



Affordable Green Housing Center



Green housing for people who need it the most

Greening Your Home

- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- Conserving and efficiently heating water
- Heating and cooling efficiently and using renewable energy
- Landscaping sustainably
- Keeping your home healthy:
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- Selecting healthy and sustainable interior finishes
- Supporting a local green economy

The House as a System

- If the system is working well, the house will be healthy, efficient and comfortable.

- Air
- Heat
- Moisture



Efficient Home

- Reduce energy demand
 - Occupant behavior
 - Efficient appliances and lighting
- Focus on building envelope
 - Air Sealing
 - Insulation
- Heat and cool efficiently



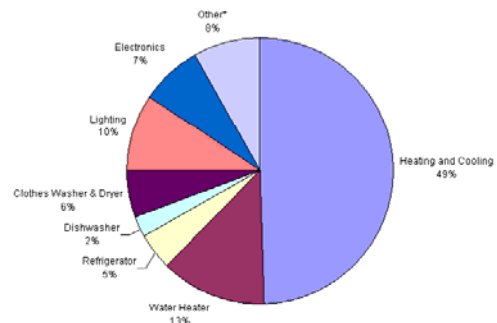
Residential Buildings = 27% of carbon emissions

lbs Carbon / million BTU (national)

Natural Gas	117
Heating Oil	161
Propane	139
Electricity from coal.....	419
Electricity 35% nuclear...	272

So... for "typical" Cleveland house in 1 year:
Total: 23,500 lbs carbon = 10.7 metric tons

Energy Use



Greening Your Home

- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- Conserving and efficiently heating water
- Heating and cooling efficiently and using renewable energy
- Landscaping sustainably
- Keeping your home healthy:
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- Selecting healthy and sustainable interior finishes
- Supporting a local green economy

Energy Star Resources



- One of the most helpful websites you can visit for information related to energy savings
www.energystar.gov

What is the actual cost of operation of our appliances or other electrical equipment?

- A Kill-A-Watt electricity monitor can tell you exactly what a particular appliance is costing to operate.



Compact Fluorescent Lights

- A CFL uses 75% less energy than an incandescent light bulb and lasts 6-10 times longer
- CFLs contain about 5 mg mercury. Over 5 years, a standard bulb = 10mg mercury, CFL = 2.4 mg generated by power plant



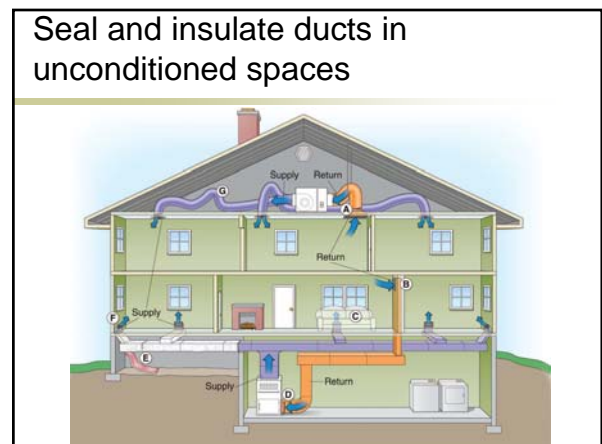
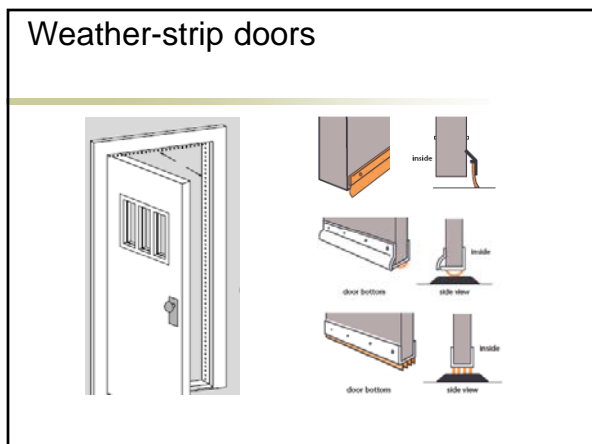
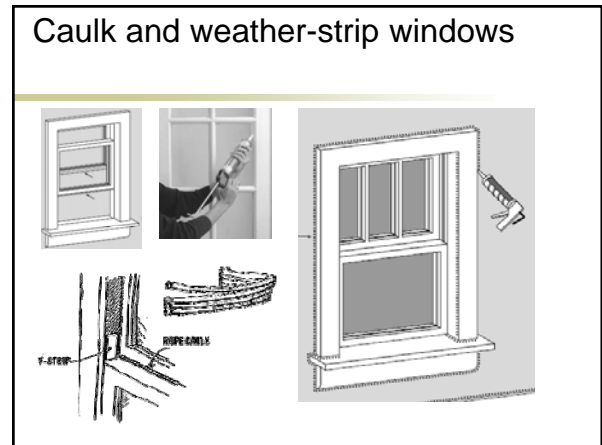
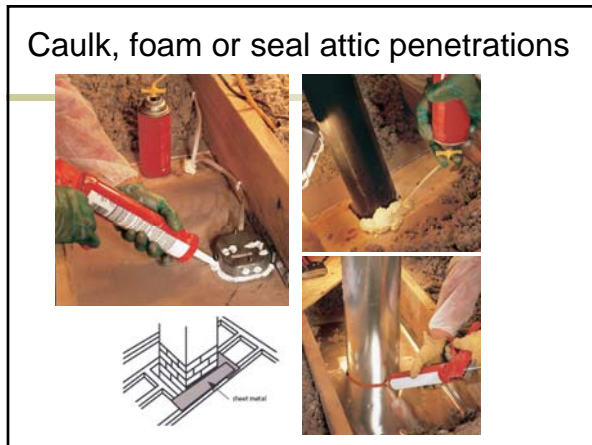
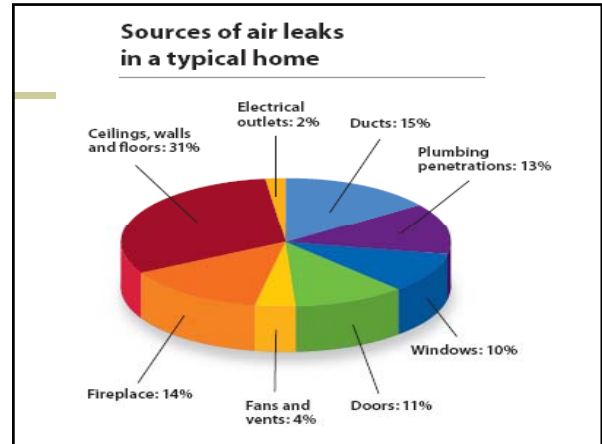
Compact Fluorescent Lights



- Do not use a vacuum or a broom to clean up a broken CFL
 - Open a window and leave the room for at least 15 minutes
 - Shut off forced air heating / AC
 - Read detailed clean-up instructions at www.ehw.org
 - Throw out fabric that came into direct contact with materials from the broken bulb
- Consider not using CFLs in children's rooms, or where they can easily be broken.
- Recycle CFLs

Greening Your Home

- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- Conserving and efficiently heating water
- Heating and cooling efficiently and using renewable energy
- Landscaping sustainably
- Keeping your home healthy:
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- Selecting healthy and sustainable interior finishes
- Supporting a local green economy

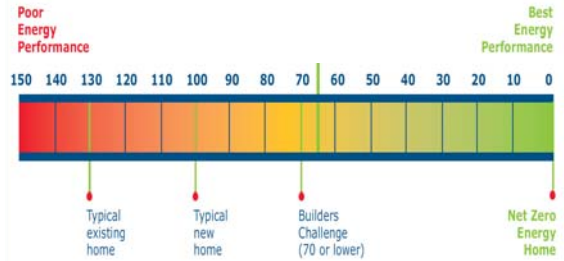


Building Envelope: Existing home assessment

- Keep an eye on your energy bills, and find out where all of that \$ is going.
- Conduct energy audit with blower door test
- Energy audit will tell you how much money you can save



Home Energy Efficiency: Measured by HERS Rating

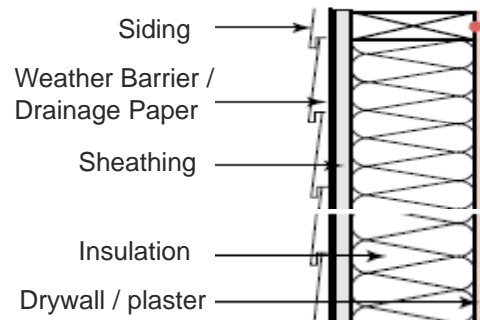


Top Six Efficiency Upgrades

- Air sealing
- Insulating attics
- Side wall insulation
- Basement insulation
- Upgrade furnace
- Upgrade hot water heater
- Don't just go straight for the windows and expect to see a quick payback.



Typical Wall Cut-away



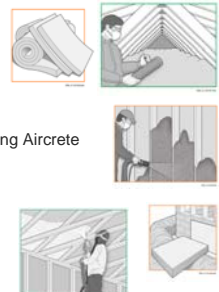
Insulation Materials

- Fiberglass
- Rock wool
- Cellulose
- Polystyrene
- Polyurethane
- Vermiculite
- Cotton/denim



Insulation Applications

- Batts
- Blown-in (closed wall cavities)
 - Fiberglass
 - Loose pack cellulose
 - Dense pack cellulose
 - Some slowly expanding foams, including Aircrete
- Spray
 - For open wall cavities only
 - Wet spray cellulose
 - Open cell foam (icynene)
 - Closed cell foam
 - Spider – sprayed fiberglass
- Rigid board



Insulation R-values

- Polyisocyanurate foam board – 5.6 – 7.6
- Polyurethane closed cell spray foam – 5.5 - 7
- Extruded polystyrene (pink/blue) – 5
- Expanded Polystyrene (white) – 3.6-4.4
- Open cell spray foam (Icynene) – 3.6
- Cellulose blown 3.2-3.8
- Fiberglass batts / Spider 3.1 – 4.3
- Fiberglass loose 2.6 – 4.2
- Mineral wool 2.6-4.4
- Vermiculite – 2.1-2.4
- Straw bale - 1.5
- Snow - 1

Dense pack cellulose in sidewalls



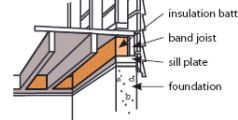
- The standard insulation retrofit for weatherization programs
- Recycled newsprint with boric acid fire retardant
- Usually blown in from outside, can be blown in from inside
- 3.5 pounds per cubic foot density
- Provides air sealing as well as R value
- Check for weather barrier
- Should be done by professional

Spray foam



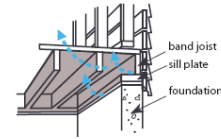
Caulk and Insulate rim / band joists

Insulate along band joists



Cut insulation to fit band joist spaces between the sill and subfloor.

Caulk basement air leaks



Get rid of drafts on the main floor by caulking along the sill plate and band joist in the basement.

Foundation: insulate walls but avoid moisture vulnerable building materials

- There is no such thing as a permanently dry basement.
- Remodel defensively so finish materials are not in direct contact with moisture sources.



Bad Crawlspace

- Crawlspace may contain:
 - Mold
 - Pests
 - Asbestos
 - Lead paint
 - Sewer gas
 - Apparently dry crawlspace can add excessive water vapor to a house



Foundation: treat all crawlspaces as conditioned spaces.

- Eliminate
 - Cold drafts
 - Moisture source
 - Unhealthy condition
- Improve
 - Comfort
 - Energy efficiency
 - Durability
 - Indoor air quality



Attic insulation details

- Ice backup
- Conditioned
- Unconditioned
- Vented
- Unvented

Avoiding Ice Backup on Roofs

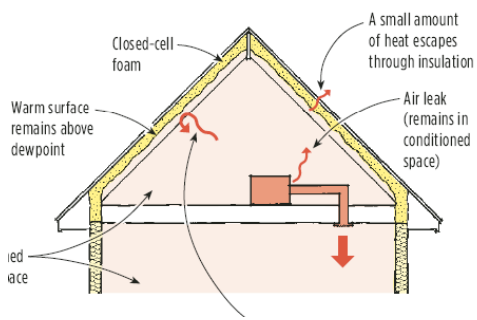
- How we insulate, ventilate and air seal our attics can determine whether we have severe ice backup and water entry into the structure during our freeze/thaw cycles.



Unconditioned attic



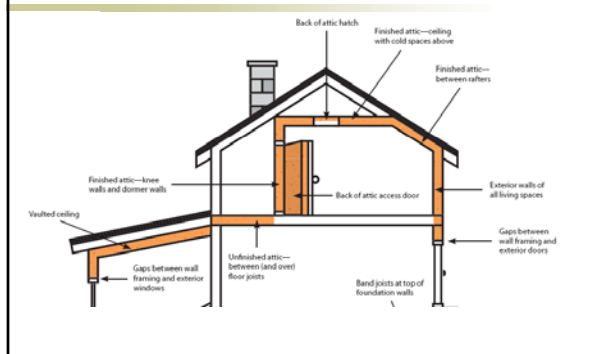
Conditioned attic, not vented



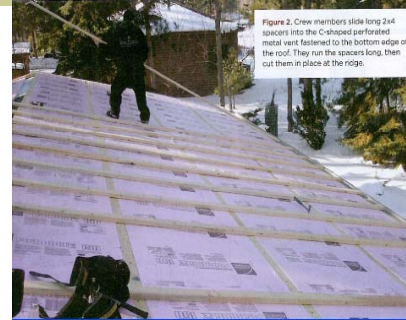
Foam attic



Combination attic

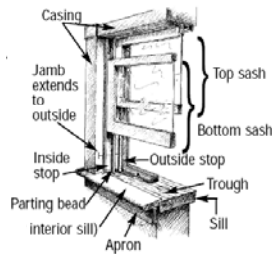


Exterior Retrofit Strategy:



Window upgrade options

- Complete window replacement
- Replace sashes
- Replace glass in sash
- replace weight system with jamb liners
- Repair windows that do not operate smoothly
- Seal and weather-strip



ENERGY STAR
National Environmental
Labels Center
CERTIFIED

World's Best Window Co.
Millennium 2000[®]
Vinyl-Clad Wood Frame
Double Glazing, Argon[®] & Low E
Product Type: Vertical Slider

ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./ft ²)	Solar Heat Gain Coefficient
0.35	0.32
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S./ft ³)
0.51	0.2
Condensation Resistance	
51	—

Manufacture stipulates that these ratings conform to applicable NFRC procedures for determining window product performance. NFRC ratings are also subject to a host of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Visit www.nfrc.org for more product performance information.

Fact Sheet: Selecting Energy Efficient Windows in Ohio
Copyright © 2007, Regents of the University of Minnesota, Twin Cities Campus, College of Design, Center for Sustainable Building Research
All rights reserved.

Deep Energy Retrofits

- 70-90% reductions
- Hang new curtain wall
- Triple pane windows
- Eliminate standard heating system
- Occupant behavior important too



Energy Efficiency Incentives

- 2009 Federal tax credits – 30% of cost, up to \$1500
 - Energy star windows and storm windows
 - Energy star doors and storm doors
 - Energy Star labeled metal roofs
 - Insulation, not including installation
 - Qualifying air conditioners
 - Qualifying 95% efficient furnaces
 - Qualifying hot water heaters
 - Biomass stove with thermal efficiency of 75%
- First Energy Home Performance with Energy Star
 - Must hire approved contractor to do energy audit and make improvements
 - www.firstenergycorp.com/homeperformance/homeowners

Greening Your Home

- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- **Conserving and efficiently heating water**
- Heating and cooling efficiently and using renewable energy
- Landscaping sustainably
- Keeping your home healthy:
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- Selecting healthy and sustainable interior finishes
- Supporting a local green economy

Water Use: Toilets



- Toilets use 25% of household water
- Old toilets use as much as 6 gallons / flush
- Current standard is 1.6 gallons /flush
- High efficiency toilets use 1.3 gallons, some pressure assisted

Water Use: Toilets



- Dual flush toilet uses only
 - 0.8 gal of water for liquid waste
 - 1.6 gal. for solid waste
- Composting toilets use no water
- Graywater toilets use water from adjacent sink

Water Use: Showers



- There is a 2.5 gal/min limit on showerheads,
- but plumbing manufacturers now producing multi-head shower units.

Tankless (demand) hot water heaters

- More efficient than storage hot water heaters, and last longer. Qualify for tax credit
- Electric, propane, natural gas options
- Provide *unlimited minutes* of hot water
- Provide *limited gallons / minute* of hot water

Wastewater Heat Recovery Systems

- Incoming cold water runs through a coil of pipe around the wastewater drain.
- As warm water drains away, it transfers its heat into the water going to the water heater.



Greening Your Home

- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- Conserving and efficiently heating water
- **Heating and cooling efficiently and using renewable energy**
- Landscaping sustainably
- Keeping your home healthy:
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- Selecting healthy and sustainable interior finishes
- Supporting a local green economy

Heating/Cooling/HVAC

- **After you have effectively weatherized, then you choose the most efficient primary heating/cooling source you can afford.**



Use most efficient heating systems you can afford

- 90+ systems eliminate chimney and its maintenance.
- Sealed combustion
- Variable speed blower



Use most efficient heating systems you can afford

- Boilers: new boilers that are 90+ efficient also have sealed combustion that eliminates chimney requirement.



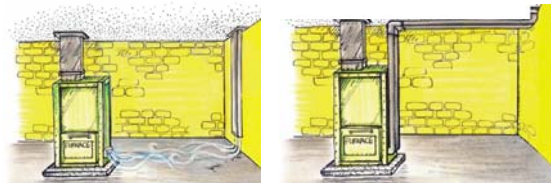
Forced air distribution

- Keep ductwork and piping out of exterior walls.
- Keep ducts in conditioned space
- Seal ducts with mastic
- Use short duct runs

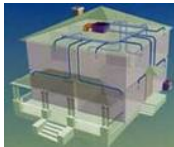


Forced Air Delivery System

- Make sure cold air returns in basement are connected directly to the furnace.



Cooling



- Trying to heat and cool the whole house can be expensive.
- Zoned or isolated systems can be more practical.
- Ceiling fans are always more efficient than AC

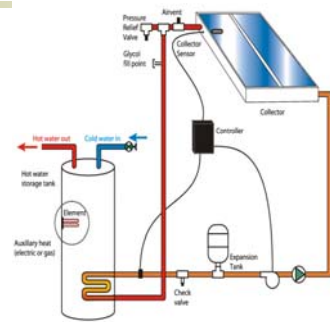
Renewable Energy

- Solar thermal
- Solar electric
- Wind electric
- Geothermal
- www.greenenergyohio.org

Solar thermal hot water

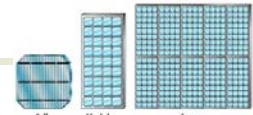
- Captures the sun's heat more efficiently than photovoltaic panels
- Need active, indirect closed loop system with anti-freeze in our cold climate
- Can supply 40-70% of hot water needs typically

Closed Loop, Freeze-Protection System

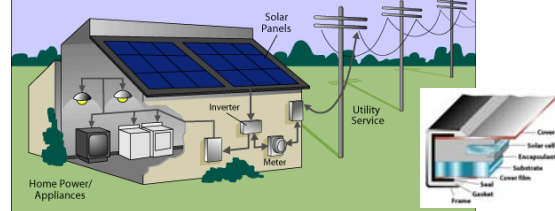


Photovoltaic Solar

- Grid-tied
- Stand alone with batteries
- Grid-tied with battery backup



Residential Grid Connected PV System

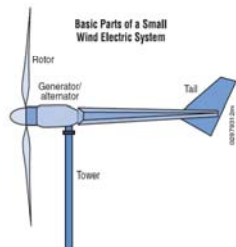


Small Wind

- Need at least 10mph average annual wind speed (10-12 mph unobstructed typical in our region)
- Guyed or free standing
- Stand alone or grid tied
- Wind power increases exponentially with height

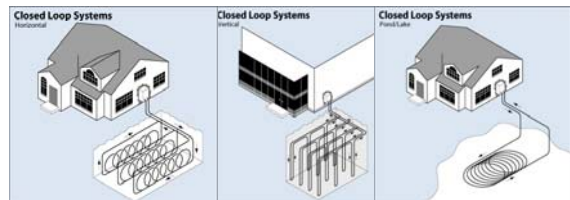


Basic Parts of a Small Wind Electric System



Geothermal (ground source) heat pumps

- Not to be confused with hot springs
- Utilizes constant temperature of the earth
- Vertical loop system can be installed in small area



Renewable Energy Incentives

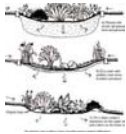
- Federal tax credits of 30% of cost
 - Solar photovoltaic
 - Small wind
 - Solar thermal
 - Geothermal
- Ohio Incentives
 - Solar photovoltaic - \$3/watt up to \$25,000
 - Residential wind – lesser of \$2/kwh or 50%, up to \$25,000

Greening Your Home

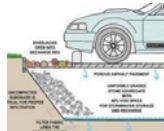
- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- Conserving and efficiently heating water
- Heating and cooling efficiently and using renewable energy
- **Landscaping sustainably**
- Keeping your home healthy:
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- Selecting healthy and sustainable interior finishes
- Supporting a local green economy

Site planning: Stormwater

- Water conservation, collection, and reuse.
- Lighten the load on our sewer and water systems.
- Reduce non-point-source pollution.



Rain gardens



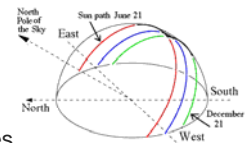
Water porous pavers and driveways



Rain barrels

Site planning: Energy efficient landscaping

- Deciduous trees on west side for shade
- Evergreen windbreak
 - 2-5 x final height of trees
- Shade air conditioner
- Plan for solar panels



Site maintenance: eliminate use of lawn chemicals

- Toxic lawn chemicals can become a soil gas
- Lawn chemicals can be tracked into the home creating a hazard for small children and infants
- According to the National Coalition for Pesticide Free Lawns, of the most common lawn pesticides:
 - 19 are linked to cancer
 - 13 are linked to birth defects
- According to the EPA, 60-70 million birds are poisoned each year due to pesticide use
- Use organic lawn care methods instead
 - Mow high
 - Leave clippings on the lawn

Landscape planning



- Native, drought resistant vegetation
- Reduce lawn areas



Greening Your Home

- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- Conserving and efficiently heating water
- Heating and cooling efficiently and using renewable energy
- Landscaping sustainably
- **Keeping your home healthy:**
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- Selecting healthy and sustainable interior finishes
- Supporting a local green economy

Healthy Home

Seven steps to a healthier habitat -

Keep your home:

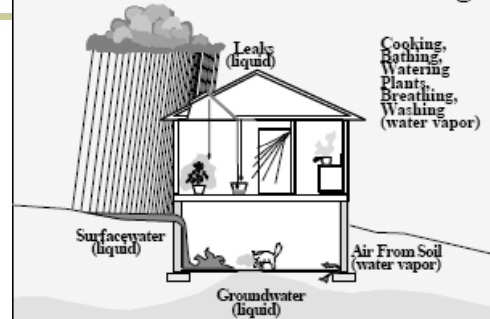
- Dry
- Clean
- Pest free
- Ventilated
- Uncontaminated
- Safe
- Well-maintained

Keep it dry



- Keeping moisture out of house and away from cellulose products/materials to reduce chance of mold.

How Water Enters a Building



National Center for Healthy Housing
Healthy Homes Training Center

Greening The Foundation/Basement



- Downspout disconnect

- Get water away from your basement, and items off the floor.



Foundation: avoid carpet on basement floors



- A backed up storm or waste sewer can bring moisture into a basement living space and destroy carpeting.
- Carpet below grade is risky.



Foundation: remove moisture vulnerable wood framing from basement walls/floors.

- Many older homes have wood framing attached to the side walls and floor of damp basements.
- Mold grows on this wood and spores can become airborne. The wood can rot causing structural issues.

We control condensation by:

- Reducing moisture levels
 - Point source ventilation
 - Dehumidification

Humidity: The amount of moisture in the air.

- Keep the humidity level in the 35-55% range when house is closed up for heating or air conditioning.
- Use a hygrometer to measure humidity in your home.

Air Conditioning Provides Two Things

- Obviously, cooling, but also dehumidification.
- It pulls moisture out of air.

Moisture Control Equipment



- Dehumidifiers can be expensive to operate.
- Size it properly and set it to address your particular moisture condition.

Keep it clean

- keep hard surfaces clean
- avoid carpeting which is a sink for lots of stuff
- use walk-off mats at all entries



Green Cleaning

- Vinegar and baking soda can be used to clean just about anything



To clean surfaces, sprinkle baking soda on a damp cloth. Wipe, then rinse with clean water.

Use a solution of equal amounts of vinegar and water to clean glass.

Use a vinegar and baking soda mix to keep your drains clear.

Green Cleaning

- Avoid air fresheners
- Avoid anti-bacterial cleansers
- Use a vacuum with a HEPA filter
- Wipe up dust with a damp cloth
- Use a green cleaning service



Keep it pest-free



- pests and their parts are asthma triggers
- use Integrated Pest Management procedures (IPM)

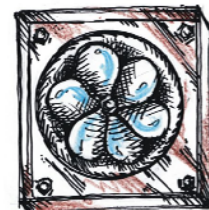
Pesticides only as needed

- least toxic
- smallest amount
- low-volatility
- precision-targeted placement
- inaccessible to children and pets
- no broadcast application



Keep it well-ventilated

- controlled ventilation avoids unnecessary heat loss
- bring in fresh air without backdrafting gas appliances



Ventilation



- Tighter homes require controlled air exchange to exhaust moisture and pollutants and bring in some fresh air.

Spot Exhaust Ventilation

- Bath fans are important for moisture removal.
- Kitchen fans are also necessary for moisture and gas by-product removal.
- Powerful fans can cause backdrafting

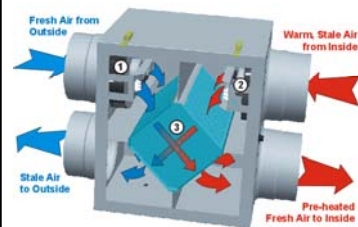


Whole House Ventilation: Controlled Supply Air



- Ventilation directly to cold air return, with proper controls, brings fresh air into house appropriately.

Balanced Ventilation



- Heat Recovery Ventilator heats air it brings in with air it vents out.

Foundation: soil gases

- There are several soil gases (radon, lawn fertilizers, pesticides) which can easily leak into the house creating health issues.
- Sub-slab ventilation is the most effective remediation measure for radon.



Avoid contaminants



- lead hazards
- asthma triggers
- VOCs
- poisons

Lead Poisoning – Still a huge problem



- Too many kids have too much lead
 - Cleveland = 26%
 - East Cleveland = 32%
 - Inner ring suburbs 13% (2006 testing)
 - If you are worried about
 - failing schools
 - crime & delinquency
 - workforce readiness...
- Worry about lead. And help put lead on the community agenda.

Lead Paint Safety

- *Assume paint in homes built before 1978 contains lead*
- *Use lead-safe practices when painting, maintaining, and repairing your home*
- *Regularly clean floors, window sills, and other surfaces*
- *Wash children's hands, bottles, pacifiers and toys often*
- *Make sure children eat a healthy, nutritious diet*
- *Wipe off or remove shoes before entering the house.*

Indoor asthma trigger sources

Inhalant Allergens:

- House dust mite
- **Cockroach**
- Warm-blooded pets
- **Rodents**
- Mold

Respiratory Irritants:

- ETS
- Formaldehyde
- **VOCs**
- Unvented gas stoves
- Outdoor pollution

<http://www.nhlbi.nih.gov/guidelines/asthma/>

Chemical hazards in home products

- Urea formaldehyde
- Phthalates from soft PVC / Vinyl
- Fire retardants: polybrominated diphenyl ethers (PBDE)s
- Variety of VOCs from
 - Petroleum based products such as foam
 - Fragrances
 - Solvents
 - Cleaners

Greening Your Home

- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- Conserving and efficiently heating water
- Heating and cooling efficiently and using renewable energy
- Landscaping sustainably
- Keeping your home healthy:
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- **Selecting healthy and sustainable interior finishes**
- Supporting a local green economy

Life Cycle Analysis

- Environmental impact from
 - Extraction
 - Manufacture
 - Transport
 - Use
 - Disposal / Reuse
- “Cradle to Cradle”

Interior Finishes: Carpet

- minimize carpet
- Green Label Plus carpet
- recycled content carpet
- carpet backing material



Carpet floor tiles

- Made of mostly recycled material.
- Can be easily removed when worn.



Interior finishes: ceramic tile



- post industrial and post consumer recycled material.
 - Example: 47.5% broken window panes and glass bottles.
 - Lead free glaze.
- Tile seconds can reduce landfills and reduce cost for remodeling.
 - About \$1.25 s/f.

Interior finishes: certified wood

- FSC certified
- Kane Hardwoods in PA is nearest source.



Interior finishes: reclaimed wood



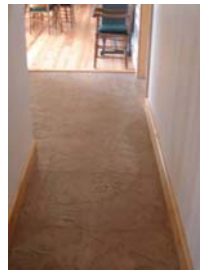
- Recycled wood for flooring and other purposes reduces demand on existing forests and reduces landfill.

Interior Finishes: Linoleum



- Marmoleum is a sheet flooring made of renewable materials including wood flour, jute, linseed oil, etc.

Interior finishes: Sealed concrete



- Decoratively finishing and sealing a concrete floor can eliminate need for additional surface material.

Interior finishes: Other flooring options

- Recycled rubber
- Bamboo
 - How green? Look for low-formaldehyde, durable, FSC, options
- Cork



Interior finishes: Countertops

- Concrete
- Recycled Glass
- Recycled Metal
- Reclaimed or FSC Wood
- Tile
- Paper composite
- Laminate with recycled content, formaldehyde free substrate, and low-voc glues



Interior finishes: Cabinets



- Wheatboard
- formaldehyde-free fiberboard
- seal edges of cabinets
- FSC wood
- reclaimed wood

Interior finishes: Paints and adhesives

- No-VOC paint
- Milk paint is another alternative.
- Water based wood finishes
- Low VOC caulks and adhesives



Interior Finishes: Furnishings

- VOCs to avoid include:
 - Formaldehyde from pressed particleboard
 - Fire retardants
 - PBDEs found in furniture, mattresses and electronics
 - Repair furniture with exposed foam
- Sustainable materials:
 - FSC certified wood
 - Recycled products
 - Natural latex



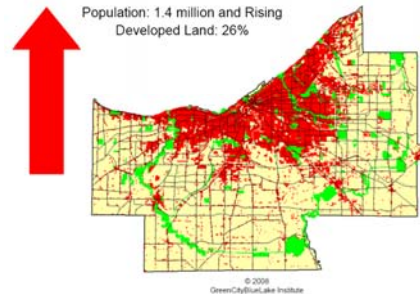
Greening Your Home

- Reducing electrical load and energy demand
- Air sealing and insulating the building envelope
- Conserving and efficiently heating water
- Heating and cooling efficiently and using renewable energy
- Landscaping sustainably
- Keeping your home healthy:
 - Dry
 - Clean, pest-free, well ventilated
 - Contaminant-free, safe, and well maintained
- Selecting healthy and sustainable interior finishes
- **Supporting a local green economy**

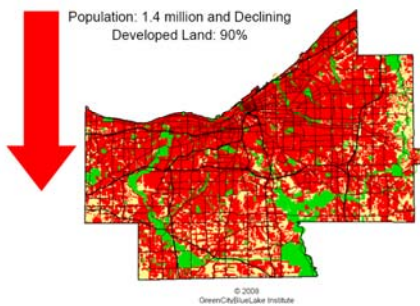
The big picture: site selection

- Typical “green” suburban home has bigger total carbon footprint than typical “non-green” urban home
- Build on infill sites
- Locate near transit access
- Live in a walkable community

1948



2002



The Big Picture: Local is Green

- It takes a lot of energy to get stuff here.
- We need local jobs
 - People with jobs = strong neighborhoods
 - Strong neighborhoods = less sprawl
 - Less sprawl = less polluted environment
- Find and create local sources.

Thanks for your attention.

www.ehw.org
216/961-4646

