



OUR BUILDINGS . . .
OUR HEALTH



Learning Objectives

- Identify Chemicals of Concern
- Improve the built environment through Design & Construction
- Find Solutions through Building Science
- Recognize best Heating, Ventilation and Cooling strategies
- Make an Impact using Quantitative Research

Our Built Environment



- Tobacco smoke
Cancer · Heart Disease · Respiratory Illness
- Biological contaminants
Respiratory Illness · Lung Disease · Stress
- Combustion by-products
Cancer · Respiratory Illness · Lung Disease
- Household products
Cancer · Respiratory Illness · Diseases (neurological)
- Toxic materials
Cancer · Respiratory Illness · Diseases (neurological)
- Radon
Cancer
- Safety & security
Stress
- Diet & Exercise
Cancer · Heart Disease · Respiratory Illness

Avoid Chemicals of Concern



- Toxic materials
- Radon
- Safety & security
- Diet & Exercise

• Tobacco smoke

• Fragrances

- Nonylphenol Ethoxylates (NPE)

• Consumer products

- Phthalates

• Paints

- Antimicrobials

- Flame Retardants

- Perfluorinated Chemicals (PFC)

Avoid Chemicals of Concern



Building Science Basics

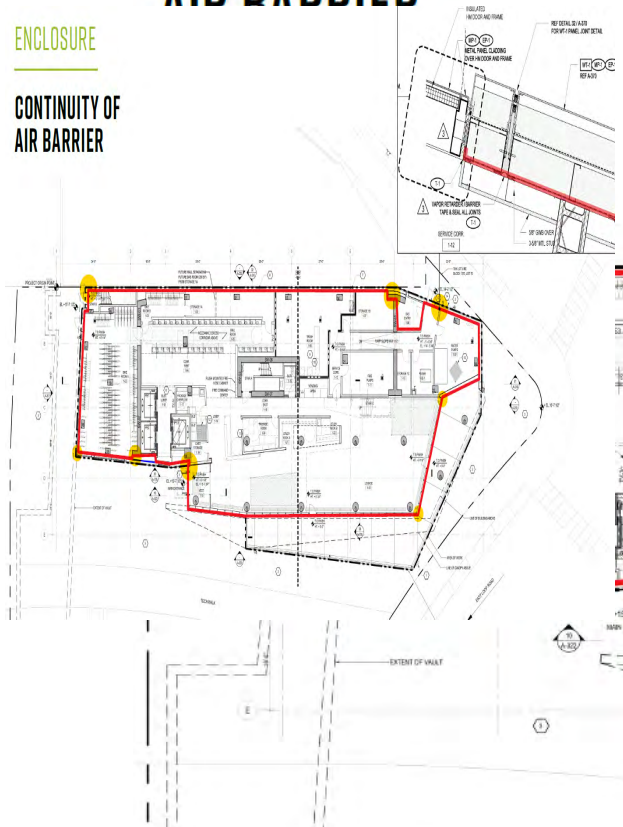


ENCLOSURE

CONTINUITY OF AIR BARRIER

ENCLOSURE

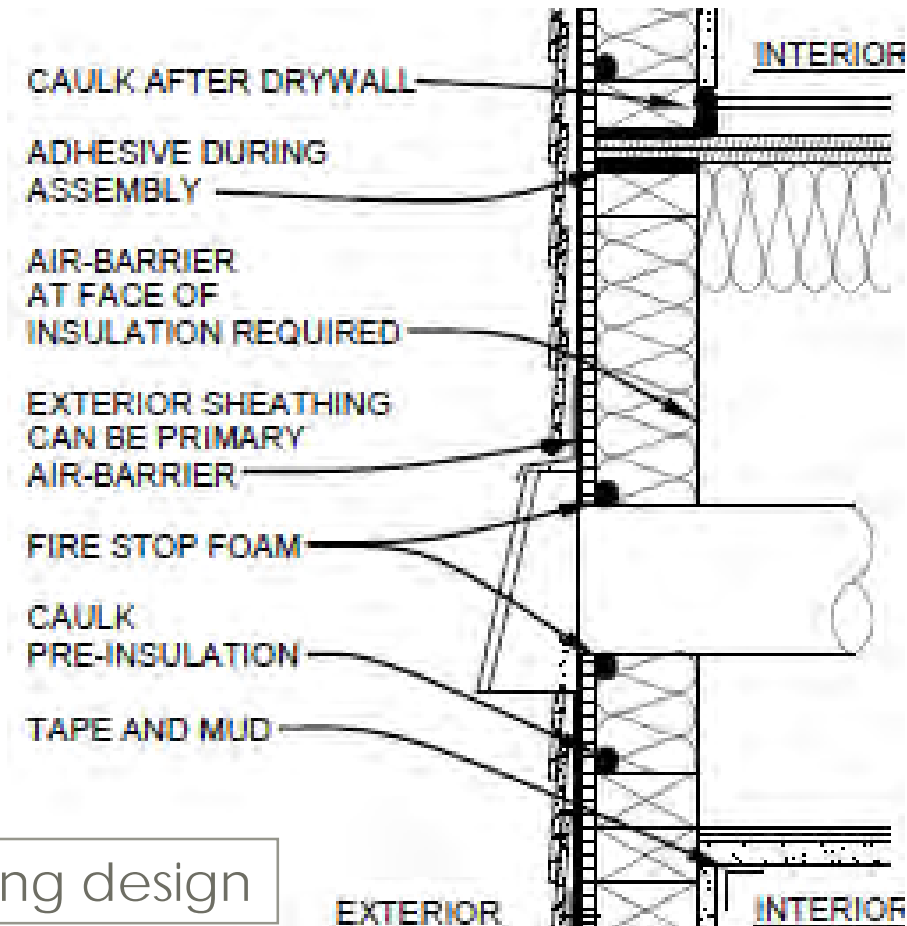
CONTINUITY OF AIR BARRIER



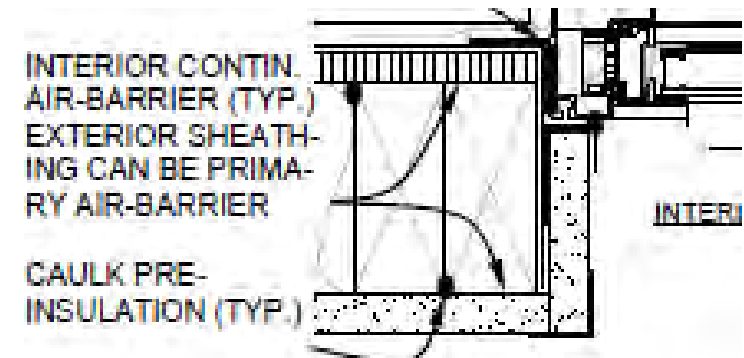
Air Barrier Drawing Set

Air Barrier Installed

Building Science Basics



Air sealing during design



Air sealing during construction

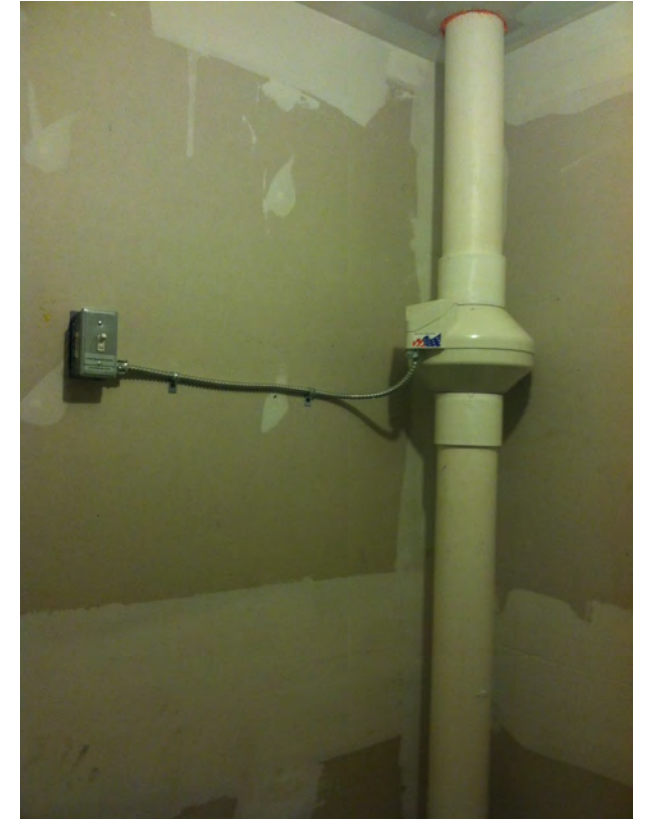
Building Science Basics



Existing · Crawl Space



New · Crawl Space



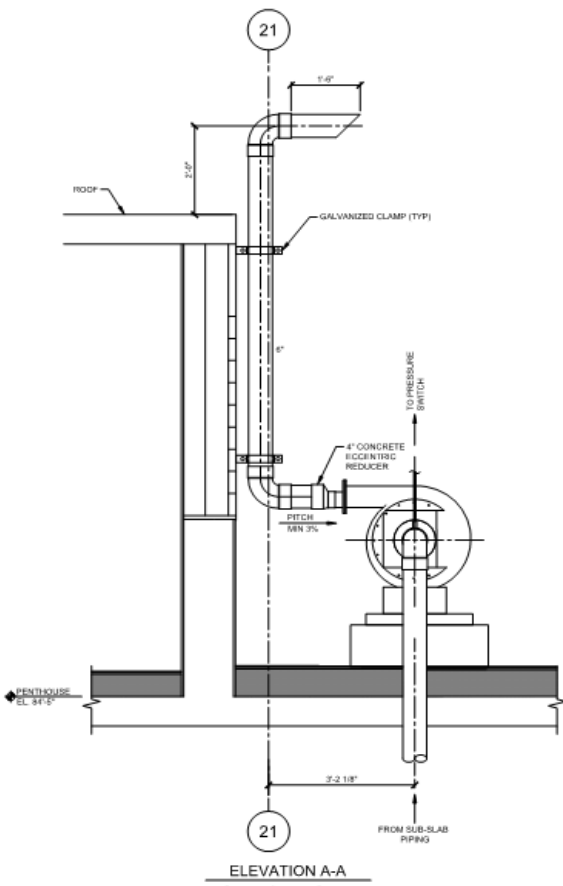
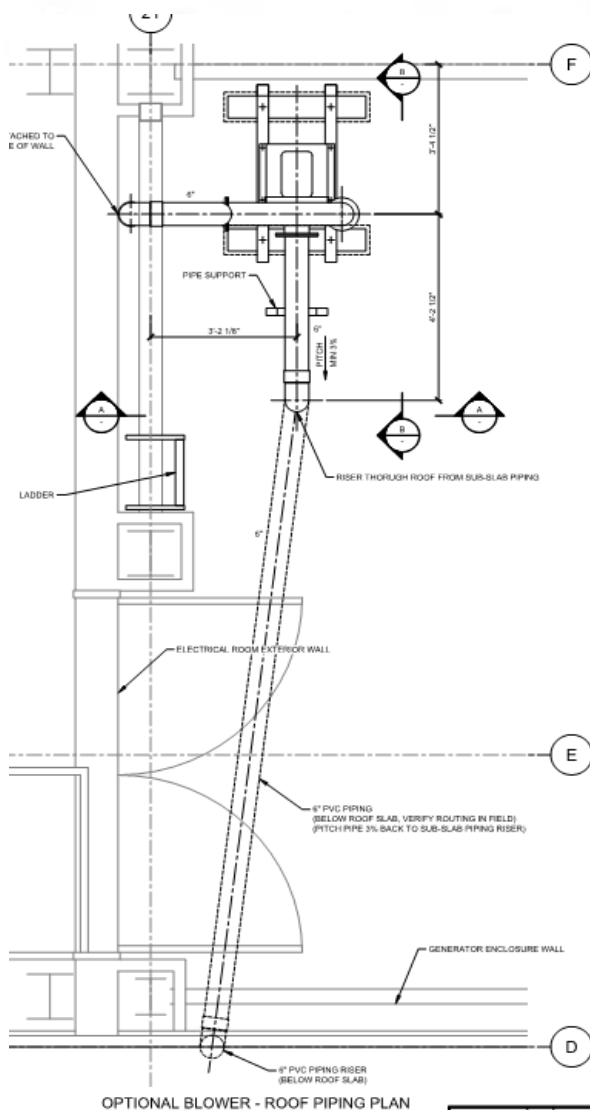
Crawl Space Exhaust Fan

During Design & Construction

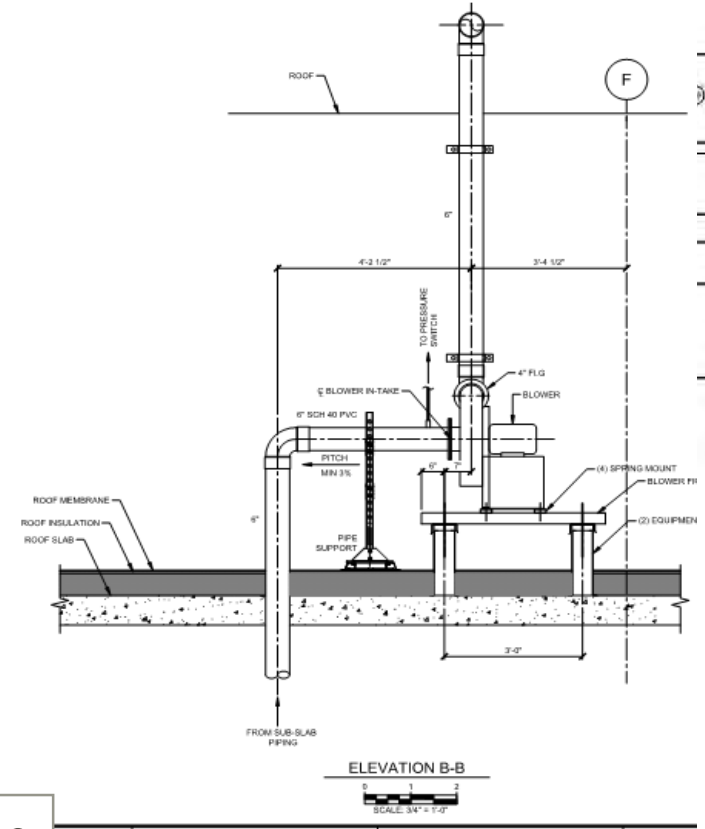


New · Full Foundation

During Design & Construction

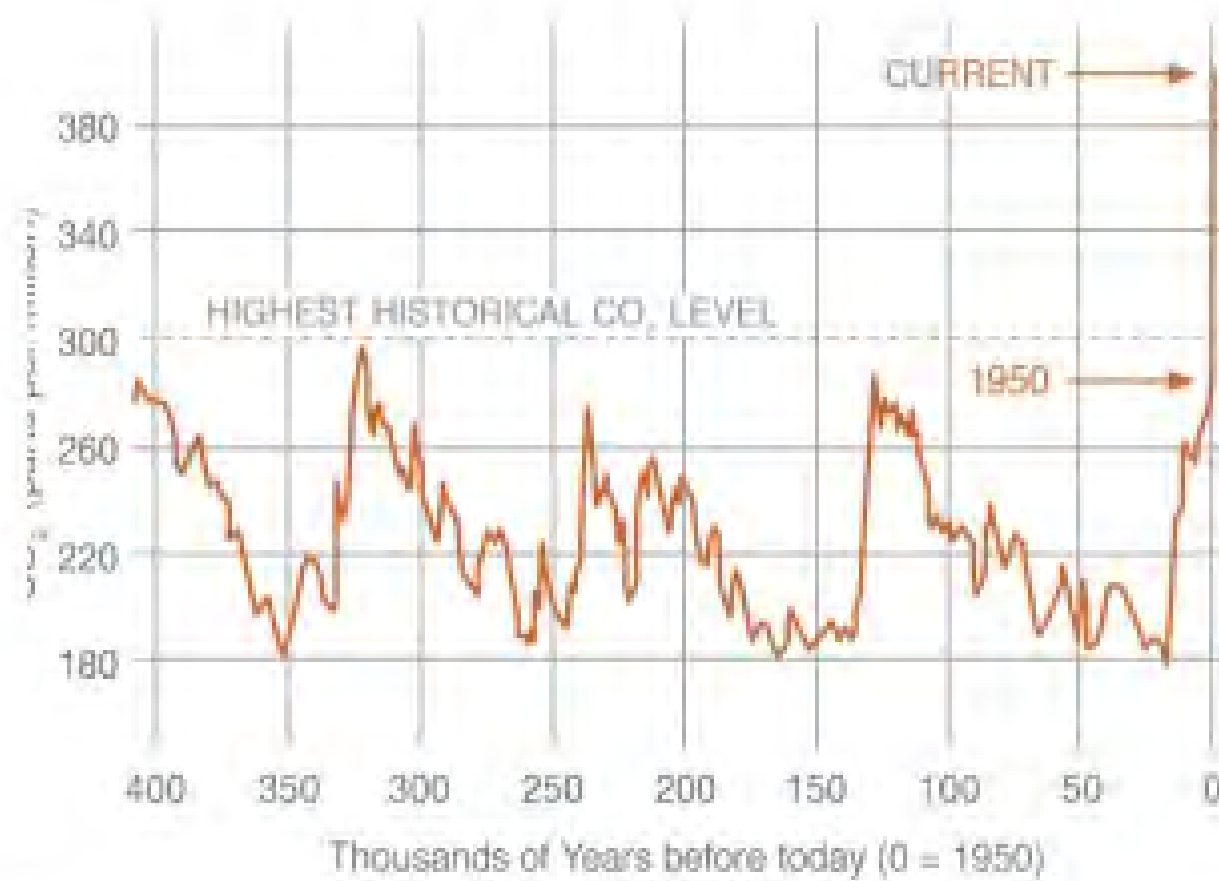


1. ALL COMPONENTS SHALL BE NEW UNLESS OTHERWISE SPECIFIED.
2. DAMAGE AREAS TO THEIR ORIGINAL CONDITION AT NO ADDITIONAL COST.
3. BLOWER: RADIAL BLADED PRESSURE BLOWER BY CONINCH/FAN HP SERIES 8, MODEL HP-4417, ARRANGEMENT 4, TOP HORIZONTAL DISCHARGE, MOTOR: 3 HORSEPOWER, 3600 RPM, 480V, 3 PHASE, 208-230V, PREMIUM EFFICIENCY, FRAME 187, CAPACITY: 590 CFM AT 30 INCHES WATER COLUMN STATIC PRESSURE AT STANDARD CONDITIONS. BLOWER SHALL BE TEST RUN AT FACTORY BEFORE SHIPPING. THE FOLLOWING MANUFACTURER'S ACCESSORIES SHALL BE INCLUDED: 1/2\"/>
- 4. BLOWER FRAME: DESIGN AND EQUIPMENT TO BE PROVIDED BY CONTRACTOR. GALVANIZED STEEL 6 GAUGE (MINIMUM) 300 LB LOAD CAPACITY (MINIMUM). MOTOR AND BEARING VIBRATION LEVELS SHALL NOT EXCEED 1.5 MILS DISPLACEMENT AT 200 RPM.
- 5. SUBMIT SHOP DRAWING OF BLOWER FRAME ASSEMBLY FOR APPROVAL.
- 6. PROVIDE VARIABLE FREQUENCY DRIVE (VFD) WITH NEMA 4 ENCLOSURE, COMPATIBLE WITH THE BLOWER. INTERLOCK THE BLOWER VFD TO THE BUILDING FIRE ALARM SYSTEM, TO SUSPEND ELECTRICAL POWER TO THE BLOWER DURING AN ACTIVE FIRE ALARM. INSTALL VFD ON BLOWER FRAME, OR ALTERNATIVELY ON EXTERIOR WALL OF ELECTRICAL ROOM.
- 7. PROVIDE SHUTOFF SWITCH ON THE BLOWER FRAME FOR THE BLOWER ELECTRICAL SUPPLY, WITH LOCK-OUT/TAG-OUT CAPABILITY. PROVIDE OUTDOOR 115V DUPLEX RECEPTACLE ON THE BLOWER FRAME.
- 8. CONNECT BLOWER TO VFD, AND VFD AND DUPLEX RECEPTACLE TO ROOFTOP ELECTRICAL RACKS/RISERS/PANELS.
- 9. ALL ROOFTOP ELECTRICAL EQUIPMENT SHALL BE RATED FOR CONTINUOUS EXPOSURE OR PROTECTED IN ENCLOSURES DESIGNED FOR OUTDOOR USE.
- 10. PRESSURE SWITCH: NEGATIVE AIR PRESSURE SENSING SWITCH, FIELD ADJUSTABLE SETPOINT RANGE FROM 1.0 TO 1.07 IN. W.C., MAX. VACUUM RATING 1.0 IN. W.C. (MINIMUM), OPERATING TEMPERATURE RANGE -40° TO 100° F, NEMA 4 ENCLOSURE. CONNECT PRESSURE SWITCH OUTPUT TO BMS ROUGH-IN.
- 11. HORIZONTAL PIPE SUPPORT: DURA-BLOCK BR. 26 SERIES, OR EQUIVALENT.
- 12. INSULATE ALL EXTERIOR PIPING WITH OUTDOOR RATED, CLOSED CELL FOAM PIPE INSULATION, MINIMUM ONE INCH THICK, WITH A WEATHERPROOF AND UV RESISTANT JACKET OR FINISH, WITH 6\"/>
- 13. ALL PIPING SHALL USE LONG RADIUS FITTINGS UNLESS OTHERWISE NOTED, OR APPROVED IN ADVANCE BY ENGINEER.



Radon Mitigation Plans

Provide Efficient HVAC



HISTORY OF ATMOSPHERIC CO₂

SOURCE: NOAA

Provide Efficient HVAC



MERV RATING CHART

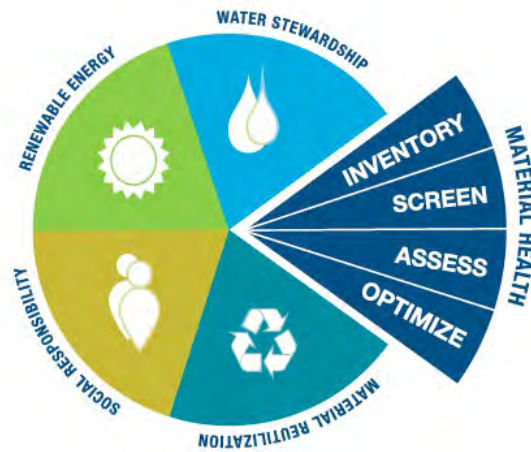
14	90-95%	>98%	Most Tobacco Smoke	Smoking Lounges	synthetic media, 12-36 in. deep, 6-12 pockets
13	89-90%	>98%	Proplet Nucell (Sneeze)	Superior Commercial Buildings	Box Filter- Rigid Style Cartridge Filters 6 to 12" deep may use lofted or paper media.
12	70-75%	>95%	1.0-3.0 pm Particle Size Legionella	Superior Residential	Bag Filter- Nonsupported microfine fiberglass or synthetic media, 12-36 in. deep, 6-12 pockets
11	60-65%	>95%	Humidifier Dust Lead Dust	Better Commercial Buildings	Box Filter- Rigid Style Cartridge Filters 6 to 12" deep may use lofted or paper media.
10	50-55%	>95%	Milled Flour Auto Emissions	Hospital Laboratories	
9	40-45%	>90%	Welding Fumes		
8	30-35%	>90%	3.0-10.0 pm Particle Size	Commercial Buildings	Pleated Filters- Disposable, extended surface area, thick with cotton-polyester blend media

Avoid Chemicals of Concern



- Asbestos
- Cadmium
- Chlorinated Polyethylene & Chlorosulfonated Polyethylene
- Chlorofluorocarbons (CFCs)
- Chloroprene (Neoprene)
- Formaldehyde (added)
- Halogenated Flame Retardants
- Hydrochlorofluorocarbons (HCFCs)
- Lead (added)
- Mercury
- Petrochemical Fertilizers and Pesticides
- Phthalates
- Polyvinyl Chloride (PVC)
- Wood treatments with Creosote, Arsenic or Pentachlorophenol

Avoid Chemicals of Concern



Declare.



Avoid Chemicals of Concern



Assembly	Component	Location	Occupant Exposure	Materials to Avoid	Concerns	Alternatives	Brand
<u>Foundation</u>	Concrete	Exterior	Negligible		Cement: CO2 & heavy metal emissions, airborne pollution, quarrying	Superior Wall (extruded polystyrene foam insulation)	
	Waterproofing	Exterior	Negligible		Styrene-butadiene (possible carcinogen)	Drainage Boards/Mats	
	Drainage Mat	Exterior	Negligible				
	PVC Drainage	Exterior	Negligible	Polyvinyl Chloride (PVC)	Manufacturing Concerns		
	Masonry	Exterior	Negligible				
	Masonry Ties	Exterior	Negligible				
<u>BG Walls</u>	Slab Insulation	Interior	Negligible	EPS, XPS, Polyiso	(MDI) methylene diphenyl diisocyanate	Cellular Glass Insulation	FoamGlas
	Studs	Interior	Moderate				
	Insulation	Interior	Moderate	Spray Foam Insulation	Isocyanates, MDI, polyols (catalysts)	mineral wool	
	Drywall	Interior	Certain	paper faced	mold/moisture	paper-less board	Dense Shield
	Drywall Sealant	Interior	Certain		toluene diisocyanates (TDIs)	California Air Resources Board (CARB) compliant	

Avoid Chemicals of Concern



Assembly	Component	Location	Occupant Exposure	Materials to Avoid	Concerns	Alternatives	Brand
<u>Floor</u>	Floor Joists	Interior	Moderate		Urea Formaldehyde Binders	Methal diisocyanate (MDT), Phenol-resorcinol Formaldehyde	Timberstrand
	Floor sheathing	Interior	Moderate	OSB	Formaldehyde	HPVA compliant (meets CARB)	Plywood, AdvanTech
	Subfloor Sealant	Interior	Certain		toluene diisocyanates (TDIs)	California Air Resources Board (CARB) compliant	Armstrong
	Rim Joist Insulation	Interior	Moderate	Spray Foam Insulation	Isocyanates, (MDI) methylene diphenyl diisocyanate; polyols (catalysts)	blown fiberglass w/ low VOC sealant	Johns Manville, Knauf
<u>AG Walls</u>	Cavity Insulation	Interior	Moderate	Spray Foam Insulation	Isocyanates, MDI, polyols (catalysts)	blown fiberglass w/ low VOC sealant	Johns Manville, Knauf
	Continuous Insulation	Exterior	Negligible	EPS, XPS, Polyiso	MDI	mineral wool	Insulated ZIPS
	Sheathing/Air Barrier	Exterior	Negligible	Particle Board	Binders	Hardwood sheathing	ZIPS
	Drywall	Interior	Certain	paper faced	mold/moisture	paper-less	

Avoid Chemicals of Concern



Assembly	Component	Location	Occupant Exposure	Materials to Avoid	Concerns	Alternatives	Brand
<u>Roof</u>	Rafters	Interior	Moderate				
	Sheathing	Exterior	Negligible			Hardwood sheathing	ZIPS
	Cavity Insulation	Interior	Moderate	Spray Foam Insulation	Isocyanates, (DMI) methylene diphenyl diisocyanate; polyols (catalysts)	blown fiberglass w/ low VOC sealant	
	Continuous Insulation	Exterior	Negligible	EPS, XPS, Polyiso	MDI		
	Ice & Water Shield	Exterior	Negligible	Petroleum, Asphalt	polynuclear aromatic compounds (PACs) Possible Carcinogen		
	Roofing	Exterior	Negligible	Asphalt	PACs		
<u>DHW</u>	Penetration Sealant	Exterior	Moderate				
	Pipe	Interior	Certain		ethyltertbutyl ether (ETBE)	NSF's Standard 61 tested PEX	
	Insulation	Interior	Moderate			low VOC	Armacell

What Determines Health Outcomes?



It's not your genetic code...

it's your zip code!

Source: <https://www.cdc.gov/nchhstp/socialdeterminants/faq.html>

- >5% Genetics/biology
- ~20% Lifestyle/behavior
- ~20% Medical care
- ~55% Physical & social environment

Health and Well Being



Top Places to Live

Health and Well Being



Dirtyest Places to Live

Health and Well Being

WHAT'S IT MADE OF?




Solutions

Nutrition Facts	
Serving Size 1/2 cup (about 82g)	
Servings Per Container 8	
Amount Per Serving	
Calories 200	Calories from Fat 130
% Daily Value*	
Total Fat 14g	22%
Saturated Fat 9g	45%
Trans Fat 0g	
Cholesterol 55mg	18%
Sodium 40mg	2%
Total Carbohydrate 17g	6%
Dietary Fiber 1g	4%
Sugars 14g	
Protein 3g	
Vitamin A 10%	• Vitamin C 0%
Calcium 10%	• Iron 6%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300 mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4



TEKNOFLOR® Naturescapes HPD™
Shannon Specialty Floors

Final Assembly: Detmold, Germany
Life Expectancy: Commercial - 12 Years, Residential - 20 Years
End of Life Options: Take Back Program (100%)

Ingredients:
Polymer: Polyurethane; **Filler:** Calcium Carbonate, Zeolite; **Flame Retardant:** Aluminium Hydroxide; **Additives and Decor Paper Dyes:** Undisclosed (0.5-1.0%); **Foam Regulator:** White Oil; **Nonwoven:** Polypropylene, Polyester, Glass; **Decor Paper:** Cellulose; **Decor Paper Filler:** Kaolin; **Decor Paper Pigment:** Titanium Dioxide

*LBC Temp Exception I10-E4 Proprietary Ingredients <1%

Living Building Challenge Criteria:
SSF-0003
VOC Content: N/A
EXP. 01 MAY 2019
VOC Emissions: CDPH Compliant

Third Party Verified ✓
Declaration Status:
 LBC Red List Free
 LBC Compliant
 Declared

SPONSORED BY 2019 IBC® IBC® WAP Sustainability
INTERNATIONAL LIVING FUTURE INSTITUTE™ | declare@products.com

WHAT'S IT MADE OF?

As a business leader I am concerned about the health of our world - my employees, customers, communities, and the global environment. I am committed to reducing the use of chemicals that pose harm to human health and the environment.

I commit to ask my suppliers about the presence of the following chemicals of concern in the products that we produce, specify or purchase:

- + Antimicrobials
- + PVC, also known as vinyl
- + Flame retardant chemicals
- + Fluorinated stain treatments
- + VOC's including formaldehyde

sustainablefurnishings.org



Supply Chain Questionnaire

Thank you for completing this supply chain questionnaire about the products you supply.

Our company has signed The Pledge to Ask 'What's It Made Of?': <https://sustainablefurnishings.org/content/whats-it-made-of/>

As a next step I am committed to determining the presence or absence of the following chemicals of concern in the products that you provide to us: Flame Retardants, Fluorinated Stain/Water Resistant Treatments, Antimicrobials, Formaldehyde and Polyvinyl Chloride (PVC). Our goal is to improve the health of our customers, employees, communities and the global environment by reducing the use of harmful chemicals that pose harm to human health and the environment.

We wish to improve our supply chain with your help, and we thank you in advance for your partnership in this endeavor.

The deadline to submit responses is by _____ (date).
If you have any questions about the survey, please contact _____ (name and phone number or person).

* Required

Email address *
Your email _____

Name and Title of Person Completing Questionnaire *
Your answer _____



Solutions

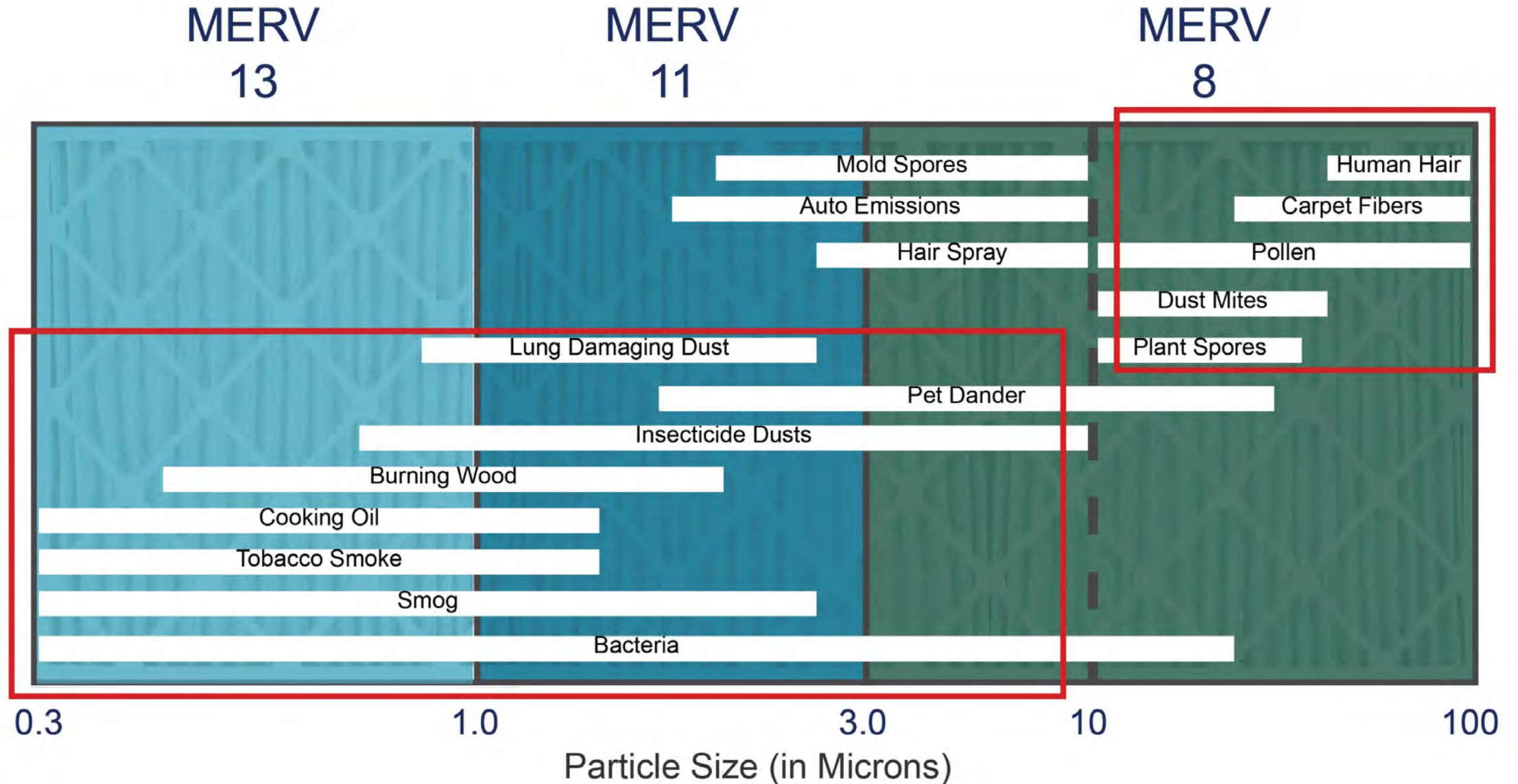


Energy Recovery Ventilation

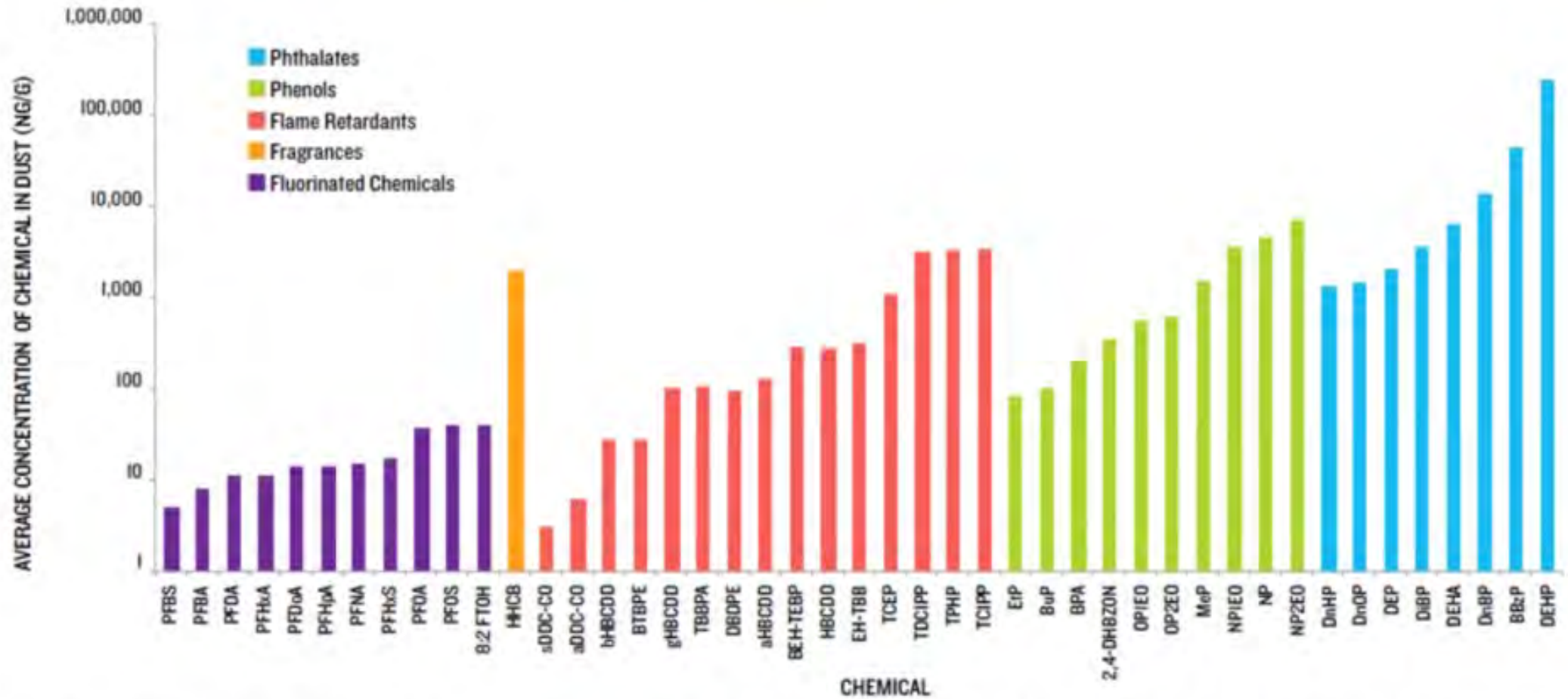


Ductless Mini-Split

Solutions

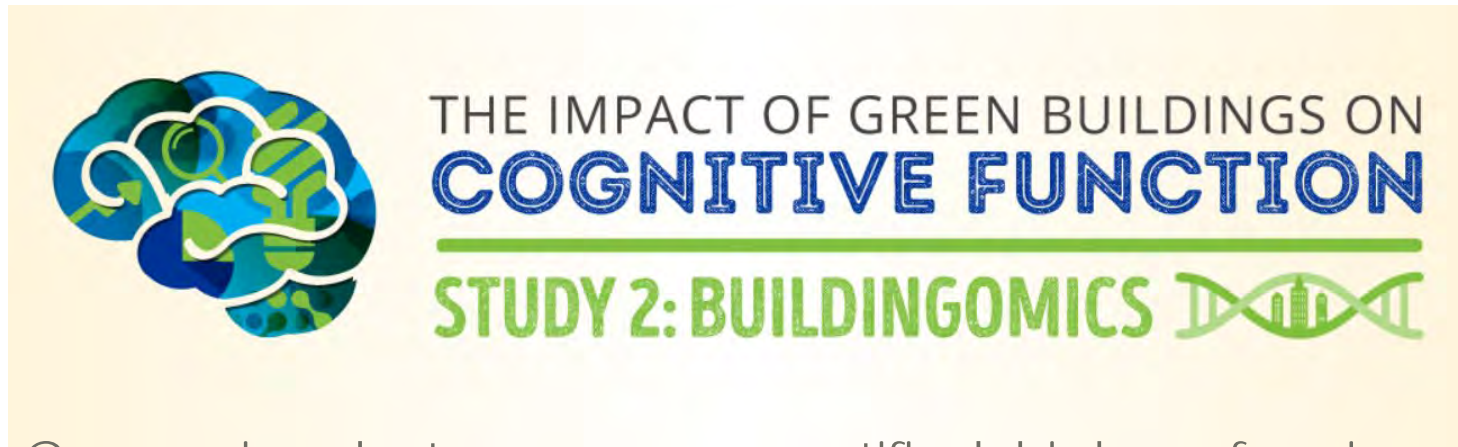


Because it's Not Just Dirt



Average (geometric mean) dust levels in nanograms of chemical per gram of dust for the 45 chemicals reported in at least three data sets. The average concentration of DEHP is about 45,000 times higher than PFBS.

Solutions



Comparison between green certified, high performing buildings & similar high performing building not green certified

- 61% higher in green building conditions
- 101% higher in enhanced green building conditions
- 26% higher cognitive function scores
- slept better
- reported fewer health symptoms

<http://naturalleader.com/thecogfxstudy/>

Home Buyers Values That Compete With Granite Counters + Hardwood Floors

\$ Affordable	\$\$ Work Force	\$\$\$ Market Rate	\$\$\$\$ Luxury
<p>Quiet</p> <p>Less Dirt/Dust</p> <p>Health Savings \$\$ Energy Savings \$\$\$</p>	<p>Quiet</p> <p>Much Less Dirt/Dust Low Odors</p> <p>Fewer Sick Days Sleep Better Cognitive Improvement +</p> <p>Health Savings \$\$ Energy Savings \$\$\$</p>	<p>Quieter Don't Feel Allergies</p> <p>Nearly Dust Free No Odors Few Bugs & Spiders</p> <p>Fewer Sick Days+ Sleep Better ++ Cognitive Improvement +</p> <p>Health Savings \$\$ Energy Savings \$\$\$</p>	<p>Peacefully Quiet Don't Feel Allergies</p> <p>Nearly Dust Free No Odors <u>No</u> Bugs & Spiders</p> <p>Fewer Sick Days++ Sleep Better +++ Cognitive Improvement ++</p> <p>Health Savings \$\$\$ Energy Savings \$\$\$</p>


Incremental Cost to Achieve Healthy Homes

(Based on a 2,500 sq. ft. house)

\$ Affordable		\$ Work Force		\$\$\$ Market Rate		\$\$\$\$ Luxury	
Air Sealing	\$5k	Air Sealing	\$5k	Air Sealing	\$7k	Air Sealing	\$9k
3 Purifiers	\$.9k	HRV/ERV	\$15k	HRV/ERV	\$18k	HRV/ERV	\$25k
MERV Filter	\$.1k	MERV Filter	\$.2k	MERV Filter	\$.2k	MERV Filter	\$.2k
HEPA Vac	\$.7k	HEPA Vac	\$.7k	HEPA Vac	\$.7K	HEPA Vac	\$.7k
Makeup Air	\$2k	Makeup Air	\$2k	Makeup Air	\$2k	Makeup Air	\$2k
ElectCook Top-		Induction	\$1k	Induction	\$1k	Induction	\$1k
Garage Seal	\$1k	Garage Seal	\$1k	Garage Seal	\$1k	Garage Seal	\$2k
Less Toxic	\$5k	Less Toxic	\$5k	Less Toxic	\$8k	Less Toxic	\$10k
Dust Protocol	\$1k	Dust Protocol	\$1k	Dust Protocol	\$1k	Dust Protocol	\$2k
Clean Water	\$.1k	Clean Water	\$.5k	Clean Water	\$1k	Clean Water	\$2k
Risk Reduction	\$	Risk Reduction	\$	Risk Reduction	\$	Risk Reduction	\$\$
Smaller HVAC	\$3	Smaller HVAC	\$4	Smaller HVAC	\$5	Smaller HVAC	\$6
No Gas Line to Cooktop		No Gas Line to Cooktop		No Gas Line to Cooktop		No Gas Line to Cooktop	
		No Penetrations & Bath	\$1	No Penetrations & Bath	\$2	No Penetrations & Bath	\$3
		Fans		Fans		Fans	
		Fewer Operable Windows	\$1	Fewer Operable Windows	\$2	Fewer Operable Windows	\$4
		*Energy Calc	\$	*Energy Calc	\$\$	*Energy Calc	\$\$\$
Net Cost	\$13k	Net Cost	\$25k	Net Cost	\$31k	Net Cost	\$40k
Hayward Score 75		Hayward Score 85		Hayward Score 90		Hayward Score 94	





	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	As Is	Behavioral Changes	Structural Changes	Behavioral + Structural Changes
Detail		<ul style="list-style-type: none"> • Reduce moisture load/run fans • Integrated pest management • Add HEPA vacuum • Improve maintenance 	<ul style="list-style-type: none"> • Fix leaks • Remove carpet • Encapsulate crawlspace 	<ul style="list-style-type: none"> • Add HRV/ERV • Add mechanical ventilation to crawlspace • Complete all maintenance
	28	58	79	92
Number of Symptoms	10.6	7.8	5.8	4.6

Very Poor

Fair

Good

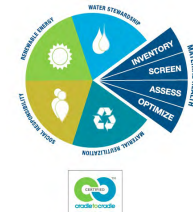
Excellent

Health Degrading

Health Supporting

HANDBOOK

Solutions



In Summary



- Identify and avoid chemicals of concern
- Good indoor air quality begins at design development
- Balanced, intentional, filtered ventilation is imperative
- Use research to make change



QUESTIONS?

OUR BUILDINGS . . .
OUR HEALTH