



FACT SHEET

COMPONENTS: ROOFING

Description

Roofing, whether it is asphalt shingles, metal roofing, wood shakes or shingles, plastic/composite shingles, or fiber-cement shingles, protects a house from the elements. Light colored roofing materials can reduce cooling costs and energy by reflecting the sun's rays and reducing thermal gains. The following analysis examines the relative economic, energy, and environmental impacts of the following roofing options: self-healing asphalt shingles, organic asphalt shingles, fiberglass asphalt shingles, clay and concrete tiles, standing seam metal roofing, metal shingles and tiles, wood shakes and shingles, composite/synthetic (plastic and rubber) shingles, and fiber cement shingles.

Recommendations

Although asphalt shingles have the lowest first cost, they require more frequent replacement than other options resulting higher lifetime costs. Asphalt shingles also make a significant contribution to landfills. Metal roofing and fiber cement shingles last longer than asphalt shingles without adding weight to the structure. Because metal has high recycled content and can be recycled after use, it has a favorable environmental impact.

In selecting roofing materials, consider the weight and whether additional structure is required. If so, factor the environmental impacts of that increased structure into the overall impacts of the roofing. Also consider how the roofing material affects the quality of water falling on it. For example, will it contribute sediment that may plug gutters or catchment containers?

Roofing Alternatives

alternative	Cost/sq. ft. (materials & labor)	expected product life (years)	life cycle thinking	practice
asphalt shingles, self-healing	.62	20-35	typical	standard
asphalt shingles, organic	.72	15-30	typical	standard
asphalt shingles, fiberglass	.81	15-30	Typical	standard
clay and concrete tiles	not available	30-50	typical	trained installers
metal roofing, shingles, tiles, and tile panels	not available	50+	good	some training required
metal roofing, standing seam	not available	50+	better	some training required
wood, shakes and shingles	2.61	30, 40-50	good	standard
composite/ synthetic (rubber & plastic) shingles	not available	40-50+	typical	standard
fiber cement shingles	2.21	40-50+	better	some training required

Criteria Summaries

Cost: Lower initial cost roofing options, like asphalt shingles, may end up costing as much as higher initial cost roofing options over their life cycle.

IAQ

Roofing materials are exterior application and do not directly affect indoor air quality. However, installation of these materials may create dust (primarily from fiber-cement products), or emissions of petroleum-based chemicals (asphalt and fiberglass shingles) which may prove allergenic to some individuals with heightened sensitivity. Precautions should be taken to prevent dust or odors from permeating the rest of the construction.

Expected Product Life: Asphalt shingles have the shortest life of any roofing products. Natural slate, clay or concrete tiles, and fiber-cement products have the longest. Metal products, if properly coated and maintained, can also last for decades and are highly recyclable into similar products at the end of their use. Wood shakes and shingles, if properly maintained, will last longer than organic asphalt and most fiberglass shingles and can be composted at the end of their usefulness.

Life Cycle Thinking:

- Energy consumption (non-renewable, fossil fuel energy):
Clay tiles, because manufacturing processes require firing, consume the most energy; they are also heavy and require more transportation energy to ship. Concrete, which is a very resource and energy intensive product, also has high embodied energy. Fiber-cement composites, which use fillers such as wood fibers or other waste products, reduce the energy consumption by reducing the amount of virgin cement, concrete, and aggregate material required. If wood or other lower-quality fibers are used in cement products, they reduce total embodied energy. Asphalt shingles,

both organic and fiberglass, have a higher embodied energy than wood or composite products, even considering their shorter life cycle. Wood products have the lowest embodied energy of any roofing materials because they come from a renewable source and require less processing before installation. They also weigh less than tiles or shingles and require less energy to transport.

- **Pollutants generated in production:** Clay tiles and fiber cement products generate the most pollutants. Producing clay is an energy-intensive process, which generates pollutants through energy used and the manufacturing process of kiln-firing clay to hardness and durability requirements. Because fiber-cement shakes, shingles and panels rely primarily on cement, they generate more pollutants due to the resources used and the process for manufacturing a finished product (cement production and pressing/curing operations.) Asphalt shingles come next in pollutant generation since they are petroleum based.
- **Potential for off-gassing in the building:** Because these are exterior products, their effects on the indoor environment are minimal.
- **Durability of the product:** Natural slate, metal roofing, and concrete, clay and fiber-cement products have the longest use cycle. Asphalt shingles, both organic and fiberglass, have the lowest use cycle and need to be replaced most often.
- **Potential for future recycling:** Metal roofing materials (aluminum and steel) have high recycled content and are readily recyclable, reducing overall higher impacts because of their more closed-loop production cycle. Asphalt shingles may use some recycled content in their paper base, and some manufacturers may use recycled aggregate in their production. Some wood composite products can be ground up and reused or recycled, but many cannot. Plastic-based composites cannot be recycled either. Fiber-cement products have limited recycling use, but can be ground up and reused in fabrication. However, there are no current programs in place to collect and reuse materials, and much of it may end up in landfills.

Practice: Slate, concrete and clay tiles, and fiber cement shingles may require training for installation. Asphalt shingles, wood shingles, and wood shakes are common roofing materials and have standard installation methods.