Choosing Flooring for Affordable Housing: Healthier and Cost Effective Options

The flooring options table and flooring matrix were developed for the Asthma Regional Council with support from ERT Associates, ICF Consulting, and Harvard/MIT graduate students.

Flooring materials today are more varied than ever before, offering a large range of practical, aesthetic, and ecological options. All choices have advantages and considerations, and especially in affordable housing, have pricing implications. With this multitude of flooring options, affordable housing developers can choose flooring that positively affects health, cost, energy and the environment. Although a range of health concerns are considered this document focuses on reducing conditions that can trigger asthma and respiratory problems. It does not explicitly address worker exposures.

To assist in making decisions about residential flooring, two tools have been developed.
The first tool is a table of traditional flooring choices used in most affordable housing as well as better/best suggestions for housing developers. It provides a sample approach to reducing asthma triggers in housing. The second tool is the Healthier and Cost Effective Residential Flooring Matrix, a detailed index of flooring options outlining health implications particularly for asthma, costs, maintenance considerations, and pollution created during flooring production. Used together, both tools can assist in making residential flooring choices that minimize asthma triggers and other health hazards while remaining affordable.

Flooring Options Table
Below is a summary table of traditional, better and best flooring options. The options presented are based on interviews with affordable housing developers and building science experts. The "Better" option seeks to reduce asthma triggers by increasing the use of smooth and cleanable surfaces that are less likely to retain allergens that trigger asthma (moisture and dust), and are easier to maintain while still maintaining first cost affordability. Moving from "Better" to "Best," a greater emphasis is placed on life cycle costs instead of first costs, and overall environmental impacts during occupancy and production of the flooring material.

Area	Traditional Flooring Choices	Better	Best
Entry	Nylon carpet	Linoleum	Ceramic Tile
Entry (if below grade)	Nylon carpet	VCT or Linoleum	Ceramic Tile or Stained Concrete
Kitchen	Vinyl	VCT or Linoleum	Ceramic Tile
Living Room	Nylon Carpet	Wood Laminate	Wood Floor
Dining Room (if part of kitchen space)	Vinyl	VCT or Linoleum	Ceramic Tile
Dining Room (if part of Living Room space)	Nylon Carpet	Wood laminate or Linoleum	Wood Floor
Bathroom	Vinyl	VCT or Linoleum	Linoleum or ceramic tile
Bedroom #1	Nylon Carpet	Linoleum with area rug or wood laminate	Wood Floor
Additional Bedrooms	Nylon carpet	Nylon Carpet or VCT with area rug (use green carpets see www.carpet-rug.com)	Linoleum with area rug or wood laminate

Note: VCT refers to Vinyl Composition Tile

Additional resources: Healthy Building Network www.healthybuilding.net and Carpet and Rug Institute Green Testing Program http://www.carpet-rug.com/

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Flooring Considerations by Area
When deciding which of the above options to use in an area, consider the following:

- **Asthma Triggers**. Moisture/mold and dust can trigger asthma attacks. Flooring that is less likely to retain moisture and dust will likely help reduce conditions that can trigger asthma attacks. Carpet, particularly with a sponge like pad below it, can retain moisture if it gets wet and is often difficult to clean in a manner that adequately removes asthma triggers such as dust. Smooth hard surfaces are unlikely to retain moisture and are relatively easy to clean to remove dust.

- **Entryways.** Entry halls are often the most used areas in a home. Steady traffic brings in dirt/dust and moisture that can get trapped in carpets and pads. A smooth surface is easy to clean and can be durable making it a good choice. It is important to use a flooring material suited to the grade level where it is installed.

- **Kitchens** are usually high traffic areas and are prone to dirt and spills. Select flooring that is easy to clean and durable. A common choice for kitchen floors is vinyl. VCT is generally more durable as tiles can be replaced. Sheet linoleum is also durable smooth flooring that has fewer environmental impacts during production than vinyl. Ceramic tile is one of the best choices when budgets allow, as it provides an extremely durable, easy to maintain surface that minimizes asthma triggers and has minimal environmental impacts during production.

- **Living rooms** are focal points in most homes and their function varies from family room to formal receiving room. In most living rooms, carpet is a popular choice. Wood laminate or hardwood can provide an attractive, durable, as asthma friendly surface.

- **Dining room** floors need to be wear- and stain-resistant, especially if the room is used regularly at mealtime. Carpets can easily trap the dust mites, moisture and other allergens (pet allergens). Wood, laminate, or tile are easy to maintain, minimize asthma triggering allergens and offer environmentally friendly options with low life-cycle costs.

- **Bathroom** floors need to be waterproof, washable and non-slip. Vinyl is a traditional floor choice for baths. VCT offers improved durability and maintenance and linoleum offers solid durability. When budgets permit, ceramic tile is one of the best choices for mold and allergy avoidance, maintenance, and durability.

- **Bedroom** floors often have less of a traffic problem than in other rooms, so stains and wear are often minimal. Carpet is traditionally used in bedrooms. VCT, linoleum, wood or laminate floors are durable alternatives that help minimize allergens triggering asthma and are easy to clean. For individuals with dust allergies that exacerbate their asthma, one bedroom with smooth hard flooring can help maintain a less dusty environment.

Healthy and Cost Effective Residential Flooring Matrix
The *Healthy and Cost Effective Residential Flooring Matrix* is designed to assist developers and managers of affordable housing make flooring decisions that will meet their performance needs (e.g., durability, maintenance, cost), reduce asthma triggers and minimize other health and environmental risks.

The types of products are listed in the left column (e.g., vinyl composition tile or VCT). The remaining columns present information about specific characteristics of each product type and product. Additional information on the various data sources and environmental information are also available upon request.

Comments and Suggestions
We welcome your comments as we continue to update and revise these tools. Please direct all comments and requests for supporting data via email to Ellen Tohn at e.tohn@comcast.net.

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Healthier and Cost-Effective Residential Flooring

Health, Cost, Energy and Ecological Considerations and Information

Key:
Good:
Fair:
Poor:

Note for users: This menu of residential flooring options is intended to be used as a guide to assist in the decision-making process when selecting residential flooring during new construction or rehabilitation. It is not intended to be comprehensive and in a rapidly changing market, the completeness and accuracy of this information cannot be guaranteed. No endorsement or recommendations on flooring options are implied or intended.

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Floor Covering Alternatives	Cost Information[1]			Maintenance Considerations[4]	Health Considerations - Relative Ranking[5]	Ecological and Energy Impacts During Manufacturing - Relative Ranking[6]	Advantages and Considerations	Additional Information
	Materials and Installation (per square foot)[2]	Expected Life (years)[3]	Life Cycle (cost per square foot over 20 years)					
Bamboo	10.00 [7]	50			**VOC/Offgassing (g VOC):** No data	No data	Adv: Bamboo is treated to prevent insect and mildew damage	
					Mold/Allergens:		Con: Materials may include formaldehyde adhesives, depending on manufacturer	
Carpet, Nylon Broadloom[8]	$1.89	11	$2.91		**VOC/Offgassing (g VOC):**		Con: Emits VOCs during and after installation.	24 oz carpet, installed using traditional glue.
					Mold/Allergens:		Con: Can harbor dust and other allergy causing particles.	Installation using a low-VOC glue can reduce VOC/offgassing.
							Con: Stains easier than other options.	
							Con: Can be a source of mold/mildew in contact with moisture.	
							Con: May need to allow time to air out before occupancy.	
Carpet, Nylon Tile[8]	$3.18	15	$3.78		**VOC/Offgassing (g VOC):**		Adv: Strongest fiber makes good choice for high traffic areas. Most durable of synthetics.	24 oz carpet, installed using traditional glue.
					Mold/Allergens:		Adv: Nylon is soil and mildew resistant, resilient and non-allergenic.	Installation using a low-VOC glue can reduce VOC/offgassing.
							Con: Emits VOCs during and after installation.	
							Con: Can harbor dust and other allergy causing particles.	
							Con: Stains easier than other options.	
							Con: Can be a source of mold/mildew in contact with moisture.	
							Con: Potentially need to allow time to air out before occupancy.	
Carpet, Recycled Polyester Broadloom[8]	$2.10	8	$4.22		**VOC/Offgassing (g VOC)**:		Adv. Polyester fiber from recycled soft drink bottles (PET).	24 oz carpet, installed using traditional glue.
					Mold/Allergens:		Con: Emits VOCs during and after installation.	Installation using a low-VOC glue can reduce VOC/offgassing .
							Con: Can harbor dust and other allergy causing particles.	
							Con: Stains easier than other options.	**Additional Sources:** http://www.flooringfashions.com/flooringguide/default.asp?topic=5&p=3
							Con: Can be a source of mold/mildew in contact with moisture.	
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Carpet, Recycled Polyester Tile[8]	$3.53	8	$7.09		**VOC/Offgassing (g VOC):** 		Adv. Polyester fiber from recycled soft drink bottles (PET).	24 oz carpet, installed using traditional glue.
					Mold/Allergens: 		Con: Emits VOCs during and after installation.	Installation using a low-VOC glue can reduce VOC/offgassing .
							Con: Can harbor dust and other allergy causing particles.	
							Con: Stains easier than other options.	
							Con: Can be a source of mold/mildew in contact with moisture.	
							Con: Potentially need to allow time to air out before occupancy.	
Carpet, Wool Broadloom[8]	$7.62	25	$6.10		**VOC/Offgassing (g VOC):** 		Adv: Natural wool fibers are biodegradable and recyclable.	40 oz carpet, installed using a traditional glue.
					Mold/Allergens: 		Adv: Wool fiber is naturally elastic, stain resistant, flame retardant, and may help purify air by absorbing harmful indoor contaminants.	Installation using a low-VOC glue can reduce VOC/offgassing.
							Con: May need mothproofing.	
							Con: Emits VOCs during and after installation.	
							Con: Can harbor dust and other allergy causing particles.	
							Con: Stains easier than other options. Easily damaged by bleaches and alkalis.	
							Con: Can be a source of mold/mildew in contact with moisture.	
							Con: Potentially need to allow time to air out before occupancy.	
Ceramic Tile	$8.48	50	$3.39		**VOC/Offgassing (g VOC):** 		Adv: Highly durable- Can sustain high traffic.	Estimates based on using 0.5 inch thick ceramic tile and 0.5 inch layer of latex-
					Mold/Allergens: 		Adv: Fire resistant - Ceramic tile doesn't burn or emit toxic fumes.	Avoid grout with latex.
							Con: Can be difficult to remove if necessary for rehabilitation.	
							Con: Hard surface, usually retains a cold temperature.	
Concrete Finishes	.25-5.00	50			**VOC/Offgassing (g VOC):** No data	No data	Adv: Concrete can be treated to create a rich variety of hues and textures, or stamped with patterns to mimic natural surfaces from marble to wood planks.	
					Mold/Allergens: 		Adv: Finish can last the lifetime of the concrete, and are durable, sanitary, and easy to maintain.	
							Con: Hard floor surface. Objections may involve warmth underfoot, sound deflection, the likelihood of dropped objects shattering, or the safety of very young children who may crawl or fall on the floor surface.	

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Cork, Natural	$8.31	50	$3.32	◯	**VOC/Offgassing (g VOC):** ◯ **Mold/Allergens**: ◯	◯	Adv: Renewable content, sound absorbent, slip and scuff resistant. Adv: Cork has excellent shock absorption. Adv: Does not emit harsh gases or shred micro-fibers; low impact on air quality. Adv: Naturally mold, moisture and rot resistant. Adv: Dent-proof, termite-proof. Con: Using cork is a relatively new practice. Many contractors may not carry cork products and it's rarity may increase the price. Con: Long term durability has not been tested.	Comes in parquet floor tiles. Usually installed using a water-based adhesive. **Additional Sources:** http://www.gerbertltd.com/docs/cork/medi_specs.htm, and http://homedoctor.net/tipsfaq/13.2.html
Laminate Wood Flooring	$4.99-6.99[7]	25		◯	**VOC/Offgassing (g VOC):** ◯ **Mold/Allergens**: ◯	No data	Adv: Ease of installation. Laminate floorings can be installed quickly with a minimum of tools.	
Linoleum Flooring	$3.16	18	$3.34	◯	**VOC/Offgassing (g VOC):** ◯ **Mold/Allergens**: ◯	○	Adv: Renewable content. Con: May discolor or deform when in direct contact with extreme heat. Con: Susceptible to dirt and debris attaching to adhesive residue between tile or sheet seams, making areas potentially hazardous breeding areas for germs and bacteria.	Information assumes using 0.1 inch thick sheet linoleum with jute backing and acrylic Installation using a styrene-butadiene adhesive.
Linoleum-Marmoleum, Forbo Industries	$2.98	18	$3.15	◯	**VOC/Offgassing (g VOC):** ◯ **Mold/Allergens**: ◯	○	Adv: Renewable content. Adv: Provides a self-sanitizing quality in the form of a bactericidal effect. Tests indicate that Marmoleum has a sterile zone around the material, inhibiting contaminants. Con: May discolor or deform when in direct contact with extreme heat. Con: Susceptible to dirt and debris attaching to adhesive residue between tile or sheet seams, making areas potentially hazardous breeding areas for germs	Assumes using 0.1 inch thick sheet linoleum and installation using a styrene-butadiene Installation using a low-VOC adhesive can reduce VOC/offgassing. **Additional Sources:** Forbo Spec Sheet
Rubber	$2.00-$5.00	30		No data	**VOC/Offgassing (g VOC):** No data **Mold/Allergens**: ◯	No data	Adv: Good wear resistance and extremely long life. Suitable for many common areas. Adv: High level of abrasion resistance enables the use in very heavy traffic areas for a long period of time.	
Vinyl, Composition Tile	$1.67	18	$1.76	⊖	**VOC/Offgassing (g VOC):** ◯ **Mold/Allergens**: ◯	⊖	Con: PVC recycling nearly impossible. Con: Some VCT requires refinishing where chemicals with high VOCs are used.	Assumes 1/8 inch thick vinyl composition tile with an acrylic latex finish coat. Installation using a styrene-butadiene adhesive. Use water-based finishes when possible. Pre-finished vinly avoids potential emissions during refinishing.

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Vinyl Sheet	$4.00-9.00[7]	12-15			**VOC/Offgassing (g VOC):** No data **Mold/Allergens**: 	No data	Con: PVC recycling nearly impossible.	
Wood	$6.50-$12[7]	30			**VOC/Offgassing (g VOC):** No data **Mold/Allergens:** 	No data	Adv: Low impact on air quality. Adv: Easier to repair than most materials. Adv: Durable and can be refinished to prolong its life. Adv: Warm, comfortable surface. Con: High initial cost.	Solid wood flooring expands and contracts with changes in a home's relative humidity.

1: Cost and life expectancy data was extracted from BEES database unless otherwise indicated and are based on an industry average. Prices may vary by region, purchase quantity and other factors. See Note on BEES cost data for further information.

2: BEES includes installation costs in its calculation, but installation costs will vary based on the condition of the existing flooring and the need to hire professional installers.

3. Expected life will vary based on use, environmental conditions, and maintenance.

4. Maintenance was based on considering the type of equipment needed, estimated labor time and skill level, and frequency of cleaning and maintenance practices.

5. Offgassing from new flooring materials, not including glue and adhesives. See Explanation of Criteria, and health data page for further information.

6. Environmental impacts from all stages of the product life-cycle, including raw materials extraction, manufacturing, use, and end-of-life. See Explanation of Criteria and environmental data page for further information.

7. Cost information is an average figured based on product specs from manufacturers and estimates from Washington, DC home improvement stores in 2003. These costs are not based on BEES data and are average costs.

8. The Carpet and Rug Institute maintains a green labeling program that evaluates carpets, pads, adhesives for various environmental and health factors. See www.carpet-rug.com

Sources:

BEES - The Building for Environmental and Economic Sustainability database developed by the National Institute for Standards and Technology

Massachusetts Technology Collaborative. Collaborative for High Performing Schools; Best Practices Manual, Volume II- Design. March 15, 2002.

Healthy Building Network: PVC Free Resilient Flooring Alternative: http://www.healthybuilding.net/pvc/alternatives.html

Please provide comments to Ellen Tohn, Senior Advisor to ARC, at e.tohn@comcast.net