

## Prioritizing Choices for a Healthy House

### Affordable Healthy Houses

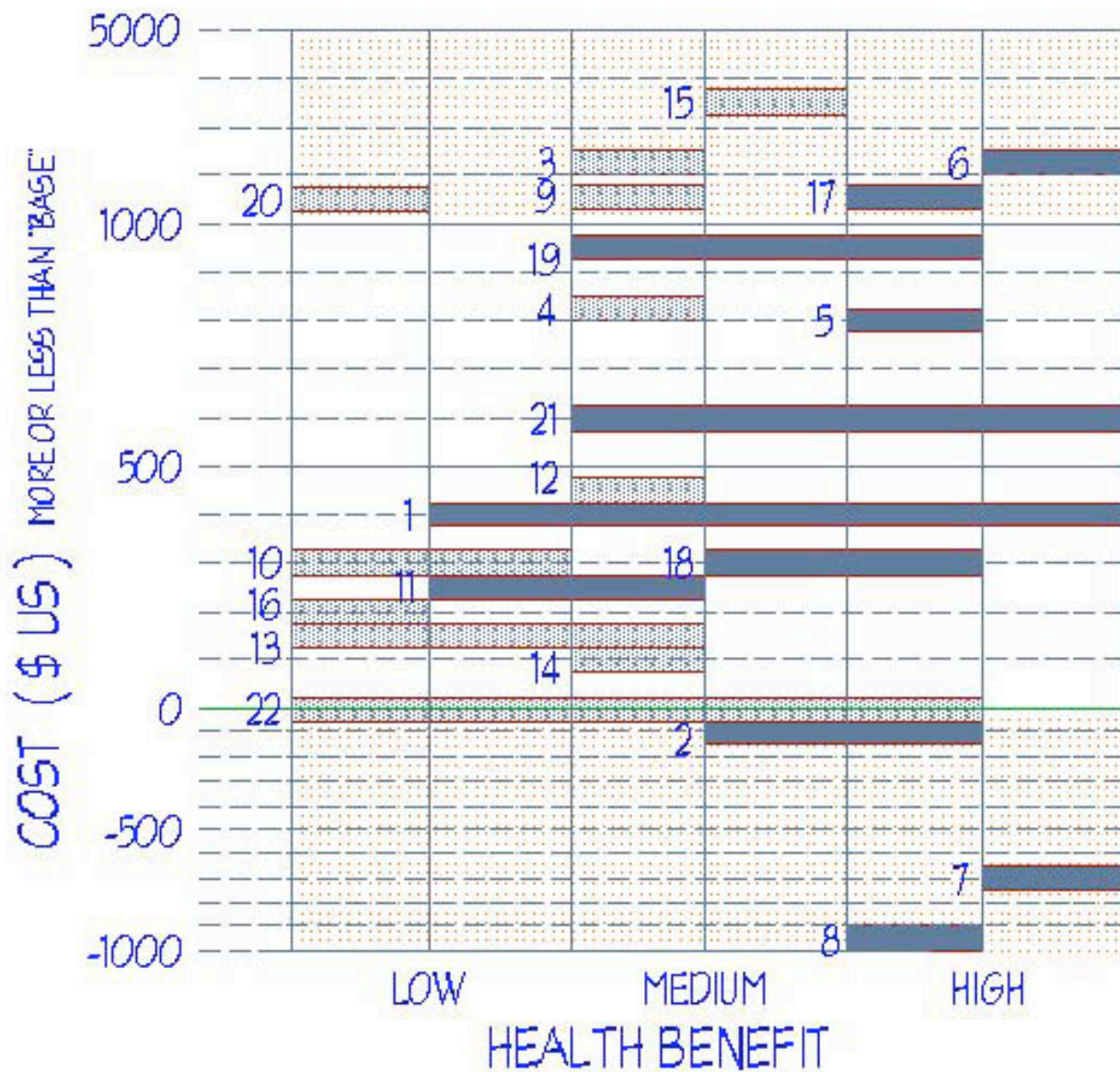
### Evaluation Strategies

by Mary Kraus and Bruce Coldham

When considering healthful materials and techniques, it's easy to feel compelled to apply every available strategy, and then conclude that healthy homes are simply unaffordable. If instead, we assess the relative merit of each measure, we can determine which options to choose to create a home that is both healthful and affordable. To this end, we have developed an approach for prioritizing choices for healthful homes. Our method is simple. First, list plausible strategies. Then, broadly rate each for its anticipated health benefit and, finally, estimate the added (or subtracted) construction cost for each strategy.

Our "base" case is a 900 sq. ft. rectangular house with a small kitchen and single bathroom. We have compiled a list of improvement strategies in which those on the left replace conventional ones on the right. The health benefit and construction premium are charted to display which healthful improvements return the highest health benefit for the money invested. Construction premium is on the vertical axis (note that it is logarithmic). Health benefit is represented on the horizontal axis rated as low, medium, or high impact. These evaluations are descriptive indications of the costs and benefits of the strategies chosen.

Healthy House Strategy	Conventional Practice
1. Radon mitigation (5" of crushed stone below slab)	1. Slab on compacted fill
2. Electric stove	2. Gas stove
3. Solid wood cabinetry (w/low-VOC finish)	3. Particle board cabinets
4. Pantry and solid wood base cabinets	4. Particle board cabinets
5. Pine floor over CDX plywood subfloor	5. Carpet & padding over subfloor
6. Oak floor over CDX plywood subfloor	6. Carpet & padding over subfloor
7. Pine plank and joist w/low-VOC finish	7. Carpet & padding over subfloor
8. Painted masonite over CDX plywood subfloor	8. Carpet & padding over subfloor
9. Wool carpet	9. Carpet & padding over subfloor
10. Ceramic floor tile in bath	10. Vinyl (VCT) tile on plywood underlayment
11. Natural linoleum in kitchen	11. Vinyl (VCT) tile on plywood underlayment
12. Oak floor in kitchen	12. Vinyl (VCT) tile on plywood underlayment
13. Water-based polyurethane	13. Petro-based polyurethane
14. No-VOC paints	14. Acrylic latex paints
15. Unpainted plaster	15. Gyp board, joint compound & acrylic latex paint
16. Natural stain on exterior siding	16. Petro chemical solvent-based stain
17. Power supply and exhaust ventilation	17. Unintended / unplanned air leakage
18. Exhaust-only ventilation	18. Unintended / unplanned air leakage
19. Central vacuum	19. Portable vacuum cleaning appliance
20. Poly-icynene foam insulation	20. Fiberglas bats in stud cavity
21. Rigid insulation under basement slab	21. No insulation below slab
22. Locating electric service panel below entry	22. Service panel below living room couch or other seating or sleeping location



DENOTES "TIME CONSTANT" BENEFIT  
 DENOTES "TIME DIMINISHED" BENEFIT

NOTE : DIFFERENT COST SCALE FOR SHADED PORTIONS OF CHART.

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## Rating the Strategies

The relative health benefit is assessed using the following criteria:

- Relative toxicity and density of pollutants.
- Amount of polluting material present (e.g. carpet everywhere).
- Intensity of human occupation of the space.
- Location of pollutant source- i.e. inside or outside of the air-sealing barrier.
- Time constancy of the benefit.
- Ease to retrofit.

Below we explain our health benefit rating with some examples.

Strategy #1, radon mitigation, has widely ranging benefits because soil radon levels can vary greatly. Installing 1" of rigid insulation below the basement slab has a wide benefit range depending upon the degree to which the basement space is habitable. Replacing a gas stove with an electric stove (#2) is highly beneficial because gas stoves contribute to respiratory problems, and gas is a sensitizing substance.

Strategies #5, 6, 7, and 8, which all substitute carpeting with wood flooring, all rate highly because carpets exude many toxic chemicals and sustain dust mites and molds. Carpeting covers a substantial area, especially in bedrooms where human occupation is greatest. Replacing a typical carpet with a natural wool carpet (#9) does not rate as highly; an untreated wool carpet won't release toxic fumes, but can still serve as a breeding ground for dust mites.

Replacing vinyl tile with ceramic tile in the bathroom (#10) receives a medium/low rating because the area covered is smaller, and direct exposure is lower due to the limited time spent in bathrooms.

Natural stain on exterior siding (#16) rates lower because it is outside the building envelope, as does poly-icynene foam insulation (#20) which is also installed outside the air-sealing barrier. Installing mechanical ventilation (even exhaust only) rates highly because exhausted pollutants and fresh air are a continuous benefit to the entire house.

The black barred strategies are more beneficial in the long term than those that are greyed. The black bars indicate strategies that are "time constant" in their benefit. The greyed bars indicate strategies whose benefit diminishes over time - e.g. since particleboard and non-VOC paints gradually lose their toxicity, their substitution has a diminished benefit as years pass.

We have emphasized the health benefit to the household occupants. An analysis extended to include health benefit considerations of builders would more highly value water-based polyurethane over petro-based polyurethanes (#13) because the VOCs (volatile organic compounds) in the latter are more hazardous to the installer than the householder.

With a cost estimate for each strategy, we can get a clear sense of which strategies provide the greatest health benefit for the lowest cost. The first strategies to consider are those in the lower right hand corner of the chart - (#7 Plank and beam floor; #8 Painted Masonite floor; #2 Electric range). Then strategies which rate "medium" or "low" but are inexpensive are worth applying. More expensive, but highly beneficial strategies such as insulating below the basement slab are always worth considering because of the practical impossibility of retrofit. Those in the upper left hand corner will be the least effective investment-plaster walls (#15) yield a moderate health benefit but at considerable cost.

The chart enables quick comparisons, for example, money is clearly better spent on a simple ventilation system than on upgraded insulation, as the ventilation system offers a higher relative health effect for a lower cost.

Estimating the health benefit of each strategy is not a clearly objective task. Research on healthy homes contains conflicting opinions, the latest studies may contradict yesterday's truths, and product formulations are changing. Each person has their specific sensitivities - for example, someone who is allergic to dust mites will have different priorities than someone sensitive to petrochemicals. Each of us must make an educated guess as to the health potential of each strategy.

## Prioritizing Choices for a Healthy House

Ratings: Low (L, L1, L2), Medium (M, M1, M2), High (H, H1, H2)

Strategy	Rating	Premium
1. Radon mitigation (crushed stone below slab)	L2 - H2	+\$400
2. Electric stove	M2 - H1	-\$30 / \$0
3. Hardwood cabinetry (w/low-VOC finish)	M	+\$1000
4. Pantry and hardwood base cabinets	M	+\$400
5. Pine floor over CDX plywood subfloor	H	+\$800
6. Oak floor over CDX plywood subfloor	H2	+\$2500
7. Pine plank and joist w/low-VOC finish	H2	-\$700
8. Painted masonite over CDX plywood subfloor	H	-\$1000
9. Wool carpet	M	+\$2500
10. Ceramic floor tile in bath	L-M	+\$300
11. Natural linoleum in kitchen	L2-M1	+\$300
12. Oak floor in kitchen	M	+\$400
13. Water-based polyurethane	L1-M2	+\$100
14. No-VOC paints	M	+\$100
15. Unpainted plaster	M2	+\$3500
16. Natural stain on exterior siding	L	+\$200
17. Power supply and exhaust ventilation	H	+\$1500
18. Exhaust-only ventilation	M2, H1	+\$300
19. Central vacuum	M1, H1	+\$950
20. Poly-icynene foam insulation	L	+\$1200
21. Rigid insulation under basement slab	M1-H2	+\$600
22. Locating electric service panel below entry	L-H?	\$0

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