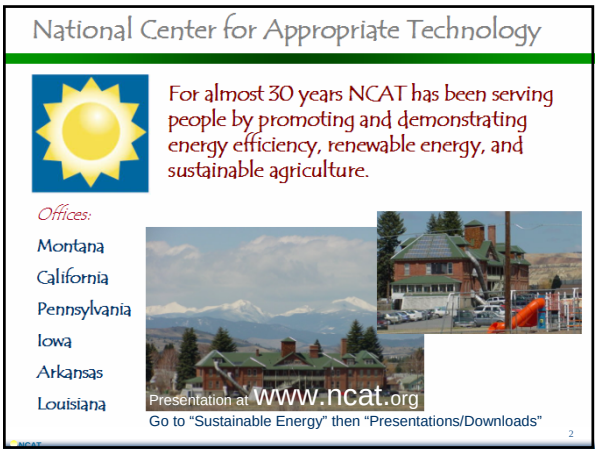
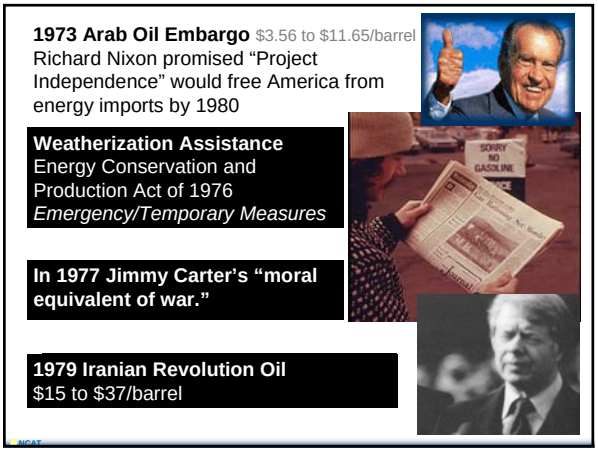
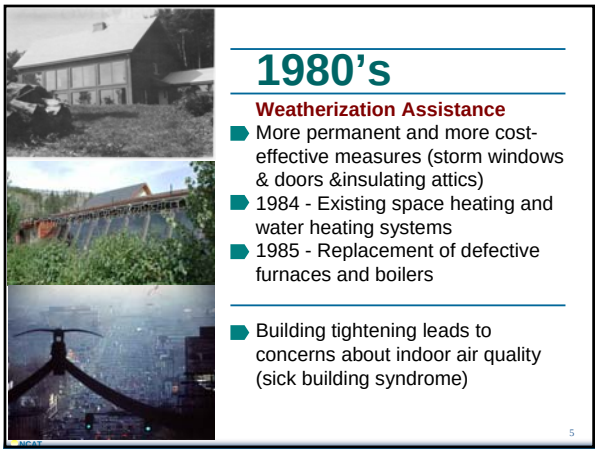

National Center for Appropriate Technology
NCAF Leveraging Conference October 2008
What Does Green Mean?
Opportunities in Weatherization, Affordable Housing, and Agency Operations
Dale Horton, Architect
NCAT Sustainable Energy Program Manager

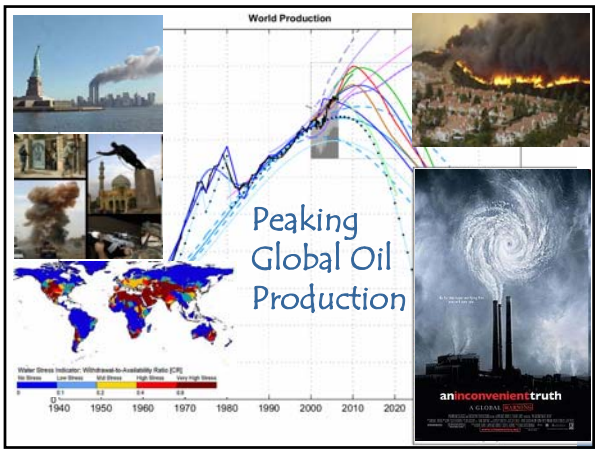

National Center for Appropriate Technology
For almost 30 years NCAT has been serving people by promoting and demonstrating energy efficiency, renewable energy, and sustainable agriculture.
Offices:
Montana
California
Pennsylvania
Iowa
Arkansas
Louisiana
Presentation at www.ncat.org
Go to "Sustainable Energy" then "Presentations/Downloads"

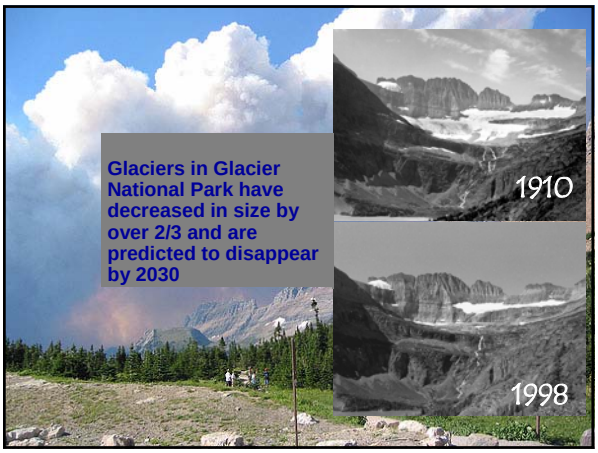

1860's in PA
1900-2000
world population quadrupled
life expectancy doubled
world economy expanded by a factor of 17


1973 Arab Oil Embargo $3.56 to $11.65/barrel
Richard Nixon promised "Project Independence" would free America from energy imports by 1980
Weatherization Assistance
Energy Conservation and Production Act of 1976
Emergency/Temporary Measures
In 1977 Jimmy Carter's "moral equivalent of war."
1979 Iranian Revolution Oil
$15 to $37/barrel


1980's
Weatherization Assistance
More permanent and more cost-effective measures (storm windows & doors &insulating attics)
1984 - Existing space heating and water heating systems
1985 - Replacement of defective furnaces and boilers
Building tightening leads to concerns about indoor air quality (sick building syndrome)


Per capita greenhouse gas emissions by country in 2000 (including land-use change)
1990's
Weatherization Assistance:
Advanced home energy audits to select the most cost-effective measures
Cooling Efficiency Measures
1993
Global Climate Change
no data
0
93.9 tonnes CO2e per capita


World Production
Peaking Global Oil Production
1940 1950 1960 1970 1980 1990 2000 2010 2020
an inconvenient truth


Glaciers in Glacier National Park have decreased in size by over 2/3 and are predicted to disappear by 2030
1910
1998


Why is Green Building important?
It connects the well-being of people with the well-being of the environment.
Social & Economic Justice
Green Building
Environmental Sustainability
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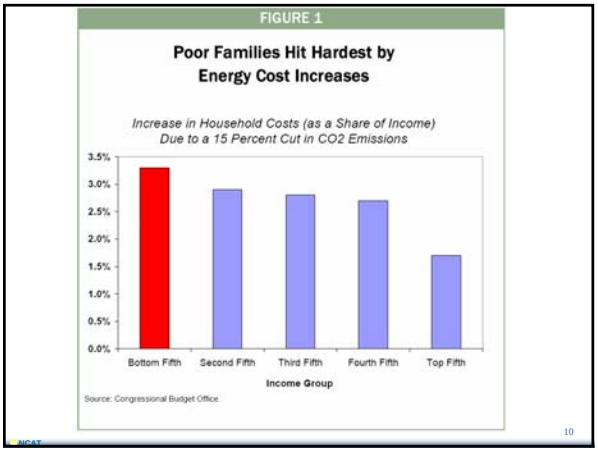
FIGURE 1
Poor Families Hit Hardest by Energy Cost Increases
Increase in Household Costs (as a Share of Income) Due to a 15 Percent Cut in CO2 Emissions
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
Bottom Fifth
Second Fifth
Third Fifth
Fourth Fifth
Top Fifth
Income Group
Source: Congressional Budget Office.
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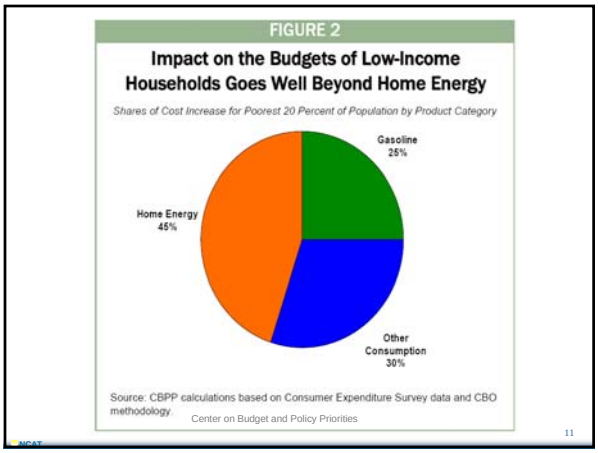
FIGURE 2
Impact on the Budgets of Low-Income Households Goes Well Beyond Home Energy
Shares of Cost Increase for Poorest 20 Percent of Population by Product Category
Gasoline 25%
Home Energy 45%
Other Consumption 30%
Source: CBPP calculations based on Consumer Expenditure Survey data and CBO methodology.
Center on Budget and Policy Priorities
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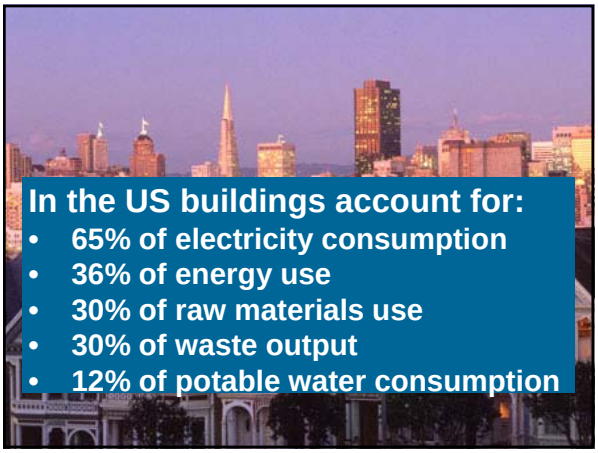
In the US buildings account for:
• 65% of electricity consumption
• 36% of energy use
• 30% of raw materials use
• 30% of waste output
• 12% of potable water consumption

US Carbon Dioxide Emissions

Buildings and the Environment: A Statistical Summary Compiled by: u.s. Environmental Protection Agency Green Building Workgroup
December 20, 2004

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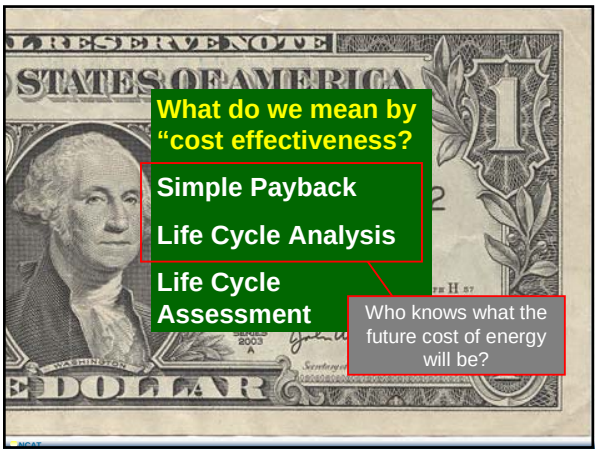

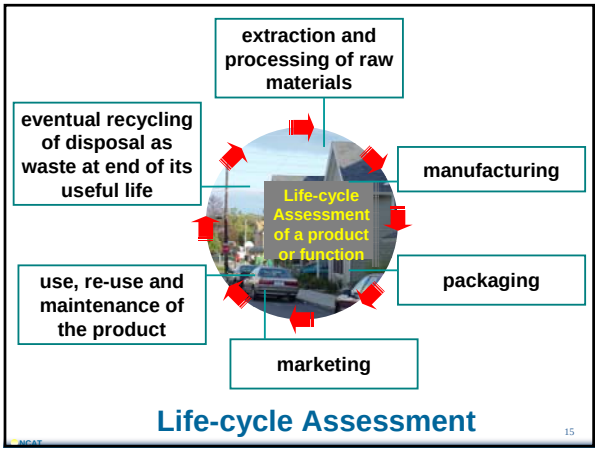

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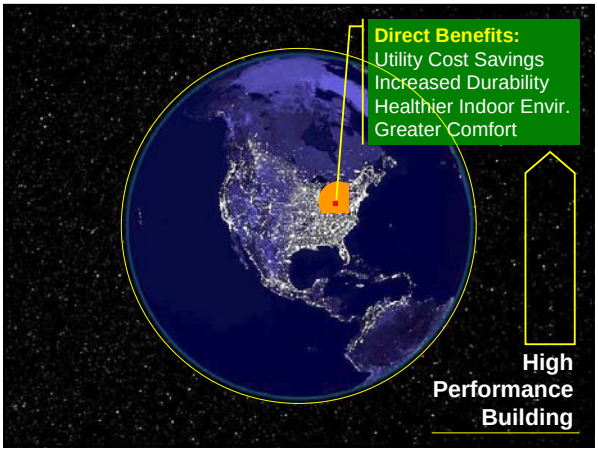

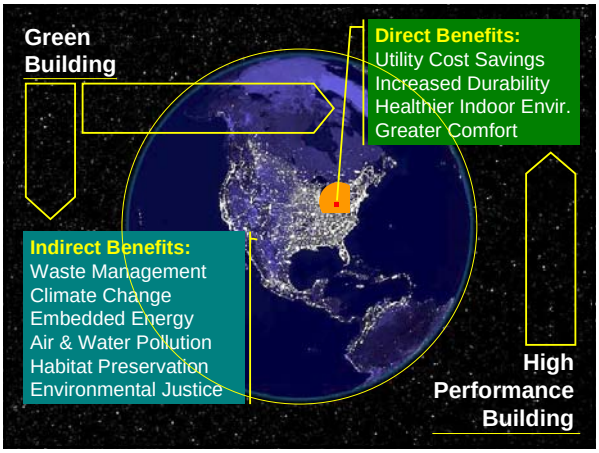

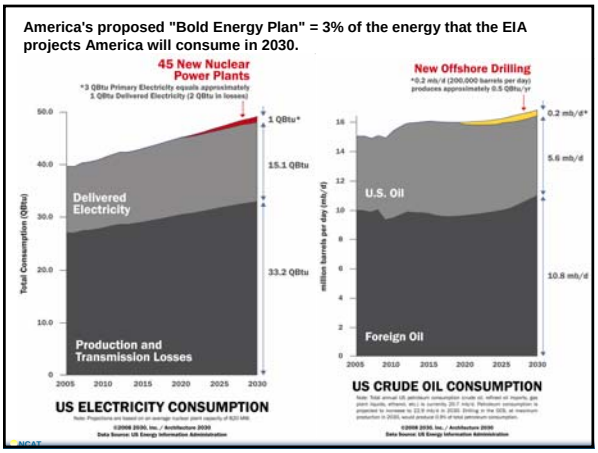

Building energy efficiency, homeowner choices and renewable energy, would:

- Supply as much as 37% of America's total energy consumption
- Replace 100% of its fossil-fuel-generated electricity
- Reduce its imported oil by as much as 89%.

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"The road to energy independence, economic recovery and reductions in greenhouse gas emissions runs through the Building Sector"
-Edward Mazria

The 2030 Challenge asking the global building community to adopt the following fossil fuel, GHG-emitting, energy performance standards :

All **new buildings & major renovations** shall be designed to meet a 50% of the regional (or country) average.

Equal amount of **existing building** area shall be renovated annually to 50% of the regional (or country) average.

The fossil fuel reduction standard for all new buildings shall be increased to:

60% in 2010
70% in 2015
80% in 2020
90% in 2025

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BuildingGreen.com

Green Building Strategies

1. Save Energy
2. Recycle Buildings
3. Create Community
4. Reduce Material Use - Reuse/Recycle
5. Protect and Enhance Site
6. Select Low Impact Materials
7. Maximize Longevity and Durability
8. Save Water
9. Make the Building Healthy

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Green Building Strategies	Weatherization Applicability
#1. Save Energy	
#2. Recycle Buildings	
#3. Create Community	
#4. Reuse/Recycle	
#5. Protect and Enhance Site	
#6. Select Low Impact Materials	
#7. Max. Longevity & Durability	
#8. Save Water	
#9. Make the Building Healthy	

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Green Standards and Guidelines

- ENERGY STAR
- ENERGY STAR IAP
- LEED for Homes
- NAHB Model Green Home Building Guidelines
- Green Communities
- ALA Health House

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What is LEED?

Leadership in Energy & Environmental Design

LEED for Homes is a floating point rating system with 4 Certification Levels.

This scale slides per a calculation which considers the square footage of the house per bedroom ratio. For a 4 bedroom 2,600sf Home the scale is:

- **Platinum: 90 – 129**
- **Gold: 75 – 89**
- **Silver: 60 – 74**
- **Certified: 45 – 59**

Materials and information can be found at - www.usgbc.org

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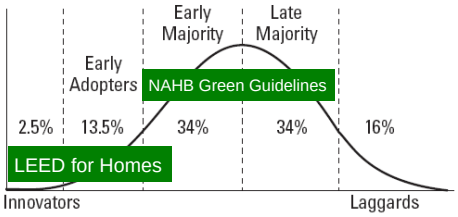
Figure 2: Innovation Adoption by Group

Rogers Adoption/Innvation Curve



www.valuebasedmanagement.net

Comparing Green Building Guidelines and Healthy Homes Principles: A Preliminary Investigation, The National Center for Healthy Housing, April 2006

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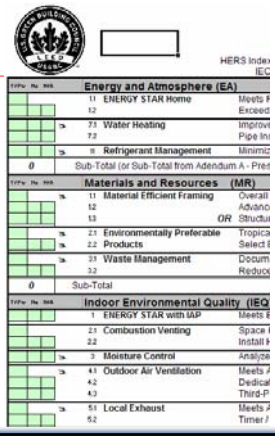
Green Standards

- Integrated Design
- Location/Site
- Materials/Resources
- Energy
- Water
- Indoor Air Quality
- O&M/Education
- Verification



LEED for Homes Points

	No. Prereq. Measures		Min. No. Pts Required		Max. No. Pts. Available	
Innovation and Design Process	4	22%	0	0%	9	7%
Location and Linkages	0	0%	0	0%	10	8%
Sustainable Sites	2	11%	5	31%	21	16%
Water Efficiency	0	0%	3	19%	15	12%
Energy and Atmosphere	1	6%	0	0%	38	29%
Materials and Resources	3	17%	2	13%	14	11%
Indoor Environmental Quality	7	39%	6	38%	20	15%
Awareness and Education	1	6%	0	0%	3	2%
	18	100%	16	100%	130	100%

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Points Required for the Three Different Levels of Green Building

Guiding Principal	Bronze	Silver	Gold
Lot Design, Preparation, and Development	8	10	12
Resource Efficiency	44	60	77
Energy Efficiency	37	62	100
Water Efficiency	6	13	19
Indoor Environmental Quality	32	54	72
Operation, Maintenance, and Homeowner Education	7	7	9
Global Impact	3	5	6
Obtain additional points from sections of your choice	100	100	100

*If the home does not have a ducted distribution system for space heating and cooling, deduct 15 points from the number of points required in the Energy Efficiency section.

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Enterprise

green communities

Green Communities Criteria 2008

- Recognizes that low-income families are disproportionately impacted by housing related health problems
- Includes focus on affordable existing housing

http://www.greencommunitiesonline.org

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Green Communities Criteria Checklist

Developer Name:

Project Name:

Address (Street/City/State):

Please note that partial points are not awarded, unless specifically noted for a criterion.

Distinguishing between types of rehab

For the purposes of this criteria, substantial rehabilitation is defined as rehabilitation where major systems, especially the HVAC system, are being replaced. In addition to HVAC systems, this also includes plumbing and electrical systems. Moderate rehabilitation is rehabilitation that does not include major system replacement.

LH= Aligned with LEED for Homes credit. For more information on the LEED for Homes rating system, please go to www.usgbc.org.

MAXIMUM POINTS

YES	NO	?			
			Integrated Design		
Y	N	?	1.1 LH	Green Development Plan Submit Green Development Plan outlining the integrated design approach used for this development that demonstrates involvement of the entire development team.	Mandatory
			Site, Location and Neighborhood Fabric		
Y	N	?	2.1a LH	Smart Site Location - Proximity to Existing Development: New Construction Provide site map demonstrating that the development is located on a site with access to existing roads, water, sewers and other infrastructure within or contiguous (having at least 25 percent of the perimeter bordering) to existing development.	Mandatory (except infill site or rehabs)
Y	N	?	2.1b LH	Smart Site Location - Protecting Environmental Resources: New Construction Do not locate new development within 100 feet of wetlands, critical slope areas, land identified as habitat for a threatened or endangered species; or on land previously used as public park land, land identified as prime farmland, or with elevation at or below the 100-year floodplain.	Mandatory (except infill site or rehabs)

www.greencommunitiesonline.org/

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Green Building Priorities

#1. Save Energy

#2. Recycle Buildings

#3. Create Community

#4. Reduce Material Use – Reuse and Recycle

#5. Protect and Enhance Site

#6. Select Low Impact Materials

#7. Maximize Longevity and Durability

#8. Save Water

#9. Make the Building Healthy

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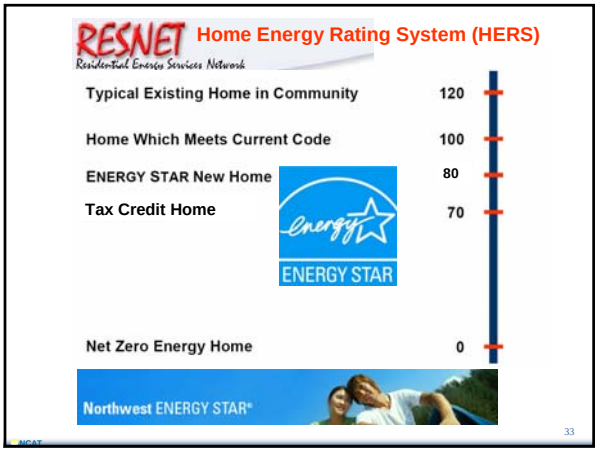

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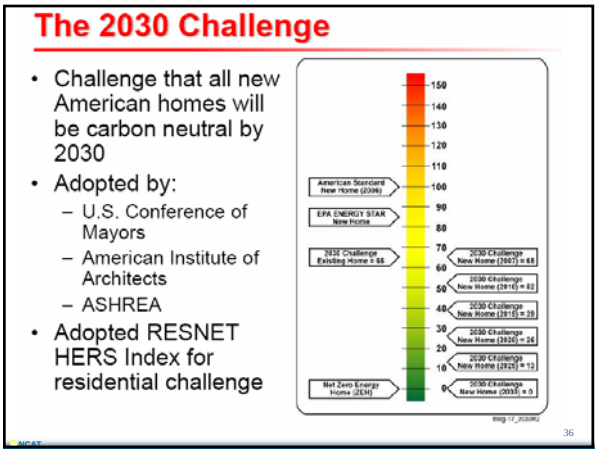

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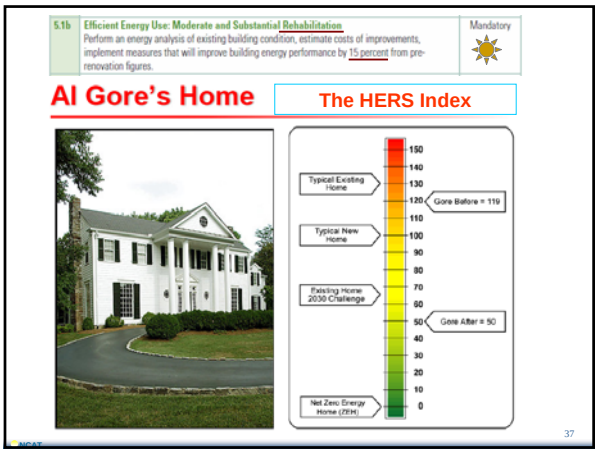
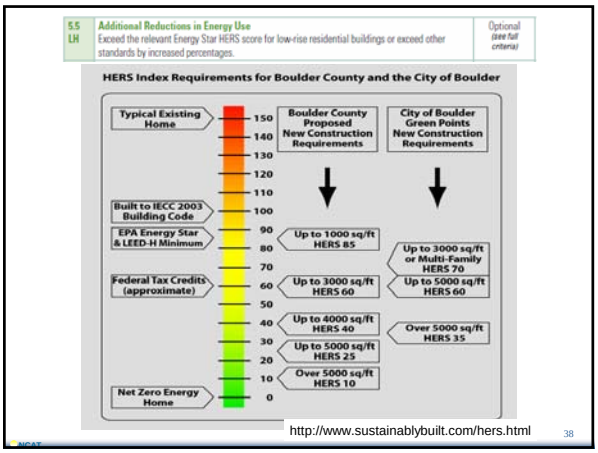

5.1b
Efficient Energy Use: Moderate and Substantial Rehabilitation
Perform an energy analysis of existing building condition, estimate costs of improvements, implement measures that will improve building energy performance by 15 percent from pre-renovation figures.
Mandatory
Al Gore's Home
The HERS Index
Typical Existing Home
Gore Before = 119
Typical New Home
Existing Home 2030 Challenge
Gore After = 50
Net Zero Energy Home (ZEH)
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
37


5.5
LH
Additional Reductions in Energy Use
Exceed the relevant Energy Star HERS score for low-rise residential buildings or exceed other standards by increased percentages.
Optional (see full criteria)
HERS Index Requirements for Boulder County and the City of Boulder
Typical Existing Home
Boulder County Proposed New Construction Requirements
City of Boulder Green Points New Construction Requirements
Built to IECC 2003 Building Code
EPA Energy Star & LEED-H Minimum
Federal Tax Credits (approximate)
Net Zero Energy Home
Up to 1000 sq/ft HERS 85
Up to 3000 sq/ft HERS 60
Up to 4000 sq/ft HERS 40
Up to 5000 sq/ft HERS 25
Over 5000 sq/ft HERS 10
Up to 3000 sq/ft or Multi-Family HERS 70
Up to 5000 sq/ft HERS 60
Over 5000 sq/ft HERS 35
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
http://www.sustainablybuilt.com/hers.html
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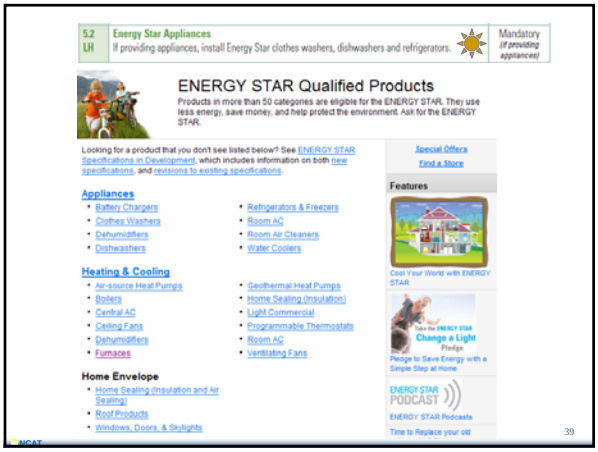
5.2
LH
Energy Star Appliances
If providing appliances, install Energy Star clothes washers, dishwashers and refrigerators.
Mandatory (if providing appliances)
ENERGY STAR Qualified Products
Products in more than 50 categories are eligible for the ENERGY STAR. They use less energy, save money, and help protect the environment. Ask for the ENERGY STAR.
Looking for a product that you don't see listed below? See ENERGY STAR Specifications in Development, which includes information on both new specifications, and revisions to existing specifications.
Special Offers
Find a Store
Features
Appliances
Battery Chargers
Clothes Washers
Dehumidifiers
Dishwashers
Refrigerators & Freezers
Room AC
Room Air Cleaners
Water Coolers
Heating & Cooling
Air-source Heat Pumps
Boilers
Central AC
Ceiling Fans
Dehumidifiers
Furnaces
Geothermal Heat Pumps
Home Sealing (Insulation)
Light Commercial
Programmable Thermostats
Room AC
Ventilating Fans
Home Envelope
Home Sealing (Insulation and Air Sealing)
Roof Products
Windows, Doors, & Skylights
Cool Your World with ENERGY STAR
Change a Light
Pledge to Save Energy with a Simple Step at Home
ENERGY STAR PODCAST
ENERGY STAR Podcasts
Time to Replace your old
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PROTECT OUR ENVIRONMENT FOR FUTURE GENERATIONS
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Heating & Cooling
Home Electronics
Lighting
Office Equipment
Store Locator
Rebate Finder
HOME IMPROVEMENT
Explore Home Improvement >
Common Home Problems
Home Energy Audits
Air Seal & Insulate
Heat & Cool Efficiently
Home Performance with ENERGY STAR
For Contractors
HEADLINES
GO TO PARTNER RESOURCES
BUILDINGS & PLANTS
Explore Buildings & Plants >
Guidelines for Energy Management
Tools & Resources Library
Expert Help
Commercial Building Design
Green Buildings
NEW HOMES
Explore Qualified New Homes >
Find an ENERGY STAR Builder
ENERGY STAR New Home Features
Benefits for Homeowners
For Residential Professionals
Take A Tour Behind the Walls
Login
Sign In
Forgot password?
www.energystar.gov


CHANGING WORLD:
BUILDER LIABILITY: NEW STORM
ENERGY STAR
air leakage in envelope
air leakage in ducts
air leakage and air barriers in envelope
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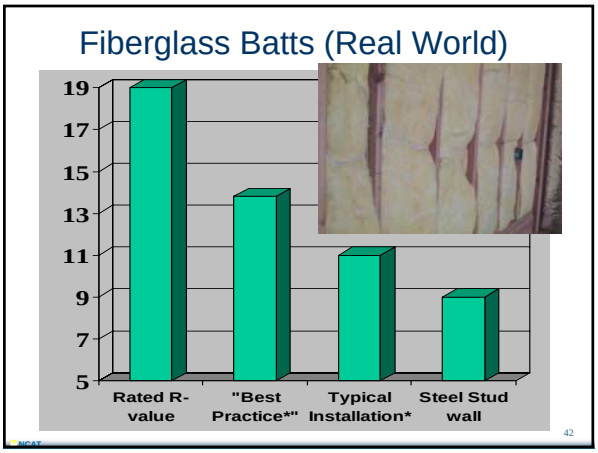
Fiberglass Batts (Real World)
19
17
15
13
11
9
7
5
Rated R-value
"Best Practice*"
Typical Installation*
Steel Stud wall
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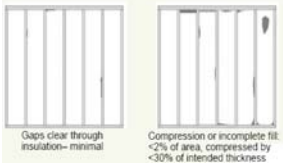
Grade I Assessment

Installed according to manufacturer's instructions, fills each cavity completely, no substantial gaps or voids, split and fit tightly around wiring and other services

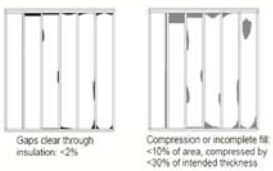
Grade II Assessment

Moderate to frequent defects such as gaps around wiring, electrical outlets, plumbing, and other services; rounded edges or shoulders.

Boundary condition for "Grade I"



Boundary condition for "Grade II"



Quick Insulation Comparison

Material	Type	R-Value	Ozone Depleting Blowing Agent	Density	Vapor Retarder Perm Rating	Recycled Content	Common or Brand Name
Fiberglass	Batts	3.6	No	3 pcf	Permeable	Doubtful	
	Loose fill	3.2	No	2-3 pcf	Permeable	Doubtful	
Cellulose	Loose Dry	3.4	No	1.5-2.0 pcf	Permeable	Yes	
	Wet Blown	4.0	No		Permeable	Yes	
Expanded Polystyrene	Rigid Board	4.0	No	low 1 pcf	Permeable	Doubtful	beadboard
Extruded Polystyrene	Rigid Board	4.0	No	high 2-3 pcf	Semi-imperm.	Doubtful	
Polyisocyanurate	Rigid Board	5.0	Yes	2 pcf	Semi-imperm.	Doubtful	Styrofoam Blue Board
Polyurethane	Rigid Board	7.0	Yes	3 pcf	Imperm (facing)	Doubtful	Thermax
	Spray Foam	3.6-3.8	No, water	low 0.5 pcf	Permeable	Doubtful	Icynene, Sealection 500
	Spray Foam	3.7-3.6	No, soy	low 0.5 pcf	Permeable	Doubtful	Biobase 501, Healthy Seal
	Spray Foam	5.5	No, soy	high 1.7 pcf	Semi-imperm.	Doubtful	Biobase 1701
	Spray Foam	6.0 - 8.0	Yes	high 2 pcf	Semi-imperm.	Doubtful	

Remarks:
1. Fiberglass is susceptable to convective currents and poor installation and may contain ureaformaldehyde.
2. Styrene and urethane insulations may give off toxic gases when if burned.
3. In general, low density foams are open cell and high density foams are closed cell.
4. Vapor permeability depends thickness, especially with foams.

Perms	Vapor Impermeability
<=0.1	Impermeable
0.1> and <=1.0	Semi-impermeable
1.0> and <=10	Semi-permeable
>10	Permeable

Fiberglass

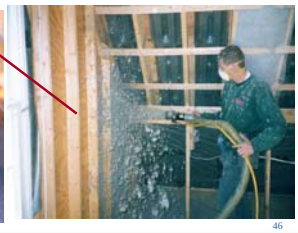
Susceptible to convective currents and poor installation, may contain ureaformaldehyde.

Type	R-Value	Ozone Depleting Blowing Agent	Density	Vapor Retarder Perm Rating	Recycled Content
Batts	3.6	No	3 pcf	Permeable	Doubtful
Loose fill	3.2	No	2-3 pcf	Permeable	Doubtful

Blown-In-Blanket

Cellulose

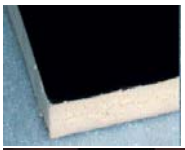
Material	Type	R-Value	Ozone Depleting Blowing Agent	Density	Vapor Retarder Perm Rating	Recycled Content
Cellulose	Loose Dry	3.4	No	1.5-2.0 pcf	Permeable	Yes
	Wet Blown	4.0	No		Permeable	Yes



Polystyrene & Polyisocyanurate

Will give off toxic gases when burned.

Material	Type	R-Value	Ozone Depleting Blowing Agent	Density	Vapor Retarder Perm Rating	Recycled Content	Common or Brand Name
Expanded Polystyrene	Rigid Board	4.0	No	low 1 pcf	Permeable	Doubtful	beadboard
Extruded Polystyrene	Rigid Board	4.0	No	high 2-3 pcf	Semi-imperm.	Doubtful	
Polyisocyanurate	Rigid Board	5.0	Yes	2 pcf	Semi-imperm.	Doubtful	Styrofoam Blue Board
	Rigid Board	7.0	Yes	3 pcf	Imperm (facing)	Doubtful	Thermax

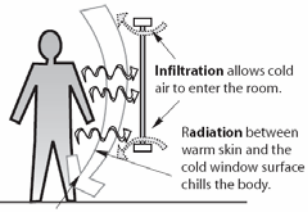


Window Surface Temperature

Glass surface temperature at 25°F outdoor, 70°F indoor temperature:

- ➔Single glass 52 °F
- ➔Double glass 59 °F
- ➔Low E + Argon 62 °F
- ➔High Performance 64 °F
  (Heat mirror films)

Winter Window Comfort Factors



Convection currents are formed when air near the colder window surface cools, becomes denser, and flows downward, creating a continuous flow pattern.

Windows create three wintertime comfort problems.

Source - Residential Energy

www.nfrc.org

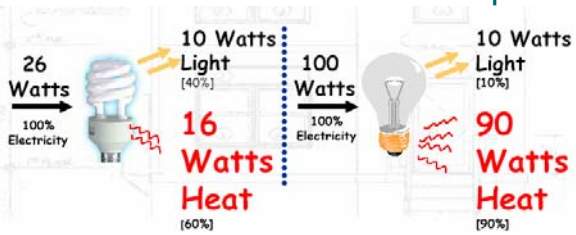
A **U-Factor** measures how well a product prevents heat from escaping a home or building. U-Factor ratings generally fall between 0.20 and 1.20. The lower the U-Factor, the better a product is at keeping heat in. U-factor, takes into account more than conductivity. It also is affected by the airflow around the window.

B **Solar Heat Gain Coefficient (SHGC)** measures how well a product blocks heat from the sun. SHGC is expressed as a number between 0 and 1. The lower the SHGC, the better a product is at blocking unwanted heat gain. Assumes the sun strikes the glass at 90 degrees.

C **Visible Transmittance (VT)** measures how much light comes through a glazing. VT is expressed as a number between 0 and 1. The higher the VT, the higher the potential for daylighting.

5.3a	**Efficient Lighting: Interior** Install the Energy Star Advanced Lighting Package in all interior units and use Energy Star or high-efficiency commercial grade fixtures in all common areas and outdoors.	Mandatory
5.3b LH	**Efficient Lighting: Exterior** Install daylight sensors or timers on all outdoor lighting, including front and rear porch lights in single family homes.	Mandatory

CFLs vs. Incandescent Lamps



Use CFLs where lights are on for long periods of time or are in areas difficult to reach.

Don't use CFLs with dimmers, motion sensors, photocells, in enclosed fixtures (unless labeled on package).

CFL Sizes and Shapes

CFLs come in a variety of shapes and sizes. The majority of CFLs are designed to look identical to the incandescent light bulb version. The table below identifies the most popular CFL shapes that are available at retail:

Bare Products		Covered Products			Reflector Products
Mini-Spiral or Twist	Tube or Universal	Incandescent/ A-line	Globe G25, G30, G40	Candelabra, Post or Bullet Shape	Indoor and Outdoor R20, R30, R40, PAR38
					

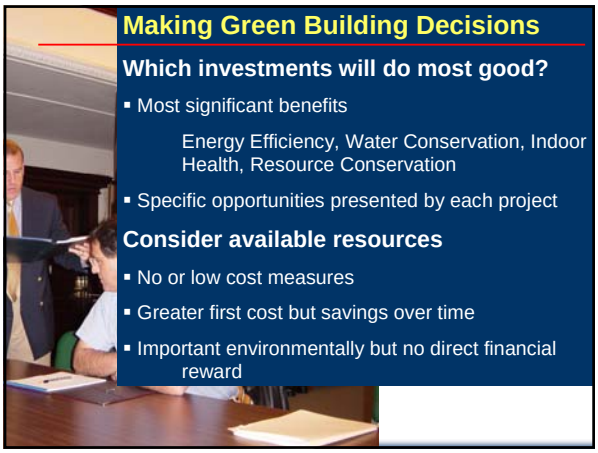
Pine Street NEIGHBORHOOD
This is Home.
New, energy efficient, affordable living, in the Heart of Hazleton.

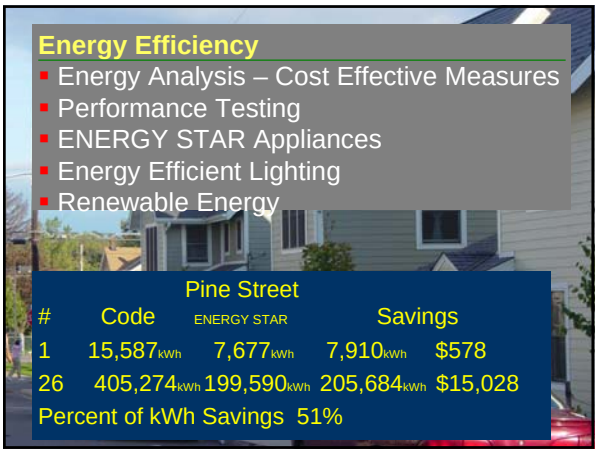
Integrated Design

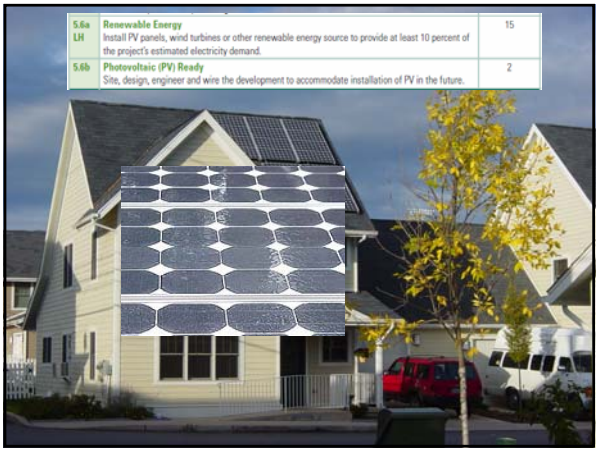
- Integrated Project Team
- Comprehensive Green Design Approach
- Design Charrette

Getting Started

- **Build Project Team**
- **Defining project priorities and adopt standards**
- **RFP for design of/consulting on a green building project**
- **Develop interview questions for selecting a green building consultant and/or architect**

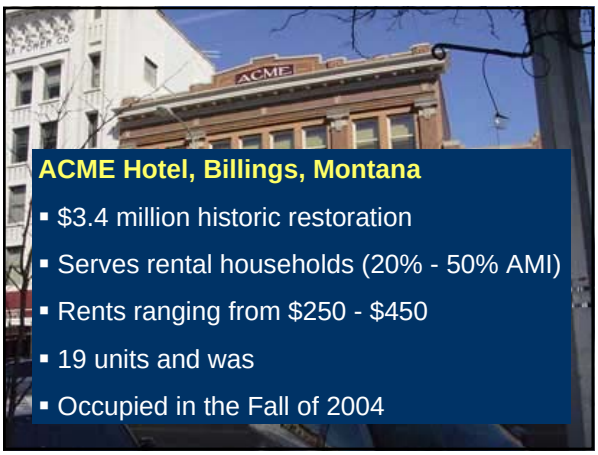

Making Green Building Decisions
Which investments will do most good?
▪ Most significant benefits
Energy Efficiency, Water Conservation, Indoor Health, Resource Conservation
▪ Specific opportunities presented by each project
Consider available resources
▪ No or low cost measures
▪ Greater first cost but savings over time
▪ Important environmentally but no direct financial reward


Energy Efficiency
▪ Energy Analysis – Cost Effective Measures
▪ Performance Testing
▪ ENERGY STAR Appliances
▪ Energy Efficient Lighting
▪ Renewable Energy
Pine Street
Code ENERGY STAR Savings
1 15,587kWh 7,677kWh 7,910kWh $578
26 405,274kWh 199,590kWh 205,684kWh $15,028
Percent of kWh Savings 51%


5.6a LH Renewable Energy
Install PV panels, wind turbines or other renewable energy source to provide at least 10 percent of the project's estimated electricity demand. 15
5.6b Photovoltaic (PV) Ready
Site, design, engineer and wire the development to accommodate installation of PV in the future. 2


Green Building Priorities
#1. Save Energy
#2. Recycle Buildings
#3. Create Community
#4. Reduce Material Use – Reuse and Recycle
#5. Protect and Enhance Site
#6. Select Low Impact Materials
#7. Maximize Longevity and Durability
#8. Save Water
#9. Make the Building Healthy
58


Reuse Buildings (use existing buildings)


ACME
ACME Hotel, Billings, Montana
▪ $3.4 million historic restoration
▪ Serves rental households (20% - 50% AMI)
▪ Rents ranging from $250 - $450
▪ 19 units and was
▪ Occupied in the Fall of 2004

61

Developing affordable housing and asset-building strategies for those most in need through innovative, sustainable and replicable methods

http://www.homeword.org

affordableHOUSING
homeownershipCENTER
policy&OUTREACH
buildingCOMMUNITY
aboutHOMEWORD
Job Openings

contactUS

Homebuyer Classes

Financial Fitness Classes

Affordable Rental Housing

62

63

"…eating up too much of the local subsidies."

"We need to get more units, not more award-winning green units."

Rocky Schnert, Affordable Housing Advocate

"Homeward receives support form foundations that value our ethic of sustainability."

"…the Montana Board of Housing now considers how energy efficient and green a project is when it ranks projects."

Andrea Davis, Homeward Executive Director

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Green Building Priorities

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#8. Save Water

#9. Make the Building Healthy

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2.1a LH	**Smart Site Location - Proximity to Existing Development: New Construction** Provide site map demonstrating that the development is located on a site with access to existing roads, water, sewers and other infrastructure within or contiguous (having at least 25 percent of the perimeter bordering) to existing development.	Mandatory *(except infill site or rehabs)*
2.1c LH	**Smart Site Location - Proximity to Services: New Construction** Locate projects within one-quarter mile of at least two, or one-half mile of at least four community and retail facilities.	Mandatory *(except infill site or rehabs)*

Pine Street NEIGHBORHOOD

66

Pine Street NEIGHBORHOOD
This is Home.

2.2	**Compact Development: New Construction** Achieve densities for new construction of at least six units per acre for detached/semi-detached houses; 10 for town homes; 15 for apartments.	Mandatory *(except rehabs)*
2.3	**Walkable Neighborhoods: Sidewalks and Pathways** Connect project to the pedestrian grid. Include sidewalks or other all-weather pathways within a multifamily property or single-family subdivision linking residential development to public spaces, open spaces and adjacent development.	Mandatory
2.4a LH	**Smart Site Location: Passive Solar Heating/Cooling** Orient building to make the greatest use of passive solar heating and cooling.	4

67

2.4b LH	**Smart Site Location: Grayfield, Brownfield or Adaptive Reuse Site** Locate the project on a grayfield, brownfield or adaptive reuse site.	10

2.5 LH	**Compact Development** Increase average minimum densities to meet or exceed: seven units per acre for detached/semi-detached; 12 units for town homes; and 20 units for apartments.	5
2.6	**Walkable Neighborhoods: Connections to Surrounding Neighborhoods** Provide a site plan demonstrating at least three separate connections from the development to sidewalks or all-weather pathways in surrounding neighborhoods.	5
2.7 LH	**Transportation Choices** Locate project within one-quarter mile radius of adequate public transit service, or one-half mile radius from an adequate fixed rail or ferry station.	12

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Green Building Priorities

#1. Save Energy

#2. Recycle Buildings

#3. Create Community

#4. Reduce Material Use

– Reuse and Recycle

#5. Protect and Enhance Site

#6. Select Low Impact Materials

#7. Maximize Longevity and Durability

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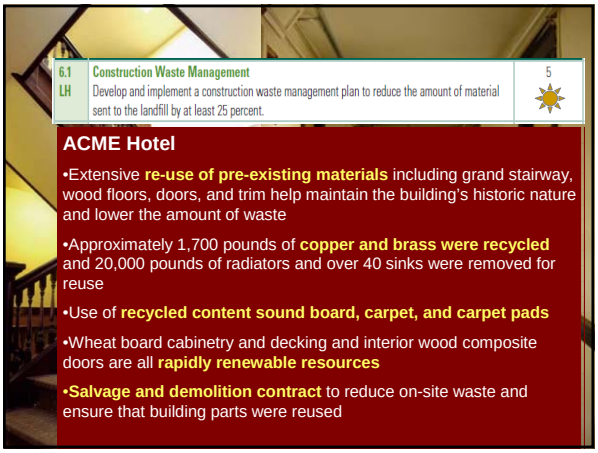
70



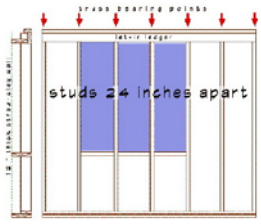
6.1 LH	**Construction Waste Management** Develop and implement a construction waste management plan to reduce the amount of material sent to the landfill by at least 25 percent.	5

ACME Hotel

- Extensive **re-use of pre-existing materials** including grand stairway, wood floors, doors, and trim help maintain the building's historic nature and lower the amount of waste
- Approximately 1,700 pounds of **copper and brass were recycled** and 20,000 pounds of radiators and over 40 sinks were removed for reuse
- Use of **recycled content sound board, carpet, and carpet pads**
- Wheat board cabinetry and decking and interior wood composite doors are all **rapidly renewable resources**
- **Salvage and demolition contract** to reduce on-site waste and ensure that building parts were reused

Wood-efficient framing

Advanced Framing



all windows 20 to 24 inches wide

walls studs at 24" spacing

single top-plate

second plate vertical as a ledger = no headers needed

Windows between studs…

Green Building Priorities

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#8. Save Water

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Synergy with rehab project: shade trees & shrubs
solar easements

If parking must be replaced: consider porous paving options

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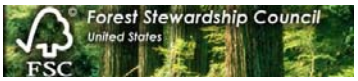
6.2 LH	**Recycled Content Material** Use materials with recycled content; provide calculation for recycled content percentage based on cost or value of recycled content in relation to total materials for project. Minimum recycled material must be 5 percent.	14

Materials and Resources

- Construction Waste Management; Minimize Waste (reduce, reuse, recycle on the construction site)
- Recycled Content Material
- Certified and Salvaged Wood
- Water Permeable Walkways and Parking

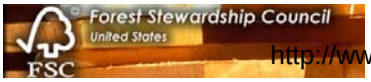
Green Building Rehab Strategies 77

6.3 LH	**Certified, Salvaged and Engineered Wood** Commit to using at least 25 percent (by cost) wood products and materials that are salvaged wood, engineered framing materials or certified in accordance with the Forest Stewardship Council.	5



Forest Stewardship Council

FSC is a non-profit organization devoted to encouraging the responsible management of the world's forests. FSC sets high standards that ensure forestry is practiced in an environmentally responsible, socially beneficial, and economically viable way.



http://www.fscus.org/

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Natural Materials

Lime for plasters
Milk Paint
Sustainably-harvested wood flooring and decking
Re-used heavy timbers
Straw, earth & stone

Green Building Priorities

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#8. Save Water
#9. Make the Building Healthy

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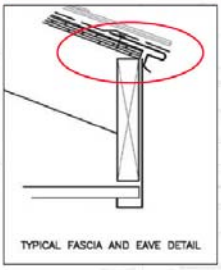
MOISTURE CONTROL HIGHLIGHTS: WATER MANAGED ROOFS

ENERGY STAR



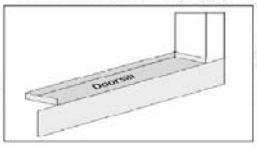
TYPICAL FASCIA AND EAVE DETAIL

BITUMINOUS MEMBRANE AT VALLEYS

MOISTURE CONTROL HIGHLIGHTS: WATER MANAGED WALLS

ENERGY STAR

WINDOW/DOOR PAN FLASHING



BEST PRACTICE INSTALLATION

Cemplank, Inc
Blandon, PA

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Green Building Priorities

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#5. Protect and Enhance Site
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#8. Save Water

#9. Make the Building Healthy

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	Water Conservation	
4.1a LH	**Water-Conserving Appliances and Fixtures: New Construction** Install water-conserving fixtures with the following minimum specifications: toilets – 1.3 GPF; showerheads – 2.0 GPM; kitchen faucets – 2.0 GPM; bathroom faucets – 2.0 GPM	Mandatory
4.1b LH	**Water-Conserving Appliances and Fixtures: Moderate Rehabilitation** Install water-conserving fixtures with the following minimum specifications for toilets and shower heads and follow requirements for other fixtures wherever and whenever they are replaced: toilets – 1.3 GPF; showerheads – 2.0 GPF; kitchen faucets – 2.0 GPM; bathroom faucets – 2.0 GPM.	Mandatory
4.1c LH	**Water-Conserving Appliances and Fixtures** Install water-conserving fixtures with the following minimum specifications: toilets – 1.1 GPF; showerheads – 1.75 GPM; kitchen faucets – 2.0 GPM; bathroom faucets – 1.5 GPM	
4.2 LH	**Efficient Irrigation** If irrigation is necessary, use recycled gray water, roof water, collected site runoff, water from municipal recycled water system, or a highly efficient irrigation system including all the follow system designed by EPA Water Sense professional; plant beds with a drip irrigation system; separately zoned turf and bedding types; a watering zone timer/controller; moisture sensor controller.	

EPA WaterSense
http://www.epa.gov/watersense/

Green Building Priorities

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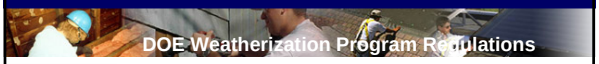
Weatherization Assistance Program



DOE Weatherization Program Regulations

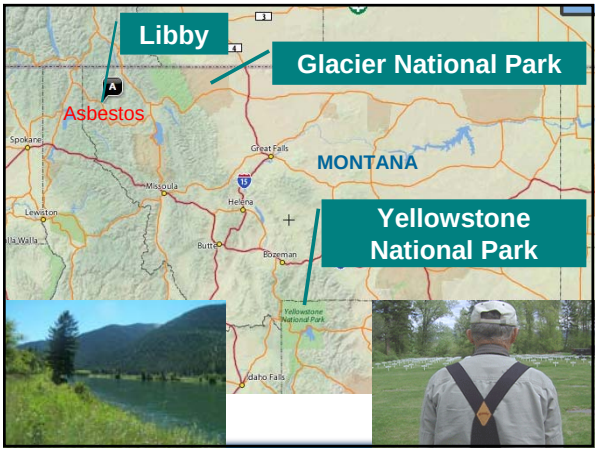
Weatherization Works

Do not cause or exacerbate health and safety problems for workers and clients

- Wood Stoves
- Knob & Tube Wiring
- Carbon Monoxide (unvented space heaters)
- Lead Based Paint

No Guidelines on broader health and environmental impacts

To reduce energy use in as many homes as possible at the least cost……



HOW DO HOMES EARN THE LABEL FOR THE ENERGY STAR INDOOR AIR PACKAGE?

START WITH ENERGY STAR

A home must first be designed and built to earn the ENERGY STAR—the government-backed symbol for energy efficiency. The result is a home that is significantly more energy efficient than a code-built home.

SHOULD BUILDERS CARE ABOUT IAQ?

- **Asthma Epidemic**
  (20 million Americans have it); ~2 million ER visits per year
- **Increasing Risks of Radon**
  >20,000 lung cancer deaths per year
- **Increasing Respiratory Problems**
  widespread indoor dampness (e.g. wet basements and visible mold)
- **Chemical Pollutants**
  EPA estimates 2-5 times more than outdoor air

Now consider this:
People spend >90% of their time indoors, and >60% in their homes!

IAQ RISK REDUCTION PRINCIPLES

ENERGY STAR

1. **Source Control**
   eliminate, substitute, or modify pollutant sources
2. **Dilution**
   ventilate to dilute unavoidable pollutants
3. **Filtration**
   remove targeted pollutants,
   last resort after source control & dilution

BUILDING MATERIALS HIGHLIGHTS:
PROTECTION

ENERGY STAR

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7.1 LH	**Low / No Volatile Organic Compounds (VOC) Paints and Primers** Specify that all interior paints and primers must comply with current Green Seal standards for low-VOC limits.	Mandatory
7.2 LH	**Low / No VOC Adhesives and Sealants** Specify that all adhesives must comply with Rule 1168 of the South Coast Air Quality Management District. Caulks and sealants must comply with Regulation 8, Rule 51 of the Bay Area Air Quality Management District.	Mandatory
7.3	**Urea Formaldehyde-free Composite Wood** Use particleboard and MDF that is certified compliant with the ANSI A208.1 and A208.2. If using nonrated composite wood, all exposed edges and sides must be sealed with low-VOC sealants.	Mandatory

BUILDING MATERIALS HIGHLIGHTS:
LOW-EMITTING MATERIALS

ENERGY STAR

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Green Seal Green Seal provides science-based environmental certification standards that are credible, transparent, and essential in an increasingly educated and competitive marketplace.

http://www.greenseal.org/

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Non-flat Paints: < 150 grams/liter

Flat Paints: < 50 grams/liter

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Product Category	VOC % by weight	VOC g/L
Construction, Panel, & Floor Covering	15%	~200g/L
Construction, Panel, & Floor Covering **(CA ONLY '09)**	7%	~100g/L
Caulks & Sealants	4%	~60g/L
General Purpose Adhesives	10%	~120g/L
Contact Cements (General Purpose) - includes 1 gallon	55%	~600g/L
Contact Cements (Special Purpose)- includes 1 gallon	80%	~735g/L

95

7.4 LH	**Green Label Certified Floor Coverings** Do not install carpets in below grade living spaces, entryways, laundry rooms, bathrooms, kitchens or utility rooms. If using carpet, use the Carpet and Rug Institute's Green Label certified carpet, pad and carpet adhesives.	Mandatory *(if providing floor coverings)*

Carpet & Rug Institute

Green Label Plus, for carpet and adhesives, sets an even higher standard for IAQ and ensures that customers are purchasing the very lowest emitting products on the market.

http://www.carpet-rug.org

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7.5a LH	**Exhaust Fans – Bathroom: New Construction and Substantial Rehabilitation** Install Energy Star-labeled bathroom fans that exhaust to the outdoors and are connected to a light switch and are equipped with a humidistat sensor or timer, or operate continuously.	Mandatory
7.5b LH	**Exhaust Fans – Kitchen: New Construction and Substantial Rehabilitation** Install power vented fans or range hoods that exhaust to the exterior.	Mandatory
7.5c	**Exhaust Fans – Kitchen: Moderate Rehabilitation** Install power vented fans or range hoods that exhaust to the exterior.	5

HVAC SYSTEM HIGHLIGHTS:
SPOT VENTILATION

ENERGY STAR

< One Sone

Controls

97

Actual flow is often less than half of the fan ratng.

Exhaust Fan Flow Test

98

7.6a LH	**Ventilation: Except for Moderate Rehabilitation** Install a ventilation system for the dwelling unit, providing adequate fresh air per ASHRAE 62.1-2007 for residential buildings above three stories or ASHRAE 62.2 for single family and low-rise multifamily dwellings.	Mandatory
7.6b	**Ventilation: Moderate Rehabilitation** Install a ventilation system for the dwelling unit, providing adequate fresh air per ASHRAE 62.1-2007 for residential buildings above three stories or ASHRAE 62.2 for single family and low-rise multifamily dwellings.	10

Mechanical Ventilation

REM/RATE assumes ASHRAE 62.2-2003

Requires continuous whole-building* mechanical ventilation based on conditioned floor area and # of bedrooms

7.5 cfm/bedroom +1 plus 1 cfm/100 SF

Example: 3-bedroom 2400 SF house

(7.5 cfm x (3+1)) + (2400/100) = 54 cfm

* - Mech exhaust system may include local exhaust fans.

99

Infiltration versus Mechanical Ventilation

	Infiltration	Mechanical Ventilation
Reliable appropriate quantity of air	NO	Yes
Air delivered to appropriate spaces	NO	Yes
Can be shut off if house is unoccupied	NO	Yes
Quality of air good as outdoor air	NO	Yes

Note: This assumes mechanical system is properly designed.

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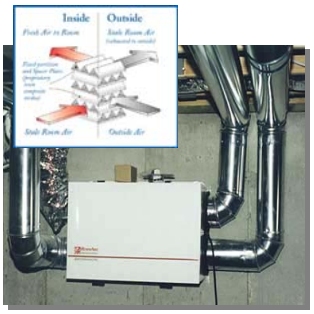
Heat Recovery Ventilator



Whole-house positive ventilation

Vents bathrooms & kitchen

Check out: www.renewaire.com

7.7 LH	**HVAC Sizing** Size heating and cooling equipment in accordance with the Air Conditioning Contractors of America Manual, Parts J and S, ASHRAE handbooks, or equivalent software.	Mandatory
7.18 LH	**Combustion Equipment: Includes Space and Water-Heating Equipment** Specify power vented or combustion sealed equipment. Install one hard-wired CO detector for each sleeping area, minimum one per floor.	Mandatory

COMBUSTION SYSTEM HIGHLIGHTS:
POWER/DIRECT VENTED EQUIPMENT

ENERGY STAR

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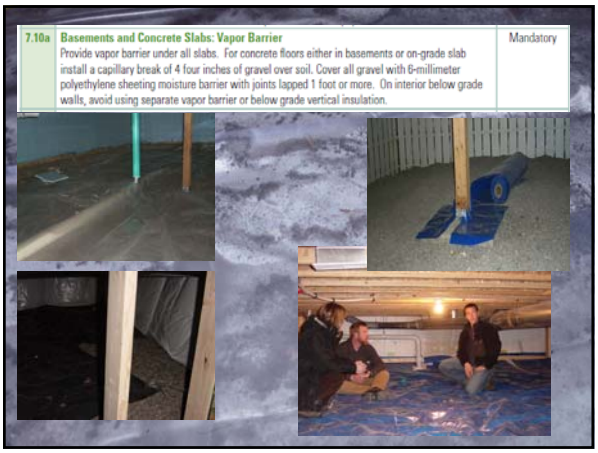
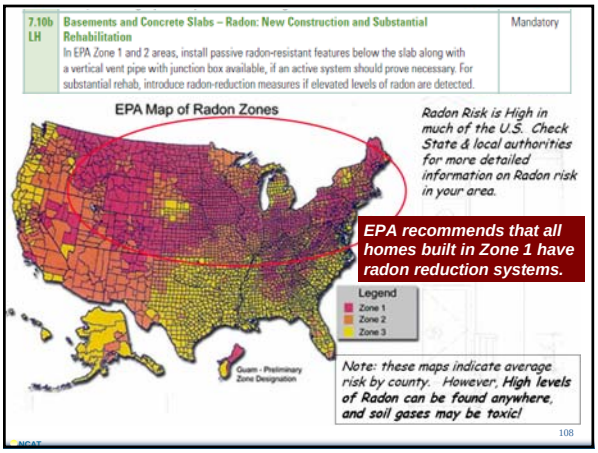


Moisture

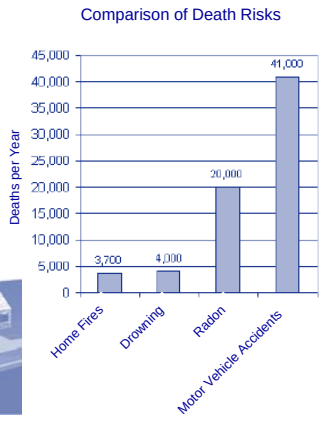
- Water related to 90% of building and material failures (ASHRAE)
- Estimated $9 Billion/year in repairs

105



Is there a safe level of radon? **No.**

Can you test for radon before construction? **No.**

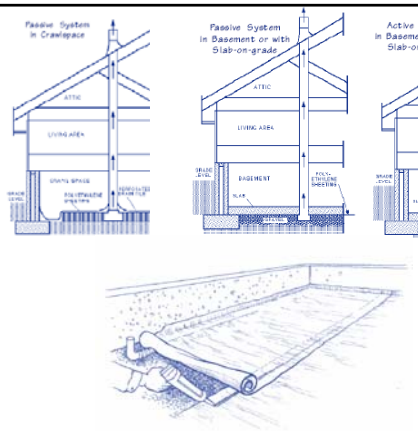


109

How Does Radon Enter A House?

Common Radon Entry Points

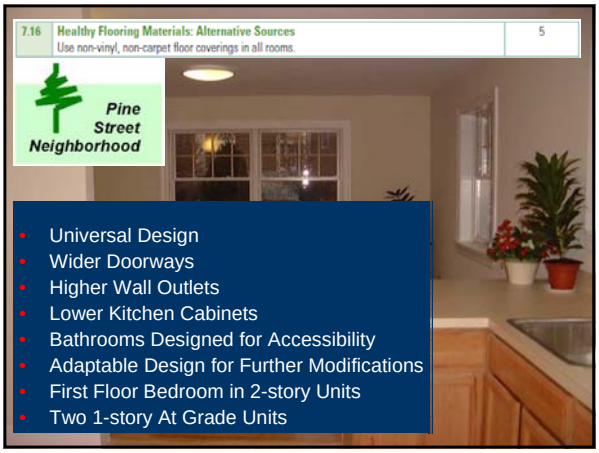
110



111

- Test for lead paint
- Follow lead safe practices

112



- Universal Design
- Wider Doorways
- Higher Wall Outlets
- Lower Kitchen Cabinets
- Bathrooms Designed for Accessibility
- Adaptable Design for Further Modifications
- First Floor Bedroom in 2-story Units
- Two 1-story At Grade Units

Greening Your Operations

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Greening Is Good Business

Saves Money
A typical office disposes of about 350 pounds of wastepaper per employee per year. Switching from single-sided to double-sided can cut this almost in half.
Ghirardelli redesigned their packaging to incorporate reusable plastic totes saving the chocolate company $520,000 annually.

Reference: NRDC Greening Advisor

Greening Is Good Business

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Reduces Risk
it is smart business to take a hard look at how to minimize the risks and costs—and increase the opportunities and savings—for your business in a carbon-constrained world.

Reference: NRDC Greening Advisor

Greening Is Good Business

Saves Money
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Ghirardelli redesigned their packaging to incorporate reusable plastic totes saving the chocolate company $520,000 annually.

Reduces Risk
it is smart business to take a hard look at how to minimize the risks and costs—and increase the opportunities and savings—for your business in a carbon-constrained world.

Creates Good Public Relations
Environmentally intelligent initiatives help enhance your standing in the community.

Reference: NRDC Greening Advisor

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Boosts Employee Health, Morale, and Productivity
Using less-toxic products and incorporating "green building" techniques have also been shown to reduce absenteeism and increase productivity.

Reference: NRDC Greening Advisor

NRDC NATURAL RESOURCES DEFENSE COUNCIL
THE EARTH'S BEST DEFENSE

THE BUSINESS CASE FOR BUILDING GREEN
More and more owners and developers are building green. Learn why, and how.

Green Building
This site offers building professionals a five-step guide to planning a green building project, from inception and design through marketing.

LEED for Neighborhood Development
New standards created by an NRDC partnership will help guide developers and communities to build greener neighborhoods.

Affordable Green Housing
The Green Communities Initiative will build thousands of affordable, environmentally friendly homes across the country.

http://www.nrdc.org/greenbusiness/

Sample Purchasing Policy

Comparable environmentally preferable products and services should receive purchasing preference.

Where possible, purchasing decisions shall favor products that:

- Reduce greenhouse gas emissions
- Reduce the use of hazardous chemicals
- Contain the highest percentage of recycled content
- Reduce air and water pollution
- Reduce waste
- Reusable products
- Are recyclable or compostable
- And use suppliers who strive to improve their environmental performance

Incorporating environmental stewardship and sustainability in business operations…….

Green Operations Checklist

- ❑ Facility Energy Efficiency (lighting, HVAC, misc. equipment)
- ❑ Utilize Utility Incentive Programs
- ❑ Energy Efficient or Alternative Fuel Vehicles (hybrids, electric cars, biodiesal)
- ❑ Employee Transportation (walk, bike, car pool, public transportation)
- ❑ Extensive Reuse and Recycling
- ❑ Office Products and Equipment
  - ❑ Recycled Products
  - ❑ Low Polluting Products (Low VOC paints, carpets, furniture)
  - ❑ Locally Manufactured Products

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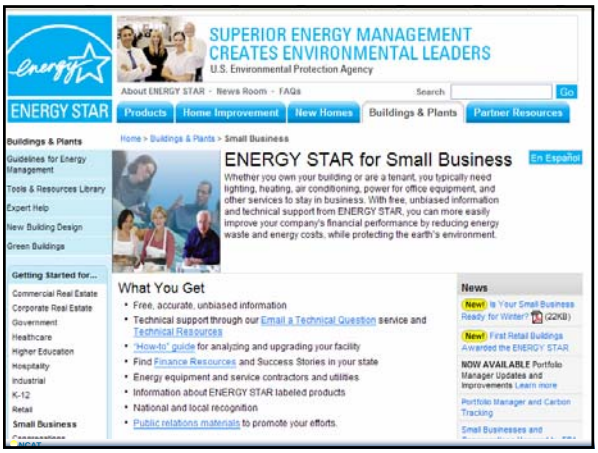

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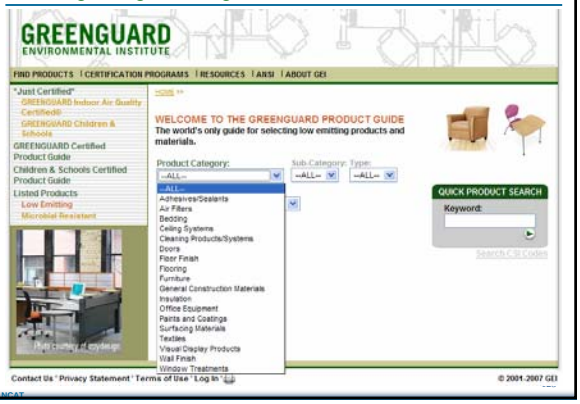
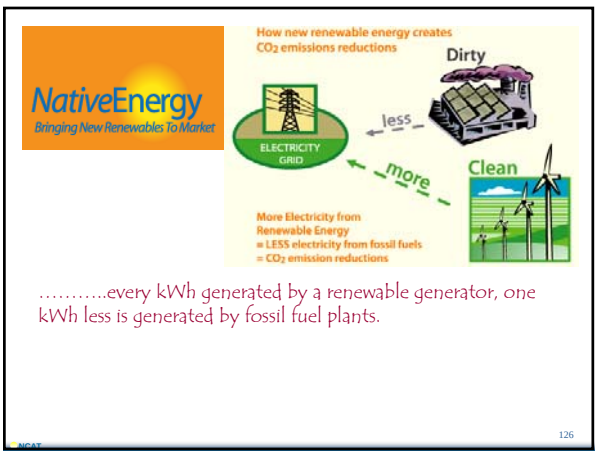
www.greenguard.org/





…….every kWh generated by a renewable generator, one kWh less is generated by fossil fuel plants.

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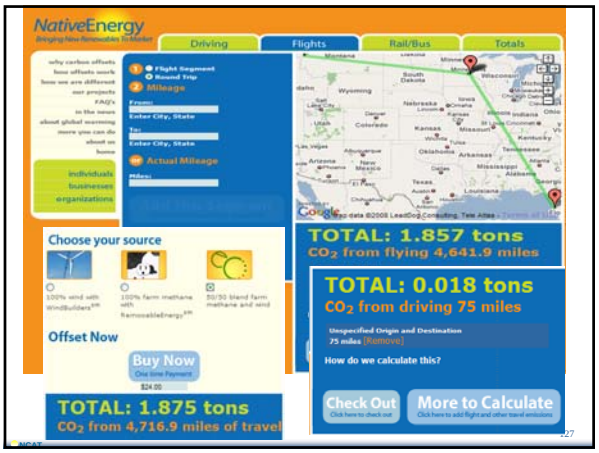


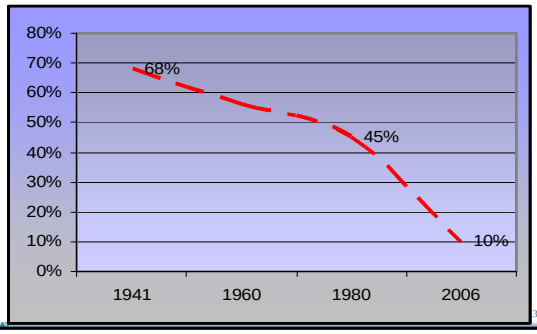
1,518 Miles……

The average distance that food travels from farm to fork in the US.

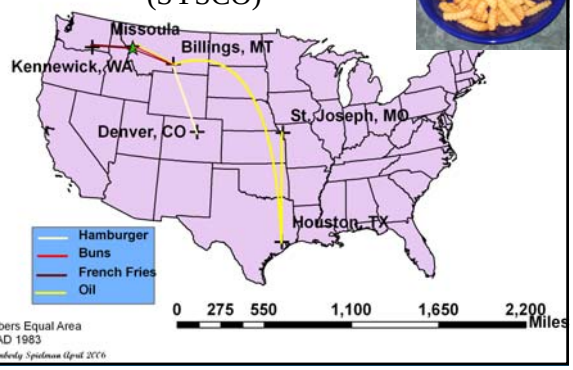
930 gallons of gasoline……

The energy equivalent required to grow, process and deliver the food consumed by a family of four in the US each year.

Montana produced 70% of its own food through the 1940s.

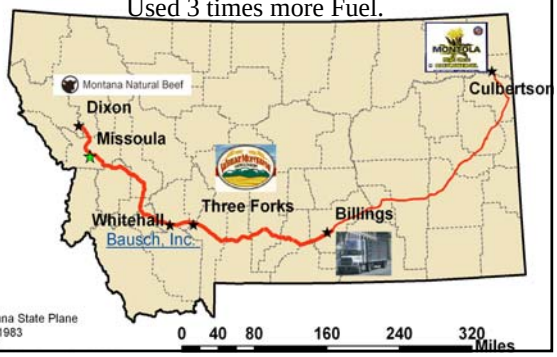


Conventionally Sourced UM Meal (SYSCO)



Conventional meal traveled **3 times** more miles than the Montana-sourced meal.

Used 3 times more Fuel.



Farmers' Markets in U.S.

•Farmers' markets still represent on 0.3% of food sales.

NCAT

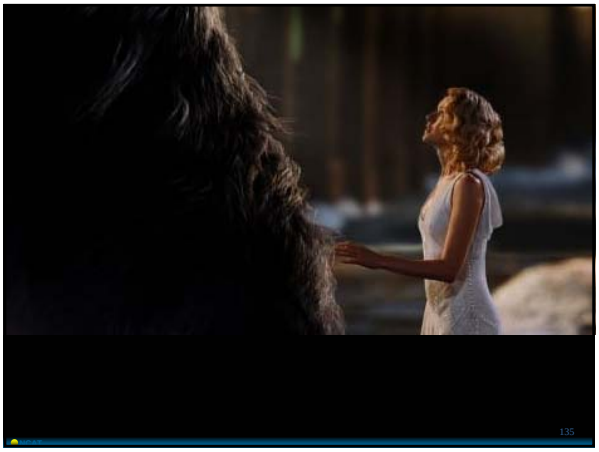
Sales of Organic Food

From $3 billion in 1997 to more than $10 billion in 2003.

Has grown by 20 percent annually.

Certified Organic

NCAT



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Green.

There is a lot at stake for all of us.

What Does Green Mean?

A holistic approach to creating better homes and communities for low-income people and a sustainable world.

What role with you play in creating clean and green jobs?

Presentation at

www.ncat.org

Go to "Sustainable Energy" then "Presentations/Downloads"

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