulating
- Especially ducts in attics and crawlspaces





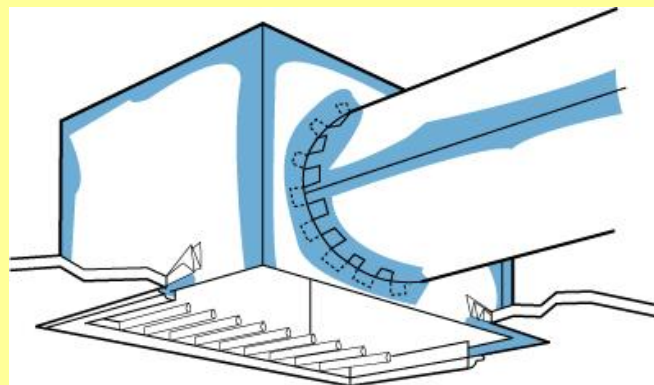
BASIC



ADVANCED

Mastic!

- Goop on to seal ducts
- Reinforce with drywall joint tape
- NOT duct tape!



“Seal Tight & Ventilate Right”

- Mechanical ventilation provides fresh air and reduces interior moisture problems
 - Particularly important for houses that have been air sealed
 - Energy professionals calculate a “Building Tightness Limit” (BTL) [aka Building Airflow Standard]
- Mechanical ventilation includes:
 - Bathroom fans
 - Kitchen exhaust hoods
 - Heat recovery ventilators (HRVs)
- How?
 - High quality bathroom fans with intelligent controls
 - Properly ducted to outdoors
 - And other more sophisticated systems...



Other Tips- Clothes Dryer Venting

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Over 12,000 clothes dryer lint fires per year in the U.S.

- Easily avoidable

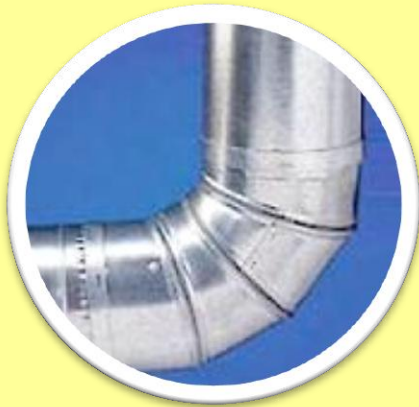




Other Tips- Clothes Dryer Venting

Use metal venting

- With a well built exterior vent hood
- Clean out lint regularly



Best:
Rigid Metal



OK:
Flexible Metal



No:
Aluminized Flex



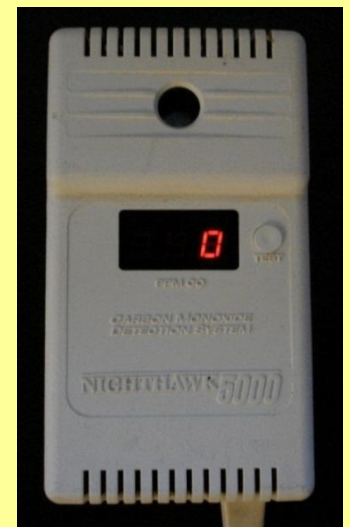
Bad:
Plastic Flex



Other Tips- Health and Safety Issues I

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- **Carbon Monoxide** – caused by incomplete burning
 - Keep heating systems tuned up
 - Install a carbon monoxide detector on each floor
- **Back Drafts** – combustion gases coming back into the house
 - Get heating systems combustion safety tested
- **Moisture** – causes health and building problems
 - Control the source
 - Mechanical ventilation
- **Radon** – causes health problems
 - Control the source
 - Special mechanical ventilation



Carbon monoxide detector



■ Volatile Organic Compounds (VOCs)

- Sources: paints, varnishes, solvents, carpets, plywood and other
- Eliminate and isolate

■ Asbestos and Vermiculite

- Sources: found in some insulation and fireproofing
- Don't touch it – get professionals to remove it

■ Lead

- Source: pre-1978 paint
- Get a professional to assess and help address situation

■ Remedies: *Remove, Isolate, Ventilate, Get Help*



Call a professional when...

- You may have difficult health and safety issues
- You need specialized diagnostic tools and experience
- You are not sure how to do the installation
- You would rather *not* explore attic eaves & crawl spaces
- The project is bigger than you have time for



*Do you really want to do
this work yourself?!*

Energy Auditors and Installers – What to Look for:

- House-as-a-system experience
 - Understanding how their recommendations or work affects other components in a home
- The right tools and materials
 - Blower door, combustion analyzer, infrared camera, etc.
 - Denspack insulation blower, spray foam systems, etc.
- Credentials and certifications (BPI, REPA, HERS, WAP, etc.)
- References and reputation
- Detailed written proposal – based on an energy audit
- Polite and pleasant, not hard-sell



Finding a Qualified Energy Auditors & Contractors

- Energy Project Connector with MyEnergyPlan.net – www.myenergyplan.net
 - Voluntary listings of contractors by specialty and location
 - No vetting, but contractors can list qualifications
- NH Residential Energy Performance Assoc. (REPA) – www.repa-nh.org
 - Full, voting members have been vetted for energy auditing skills
- NH BetterBuildings qualified energy professionals – www.betterbuildingsnh.com
 - Working in Nashua, Plymouth and Berlin
- Consider: independent energy auditor vs. integrated home performance contractor



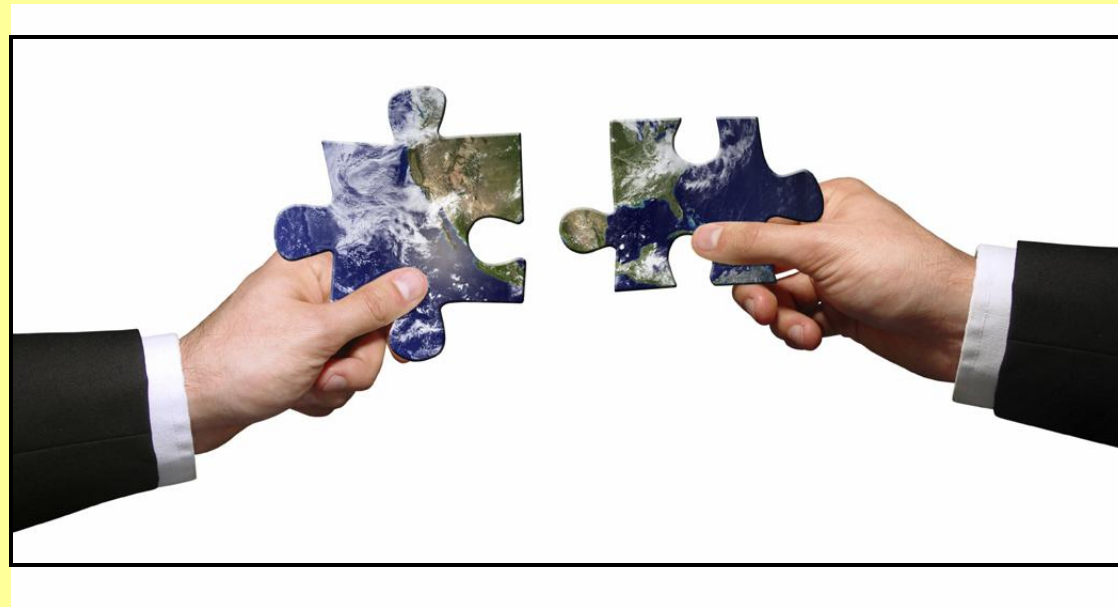
Other Tips- DIY Resources

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- ENERGY STAR -- www.energystar.gov
 - “DIY Guide to Air Sealing”
 - “Home Energy Yardstick”
- Button Up Vermont video -- www.cctv.org/node/82725
 - 31 minute DIY video accompanying 2009 Button Up Vermont presentation
- Weatherization TV -- wxtvonline.org
 - Great how-to weatherization videos
- Air Sealing & Insulation Supplies
 - Energy Federation Inc. -- www.efi.org
 - J&R Products, Inc. -- jrproductsinc.com
 - nhsaves Catalog -- catalog.nhsaves.com



Working together to help YOU with your home energy plan...



FREE web tools to help reduce YOUR Energy Costs

My Energy Plan™



Personal Energy Planner™: Find ways to make your home more comfortable and save money



Energy Project Connector™: Find financial tools to help pay for the work

And search for energy professionals: auditors, installers, etc.



Green Homes Tourist™: Learn from your neighbors by taking “virtual” (or in person) tours of NH homes that have completed energy projects.



Energy Project Connector

Energy Project Connector™

Your Information | Review Contractors | Available Incentives | Next Steps

THESE CONTRACTORS MATCH YOUR SEARCH CRITERIA:

Contractors 1 to 10 of 105 [NEXT PAGE >>](#)

Company	Location	Geographic Proximity (miles)	Contact	Phone	Add to Energy Notebook?
American Home Energy Auditing & Design Services, LLC	Epping, NH	6	John Donati	603-953-3139	<input type="checkbox"/>
Seacoast Home Services & Energy Auditing	Madbury, NH	10	Josh Turgeon	603-828-2290	<input type="checkbox"/>
Lean Energy Associates	Newfields, NH	11	Mark Kasper	6036863131	<input type="checkbox"/>
Dawn Solar Systems, Inc.	Brentwood, NH	11	John Barry	603-642-7899	<input type="checkbox"/>
Seacoast Energy Alternatives	Dover, NH	12	Jack Bingham	603-749-9550	<input type="checkbox"/>
SDES Group, LLC	Dover, NH	12	Tobias Marquette	(603) 617-3767	<input type="checkbox"/>
ReVision Energy - Exeter NH	Exeter, NH	13	Dan Clapp	603-486-7170	<input type="checkbox"/>
Shift Energy, LLC	Rochester, NH	14	Michael Dunn	603 335-1876	<input type="checkbox"/>
Intelligent Heat and Power, LLC	Stratham, NH	14	Jeff Brideau	877 434 1177	<input type="checkbox"/>
Earthborn Renewables, LLC.	Stratham, NH	14	Dennie Foss	603-770-8183	<input type="checkbox"/>

Green Homes Tourist

VIRTUAL HOME TOUR

The Energy Emporium and Quirk Home

Enfield, NH 03748

CONSTRUCTION DETAILS:

Year Built: 1858
Building Style: Greek Revival
Square Footage: 3200
Builder: Renovation: Don Roberts



DESCRIPTION OF HOME:

We renovated an 1858 house that was gutted on the inside to a zero net energy building. It starts with a super-insulated, air sealed shell, and a seasonal storage tank. The solar thermal collector heats the tank water all summer and the house uses this stored energy in the winter to help get through the coldest days. A solar array of PV panels will be added this summer to offset the electrical usage, providing a building that runs entirely on the sun.

ENERGY COSTS AND SAVINGS:

Estimated costs of the energy improvements made to this home:

The insulation to meet energy star levels was priced at \$27,000. We chose to go to R40 walls, R80 roof, and foamed in basement. That was an additional \$9,000. There was a \$1500 tax credit for this efficiency improvement.

The solar collector, seasonal storage tank, and low temperature hydro-air distribution system was about \$42,000. With the NH solar hot water rebate and federal tax credit for renewables, this resulted in \$27,000 effective cost. We expect that was \$8,000-\$10,000 more than a traditional furnace and distribution system.

The solar electric system will be an additional \$15,000. It isn't clear if there will be a NH state rebate for this, but the federal incentive is \$4,500.

Incentive programs utilized:

Federal Tax credit for Energy Efficiency, Federal Tax credit for renewable systems, NH solar hot water rebate and possibly NH Solar PV rebate in 2011 (assuming there is something later this summer).

Total annual energy costs for this home:

\$0 !! We'll have to see... I moved into the house in March of 2011. We will have a full year's data next March, 2012.



Search Contractors...

View Homes & Energy Projects



If you have energy questions. We have

Energy Answers

Email us anytime at answers@unh.edu



OR
CALL TOLL FREE
1-877-EXT-GROW
(1-877-398-4769)

Call Center Hours: Monday-Friday
9:00 a.m. - 2:00 p.m.





Energy Advisors – A Statewide Service Provided by the Plymouth Area Renewable Energy Initiative

- Advisors are partnered with homeowners to personally assist them in taking the next step towards Buttoning Up their home
- Designed for homeowners who need extra assistance with:
 - Coming up with a home energy plan and following through on it
 - Becoming better acquainted with their home's energy sources, equipment and current energy usage
 - Understanding and accessing educational information
 - Identifying and helping to sign up for additional weatherization services
- *A limited number* of Energy Advisors are available
 - Sign up for an Energy Advisor by mailing the sign up card, by calling 603-536-5030 ext. 3 or through www.plymouthenergy.org



Additional Energy Resources

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There are many additional resources to fill in **YOUR** energy plan...



Other Resources: NH Energy Efficiency Incentive Programs

- Weatherization Assistance Program through Community Action Programs - *call 211*
 - No-cost weatherization for income-qualified participants
- Home Performance with ENERGY STAR throughout NH - *www.nhsaves.com*
 - Fuel consumption qualification process (HHI)
 - Up to \$4,000 in energy efficiency incentives
- BetterBuildings Program in Nashua, Berlin & Plymouth - *www.betterbuildingsnh.com*
 - Technical and financial assistance helping building owners save energy





nhsaves: Utility Sponsored Energy Efficiency



Order Energy Efficiency Tools & Supplies at Reduced Prices

Home Heating Index Results

The home heating index compares your home heating consumption against other energy efficient homes. Scores can be between 0 to 15+ with 0 being the most energy efficient.

Your Home Heating Index: 7

Congratulations, your home appears to be energy efficient. Although you may not have participated in our weatherization program, you may be able to improve your home's efficiency.



0 - 3	Zero Energy
4 - 6	Energy Efficient
7 - 8	Code Compliant
9 - 15	Room for Improvement
15+	Inefficient

About Your Home

Town: Barrington, 03825
 Square Footage: 2,500
[Edit Values](#)

Fuel Types

Propane
 Heating Oil

Energy Use

Propane: 200 Gallons
 Heating Oil: 800 Gallons
 Total All Sources: 51,780 BTUs/SF

Improve your efficiency

- Find out more by visiting [Star's website](#).
- Shop online for energy efficient products at [nhsaves.com](#).
- Request a copy of our booklet for tips on saving money at home. [Download Booklet](#)
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Save instantly on ENERGY STAR® qualified products. Every ENERGY STAR lighting product in the nhsaves catalog is offered at an instantly rebated price – \$2 off all compact fluorescent light bulbs (CFLs) and \$10 off all energy efficient interior and exterior light fixtures, table lamps, desk lamps, and torchieres. Best of all, you don't need to send in any rebate forms or coupons!



Calculate Home Heating Index & Qualify for Programs



Home Performance with ENERGY STAR

Typical Measures

- Comprehensive energy audit and written report
- Blower door-guided air sealing in attic, basement, around doors, hatches, chases, etc.
- Loose blown insulation in the attic
- Dense pack insulation in accessible cavities
- Duct sealing (if applicable)
- New programmable thermostats
- Low flow water devices & pipe insulation
- Energy efficient lighting
- Pre- and post- diagnostic tests





Button Up!

What to Do Now:

- Develop an **Home Energy Action Plan**
 - What air sealing, insulation and other activities need to be done and why?
 - Know when to enlist additional help
- Materials: What is needed, where to get it and cost?
- Tools & Techniques: What will it take to do the job right?
- Labor: How long will it take, who will do it, and when?
- Safety: Know your limits and plan for worst case
 - What you don't know *can* hurt you!

Save energy, save money, help the planet and have fun!



Please fill out the workshop evaluation



Thank You:

**Community Action Partnership
Our Outstanding Presenters**

Bob Walker (SERG) and Paul Markowitz (BU VT)



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Funded by a grant from the NH Office of Energy and Planning, with funding from the American Recovery and Reinvestment Act of 2009

