

Healthy Homes – The Delicate Balance between Energy Efficiency and Good Indoor Air Quality

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Learning Objectives

- Introduction to “green and healthy”
- Importance of good indoor air quality and achieving healthy homes
- Energy conservation and IAQ
- Recommendations



Environmental Footprint of Homes is Significant

- 48% of total US electricity consumption
- >21% of total US primary energy use
- 18% of total US greenhouse gas emissions
- 80 million tons construction / demolition waste in US
(~1.9 lbs/person/day)
- 25% (2 billion tons annually) raw materials used globally
- 72% of exposure to environmental pollutants

Source:



What is “Green Building”

To significantly reduce or eliminate the negative **impact of buildings** on the environment and on the **building occupants** (USGBC)

Increasing the efficiency with which buildings and their sites use and harvest energy, water, and materials; and **protecting and restoring human health** and the environment (US EPA)

The practice of increasing the efficiency with which buildings use resources — energy, water, and materials — while **reducing building impacts on human health** and the environment (Wikipedia)



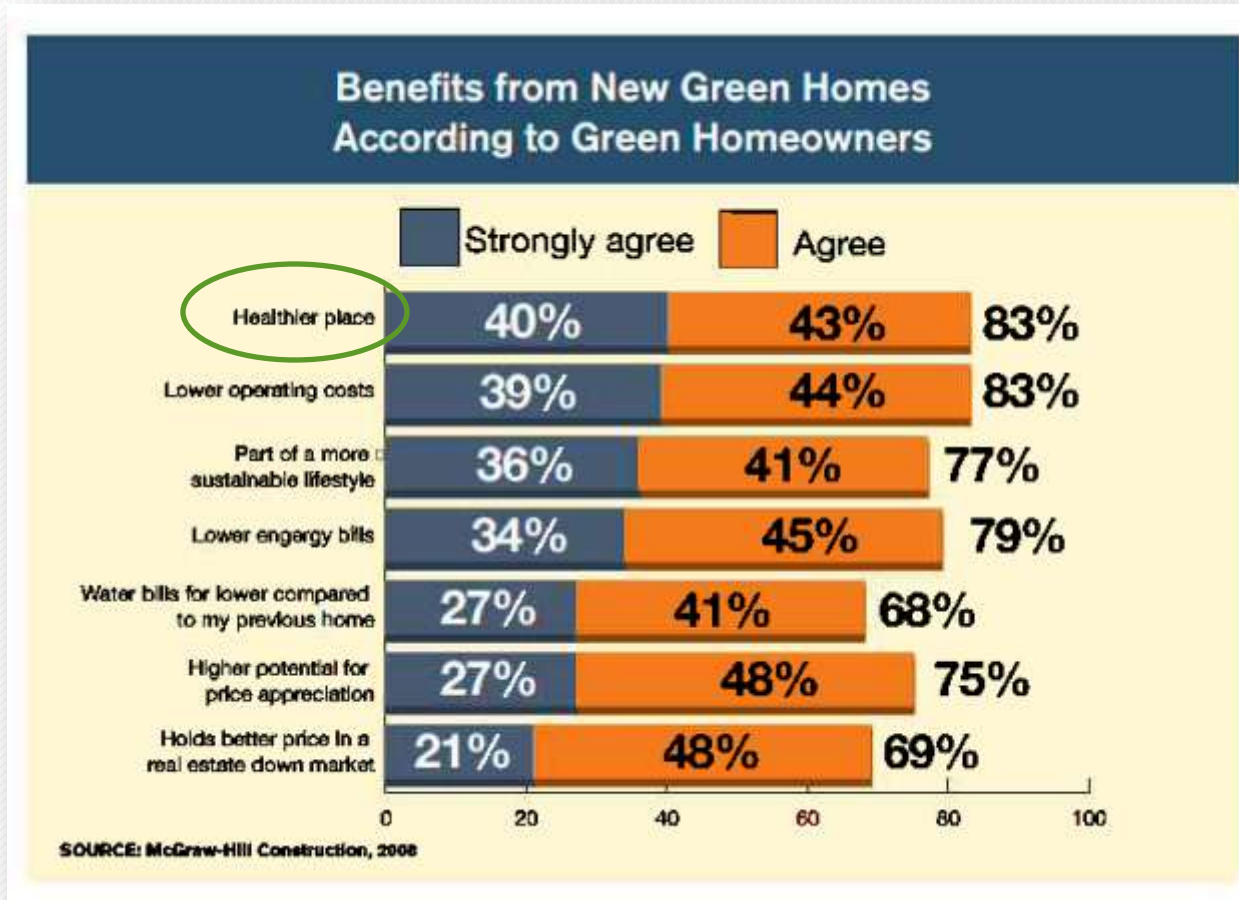
“Green” or “Sustainability” ??

Terms often used interchangeably

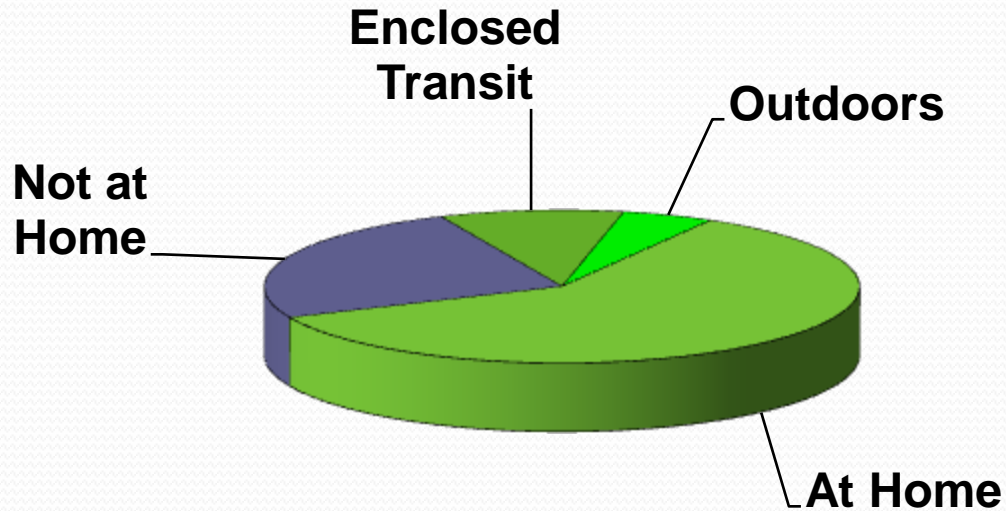
However...sustainability concepts are often much broader having the “Triple Bottom Line” goals of:

- *Social (**People**) ... Be Good*
- *Environmental (**Planet**) ... Do Good*
- *Financial (**Profit**...the lasting economic impact a company has on its economic environment) ... Make Good*

Health & Well Being is Key Consideration



The IAQ Connection



Buildings are for All Populations

- Children
- Adults
- Elderly
- Sick
- Even pets!
- All sensitivities

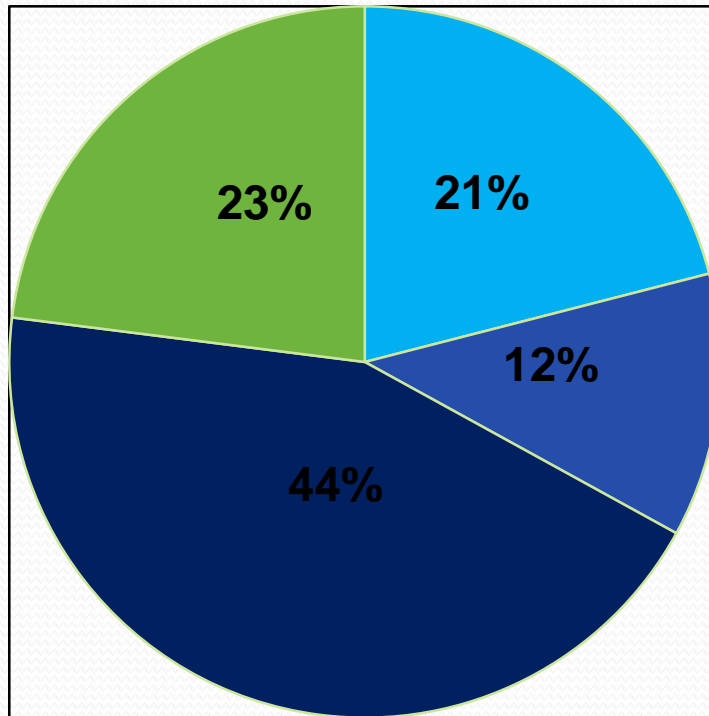






Indoor Air Quality

- Air pollutants 2-5 times (sometimes 1,000) higher than found outdoors
- Homes 2-3 times higher than commercial spaces
- Carcinogens
- Reproductive toxins
- Neurotoxins



Common VOCs in the Air



-  Carcinogens
-  Reproductive Toxins
-  Odorants/irritants
-  Other

Indoor Air Pollution Leads to Health Consequences

- Asthma and allergies
- Cancer
- Reproductive / developmental defects
- Cardiovascular disease
- Respiratory disease
- Irritation

- Autism
- Neurological Disease



Most Common Indoor Pollutants

- Molds and allergens
- Volatile Organic Chemicals (VOCs)
- Formaldehyde
- Radon
- Particles (dust)
- Carbon monoxide
- Carbon dioxide
- Ozone



Additional Millennial Pollutants

- Phthalates
- Mercury
- Pesticides
- Combustion VOCS



VOCs Sources Are Numerous...



- Wallcovering, floor covering
- Paints, adhesives, sealants, cleaners
- Cabinetry, furniture
- Computers, printers
- Hobby/repair supplies
- Bedding
- Mold VOCS

Most Common Residential Pollutants

- Formaldehyde
- Hexanal
- Toluene
- Glycols
- Xylenes
- Undecane



Common Indoor Odorants/Irritants

- 4-Phenylcyclohexene
- Limonene/pinene
- Ethanol/hexanol
- Methylbenzenes

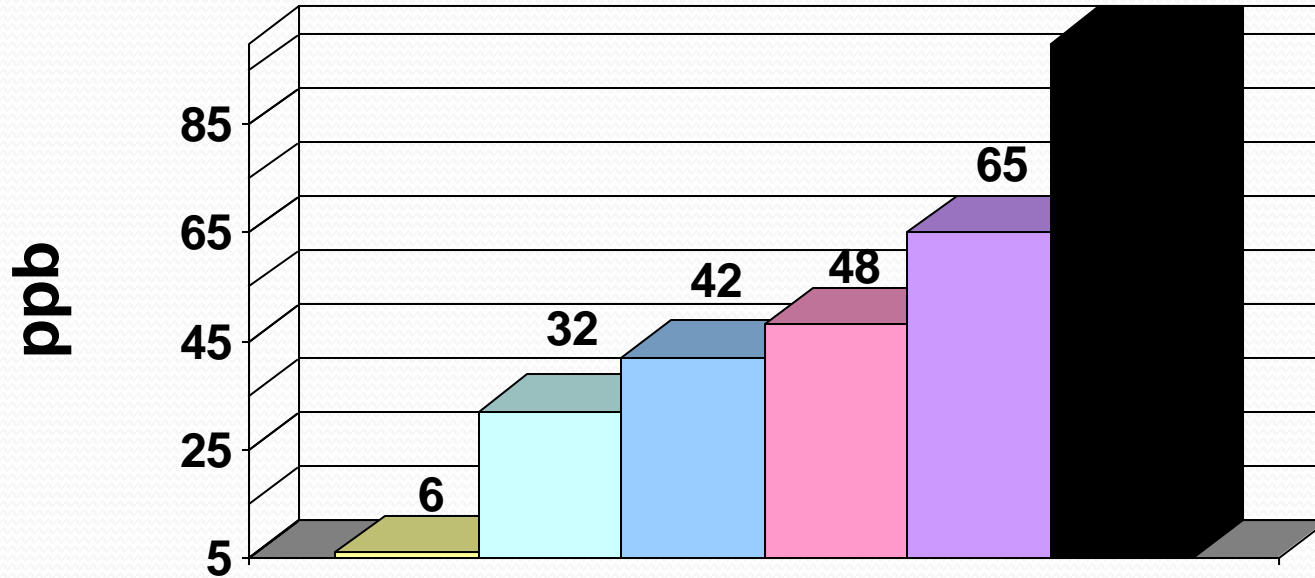


VOCs and Formaldehyde - What's the Fuss??

- Prolific chemicals
- Indoor and outdoor
- Upper/lower airway irritant
- Eye irritants
- Exacerbates asthma/allergic reactions
- Carcinogens
- Reproductive toxins
- State/federal efforts to reduce levels

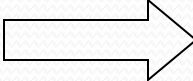


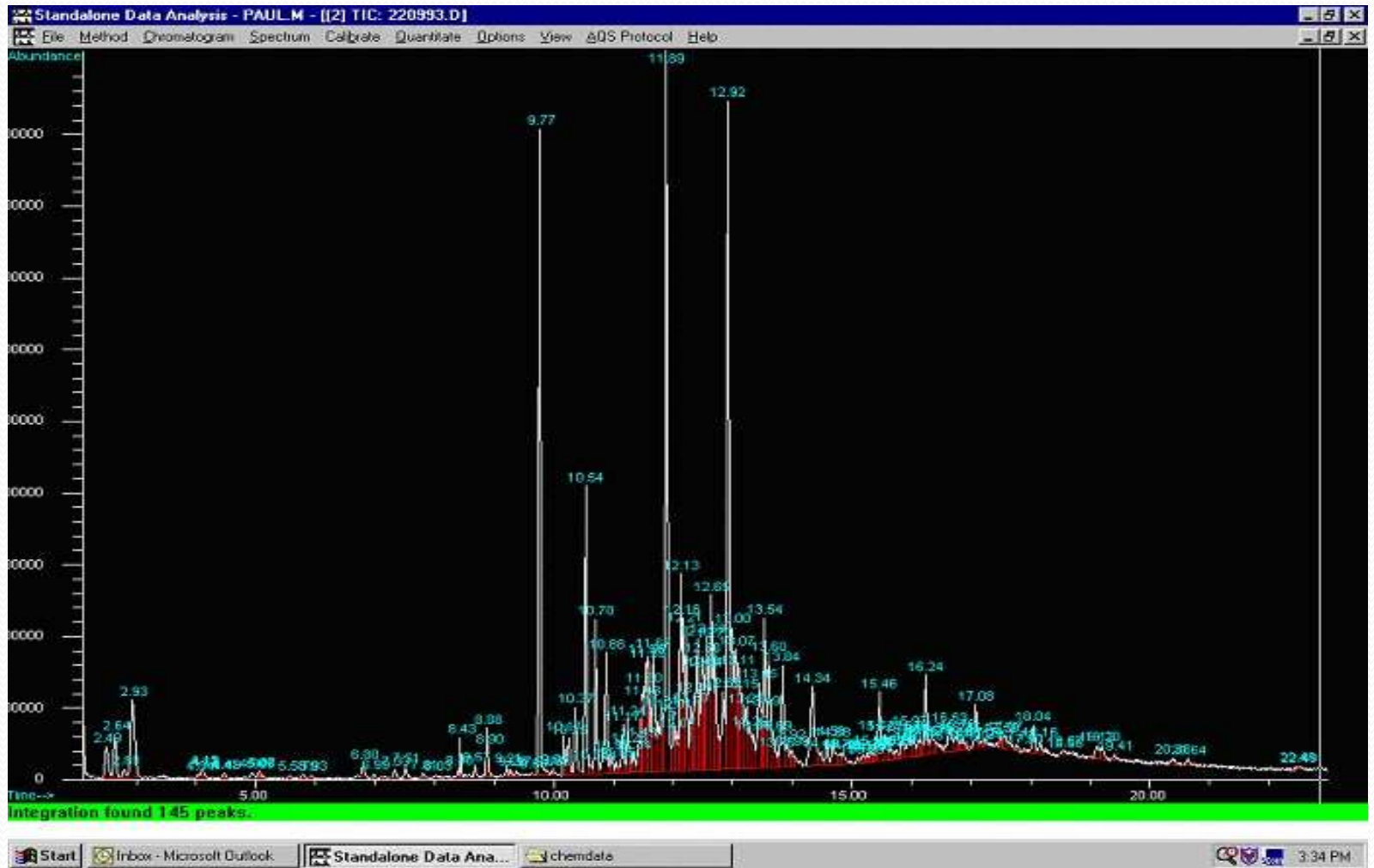
Airborne Levels - Formaldehyde



- Outdoor
- Offices
- Schools
- Residences
- Manufactured Homes
- Home-1

Mercury - Hg

- Neurotoxin
- Children very sensitive
- Pass from Mother  Child
- Nervous, digestive, kidney damage
- Can become airborne



Green Building Certification

- An important step in achieving a high performance sustainable building
- But it must provide a healthy environment instilling a sense of well being



A Survey of 6 High Performance Homes Advocating Healthier Resource Efficient Living

- Energy and Water Focus

- Solar Panels
- Solar Tubes/Highlights
- Ground Source Heat Pump
- Tankless Water Heaters
- Low/Automated Faucets
- Rain Water Cisterns
- Dual/Low Flush
- Use of Greywater



A Survey of 6 High Performance Homes Advocating Healthier Resource Efficient Living

Continued....

- Low VOC materials
- Natural Fibers
- Soy Based Foam Insulation
- Hay Straw Cabinets
- Wood Floors
- Recycled Content
- HEPA Filters

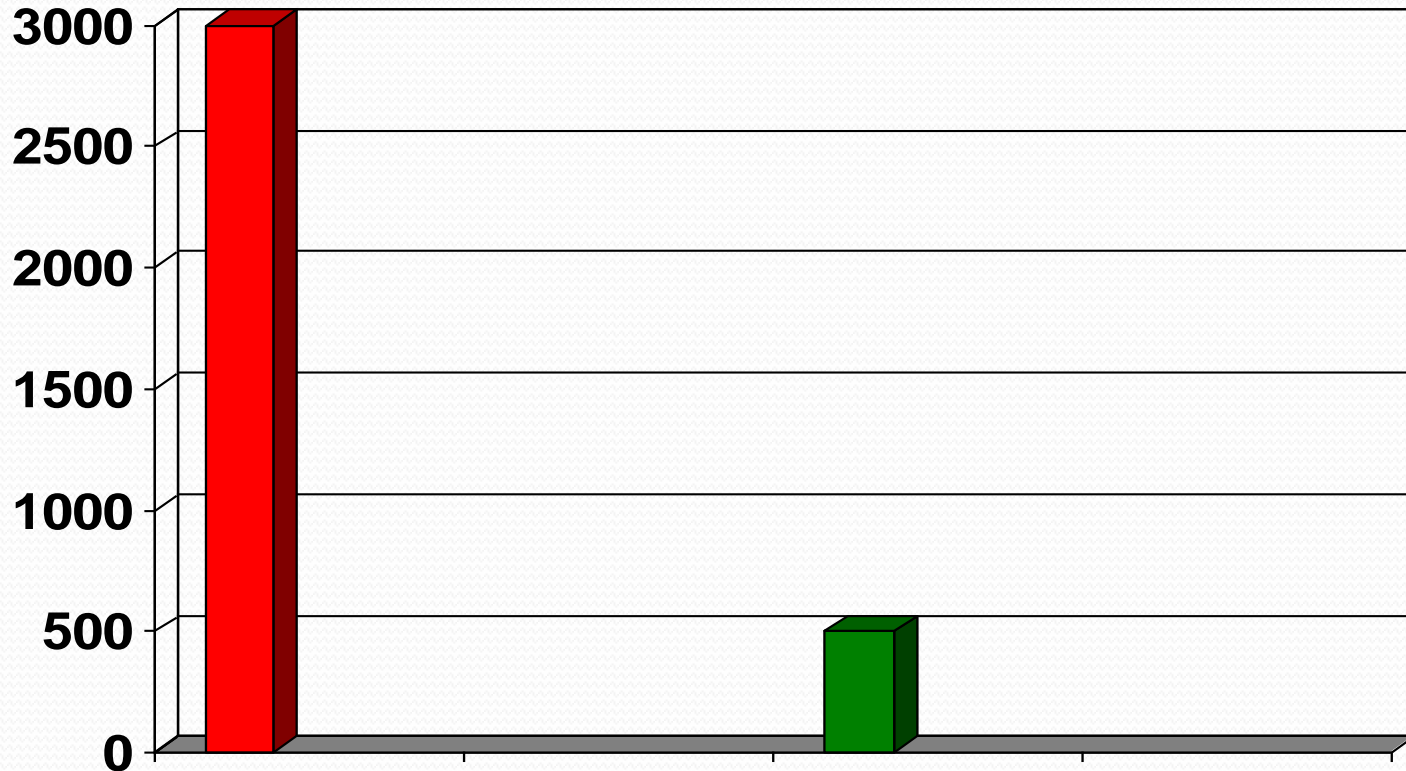


Case Study-Home 1

- LEED Gold Certified home
- 6 months old
- Home residents experiencing irritation and flu-like symptoms
- Odor present



TVOC Levels



Chemicals Present – Over 375 Different Ones

- Formaldehyde
- Acetaldehyde
- Glycols
- Mercury
- Ammonia
- Plasticizers



Sources Of Chemicals In Home

- Gypsum Board / light bulbs - mercury
- Spray Foam insulation - glycols/acetaldehyde
- Wood floor / adhesive – acetaldehyde
- Cellulose insulation – ammonia
- Kitchen cabinetry/finish – formaldehyde
- Bamboo bedding – formaldehyde
- Light fixtures - plasticizers

Additional IAQ Issues

- Moisture leaks – leading to mold / ammonia
- Ozone from electrostatic air cleaner
- Terpenes / butylcellusolve from “green” cleaners being used (50 times higher in VOCS than fragranced counterpart)

Mold In Garage

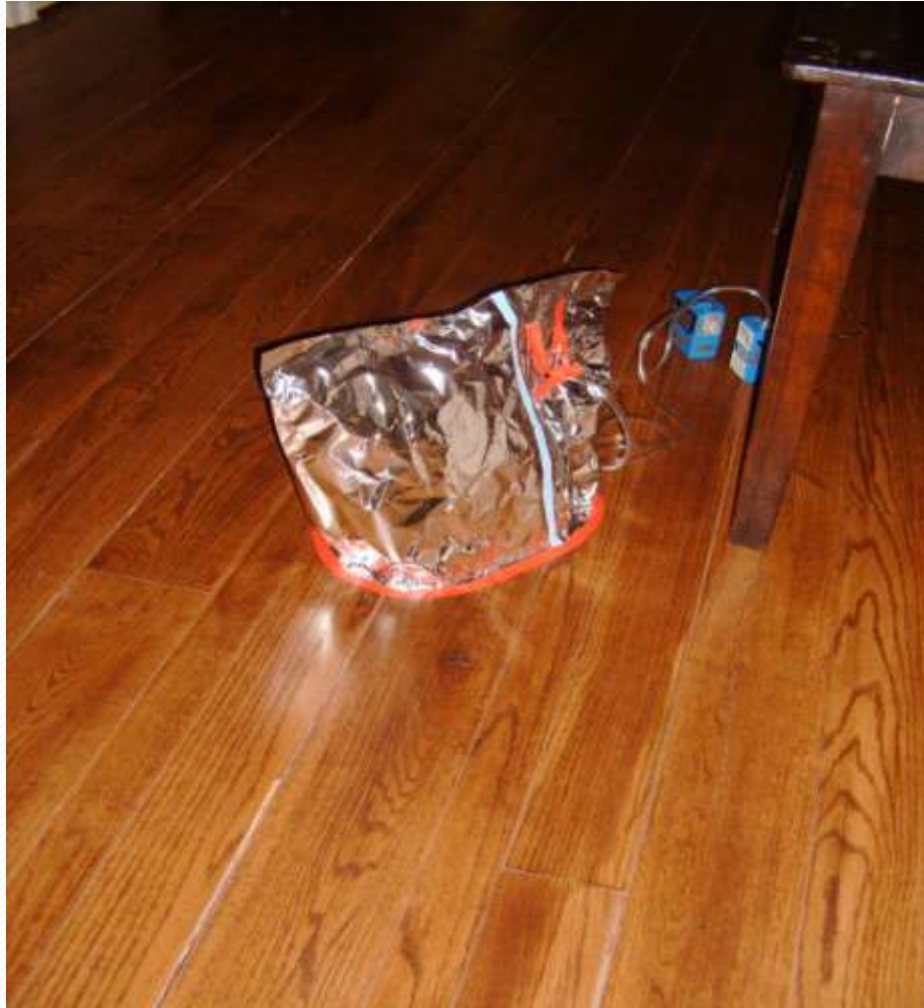


Key Primary Sources Of High Chemical Levels

- Wood Flooring Finish
- Foam Insulation
- Kitchen Cabinetry



Floor Sampling



Kitchen Cabinets



Foam Insulation In Test Chambers



Chemical Levels 18 Months Later

Acetaldehyde	-	76	vs	9	X
Formaldehyde	-	70	vs	13	X
TVOC	-	52	vs	500	OK
Mercury	-	none	vs	<0.1	OK

Did Home-1 Follow Green Design Principles?

- Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas:
- Sustainable site planning
- Safeguarding water and water efficiency
- Energy efficiency and renewable energy
- Conservation of materials and resources
- Indoor environmental quality - NO



What are the Problems?

- Green Building Rating systems are heavily weighted to energy conservation
- Less emphasis on Indoor Air Quality
- No Building or Home IAQ Acceptance
- Tight Homes/ High Emitting Products lead to unhealthy homes



Be Aware of Greenwashing

- Beware “VOC-Free” Products!
“...does not participate in outdoor atmospheric photochemical reactions”
- Does NOT mean it does not emit VOCs (most do!)
- Beware of
“Natural”...”Alternative”...”Generic”...
- Make sure products are verified as whole



Natural is Not Always GOOD

Cellulose Insulation

- Ammonia source
- Replacement
- Susceptible to mold growth

Cleaner

- Limonene / Terpene source
- 50 times higher than non-fragrance product

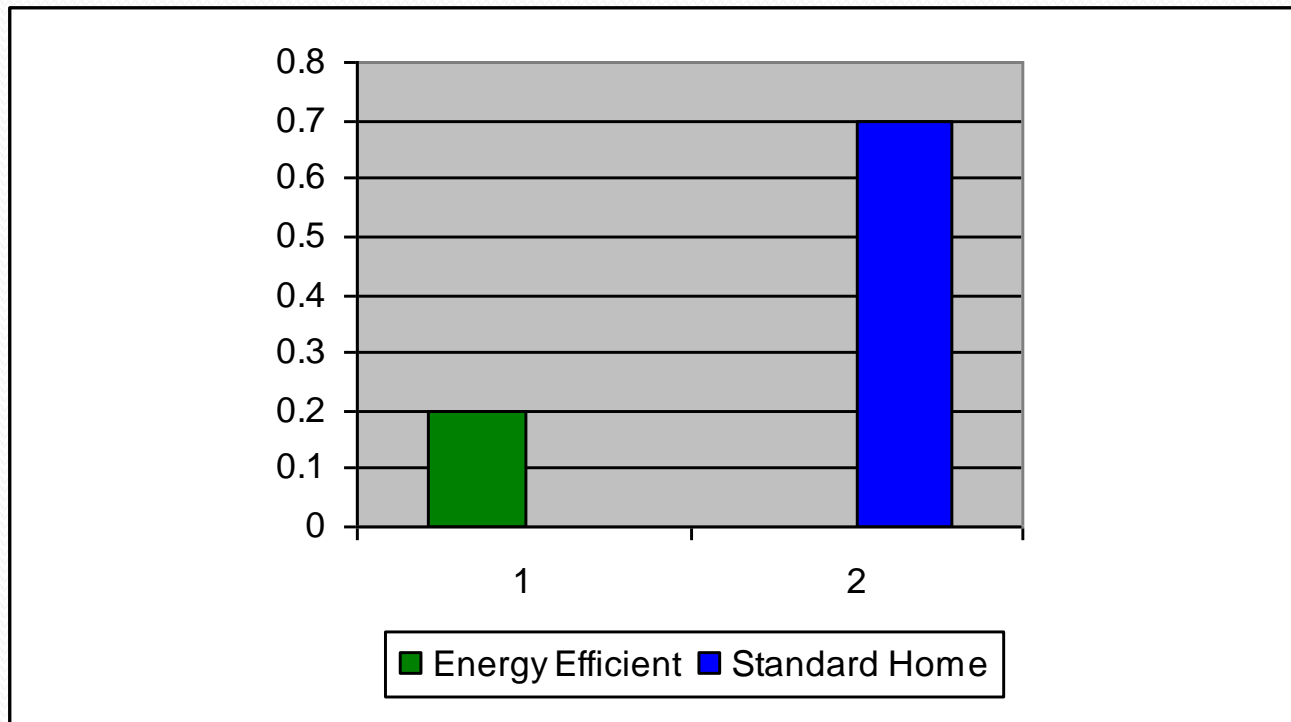
Recycled Fiberboard

- Formaldehyde
- 20 times higher than original



Energy Efficient Ventilation Means Less Air

Higher Pollutant Levels



Focus Key Products/ Construction for Low Emissions

- Paints/ wallcoverings
- Adhesives / sealants
- Cabinetry
- Floor finishes
- Insulation
- Wallboard
- Decorative paneling



Follow Important Guidelines For Construction/Renovation



Considerations to Minimize Indoor Pollutants:

- Select low emitting products / materials
- Select mold resistant products
- Scheduling: allow wet materials to dry / cure before installing porous materials (secondary sources or “sinks”), and before re-occupancy (paints, adhesives)
- Clear air before occupancy
- Flush out if necessary

Perform Clearance Evaluation Prior To Occupancy

- <500 mg/m³ TVOC
- <50 µg/m³ particles (<10µm)
- <27 ppb formaldehyde
- <0.05 ppm ozone
- <9 ppm carbon monoxide
- No measurable heavy metals / phthalates
- No individual VOCS above acceptable health risk recommendations
- No moisture intrusion



Must Use Low Emitting and Non-Toxic Mold Resistant Products

Independent Third Party Certification with emission testing

- Provides a label to easily identify certified products
- Provides specification confidence of final product
- Requires ongoing verification



IAQ as an Extremely Important Health & Environmental Issue

IAQ is an extremely important *health and environmental issue* to approximately 1/3 of respondents

KEY TRENDS:

- *Interest in IAQ increases substantially when consumers reach 35*
- *It is more important to women than men*
- *It decreases in importance with education & income*
- *Much more important to 45+ women versus 45+ men*

Importance of IAQ to Consumers

- 69% of consumers prefer to buy IAQ Certified products
- Consumers preference for types of products to be IAQ certified
 - Paint, carpet/flooring & bedding/mattresses
 - Textiles, furniture & appliances
 - Consumer electronics (computers, TVs, printers)
- Consumers want objective, outside organizations to handle IAQ certification, and not:
 - 54% retailers
 - 45% manufacturers
 - 39% industry trade associations

Why Third-Party Certification Matters?

- Public health concerns
- Trust and credibility vs. marketing claims
- Cut through “greenwashing”
- No official standards or regulations worldwide



Questions?

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