Defining a Sustainable Roof

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WHITE PAPER

Many of us selecting, designing, manufacturing or installing a roof system are striving to conform to the sustainability ideal. Forging our way, we often find ourselves entangled in a debate. In roofing, what is sustainable? Are we achieving it if we paint our black roofs white to save energy? Surely we are if our roof is reflective. Are our roofs sustainable if we plant landscaped gardens above them and create space on them for the public to play? How about if our products endure rooftop harassment indefinitely? Or, are we only really achieving sustainability if we can tear off our old roofs, recycle and transform them into new roofing products like walkways, tiles or even new roofing membranes?

A crystal clear definition of sustainability is elusive. That's because, sustainability in general is a science that is still maturing. Yet, as we chase the ideal, it is easy to lay claims on sustainability with any enhancement aimed at decreasing the stress of our products on the natural world. But the effort must go much deeper than that. If sustainability is truly achievable in roofing, companies must undertake the quest organization-wide. Sustainability requires that we make conscious choices about resources and the way we use them at every stage of a product's life.

As a roofing manufacturer, we are actively engaged in this journey. The intent of this article is to offer our learning as a roadmap for those of you who have a similar destination in mind, but still find yourselves navigating through fog. The following will be our focus:

Section 1: Sustainability: Defining it for the Roofing Market
Section 2: The Stages and Environmental Impacts of a Roof's Life Cycle
Section 3: Conclusion

Sustainability: Defining it for the Roofing Market

Living sustainably, according to many, requires that we use resources to meet our present needs without compromising the ability of future generations to meet their needs. Living sustainably does not, however, require that we live in thatch huts that periodically biodegrade. In fact, a roof that won't last is not sustainable at all. Wikipedia agrees. According to the free online encyclopedia, the definition of sustainability is, simply, "the capacity to endure."

The most widely recognized definition of a sustainable roof system comes from the *Proceedings of the Sustainable Low-Slope Roofing Workshop*, held at the Oak Ridge National Laboratory in October 1996:

A roofing system that is designed, constructed, maintained, rehabilitated, and demolished with an emphasis throughout its life cycle on using natural resources efficiently and preserving the global environment.

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People, resources and the environment are all intertwined. In roofing, we have an impact on the environment when we extract raw materials, manufacture, install, use and dispose of a roof. This is why endurance counts. A longer lasting roofing system delays the repeat of the manufacturing cycle, uses fewer resources, costs less money and causes less stress on the environment.

The Stages and Environmental Impacts of a Roof's Life Cycle

Stage 1: Design

The design stage covers the design and engineering of each component in the roofing system to meet the market's needs.

Environmental Impact:
Designers and engineers are the first people who can affect the environmental impact of a product. Their product and system design concepts can influence the sustainable nature of raw material inputs. Raw materials that include recycled content or bio-based materials are examples of more sustainable inputs. Designers can influence production processes, product performance, product longevity and the product's end of life options. They also can be involved in product packaging decisions and impact corresponding landfill waste.

Examples of more sustainable roofing product and system designs:

1. A more sustainable roofing product is designed for longevity in a variety of rooftop environments. Some roofing membranes as well as accessories like adhesives and insulation are now being made with renewable resources or recycled content.
2. A more sustainable roofing system design ensures proper drainage, minimizes maintenance and excludes items like pitch pans and exposed sealants. These items, if not constantly maintained, can be the cause of leaks, which in turn compromise the roofing system's ability to reach its performance potential.

Stage 2: Material Inputs

The source of all raw materials used to make any product can always be traced back to the natural environment. In this stage, raw materials are extracted from nature and converted into other synthetic materials before manufacturing into a roofing product.

Environmental Impact:
The natural resources we select for products, the quantities we use, and the methods we use to harvest them impact the environment. Minimizing the amount of resources extracted from nature, especially those that are scarce, makes for a more sustainable product. Creating synthetic raw materials involves manufacturing processes, which could include chemicals of concern; those that may be harmful to people and/or the environment. If not handled properly, waste generated by manufacturing can cause pollution of local land, air and waterways.

Examples of more sustainable material inputs:

1. The polymers of almost all modern roofing membranes are made from nonrenewable fossil fuels. Some products are more fossil fuel dependent than others. A product that uses less fossil fuel and lasts longer is significantly more sustainable than an alternative product that uses more energy and has a shorter lifespan.
2. Companies making a more sustainable product are making conscious selections of raw material inputs, and monitoring their supply chain to minimize or eliminate any inputs that include chemicals of concern, or create environmentally destructive emissions.

Stage 3: Manufacturing

In the manufacturing stage, all of the natural and synthetic materials are brought together to make the components of a roofing system.

Environmental Impact:
Manufacturing processes generate waste, which, if not handled properly, can cause pollution of air, land and waterways. Manufacturing also can consume a lot of water and energy and cause stress on non-renewable resources.

Example of more sustainable manufacturing practices:
Companies striving to achieve sustainability in manufacturing should be able to demonstrate it in many ways, by doing all or many of the following things:

1. Designing and operating manufacturing processes so as to minimize air and water pollution;
2. Minimizing the disposal of solid and hazardous wastes to the environment (e.g. landfill, incineration) by source reduction, recycling or finding other beneficial uses;
3. Identifying opportunities for energy use reduction;
4. Incorporating sources of renewable energy into manufacturing (e.g. solar, wind, biogas, etc.) when possible;
5. Putting in place an environmental management system;
6. Minimizing the use of water;
7. Minimizing the use of chemicals of concern;
8. Utilizing raw material suppliers that are achieving a lower environmental profile through these same actions.

Stage 4: Transportation

Transportation can occur at any point in the life cycle: delivery of the raw materials to the manufacturing site, shipping of the finished product to the point of installation and the transportation of the expired product to a landfill or recycling plant.

Environmental Impact:
The majority of commercial transportation vehicles consumes non-renewable fossil fuels, and emits carbon monoxide. The greater distance between transportation points, the greater the impact on the environment.

Examples of more sustainable transportation:

1. Strategically placing stocked warehouses so as to maximize railroads for shipment. Shipping by rail uses significantly less fuel per ton of freight moved.
2. Designing the product to achieve the performance requirements with less weight per square foot of roof. Less weight translates into fewer vehicles needed to ship.
3. Utilizing suppliers local to manufacturing and installation points for raw material inputs and system accessories.

Stage 5: Installation

In the installation stage, the product is put into place for its intended use in the roofing system.

Environmental Impact:
The selection of accessory items and the methodology required to install a roofing system (adhered, ballasted or mechanically fastened) contribute to the roof system's sustainability profile. Adhesives, primers, cleaners and sealants may include chemicals of concern or exceed recommended VOC

limits. Construction waste, especially fuel and oil spills or leakage from equipment and generators can pollute land, air and waterways.

Examples of a more sustainable installation process:
Ballasted roofing systems generally require the least intrusive inputs and simplify end of life removal but have performance limitations in high-wind regions. Mechanically fastened roof systems are also easily "disassembeled" at the end of the life cycle.
Adhered roofing systems relying on adhesives and bonded composites may contaminate membrane components and complicate their separation at the end of the roof's life cycle.

Stage 6: Service Life

The service life is the time period during which a product serves its intended function.

Environmental Impact:
It cannot be overemphasized. The length of a product's service life has significant environmental impact. The shorter the lifespan of a product, the more frequent the need for a repeat of the production cycle; hence, causing greater demand on resources and stress on the environment.

Example of a more sustainable service life:

1. Some roofing products use more resources and have a shorter service life. Some use fewer resources and have a longer service life. The latter is more sustainable. Use the following indicators when verifying a product's projected service life:
    a. The manufacturer can provide documentation of past product performance history in various climates (e.g. hot and humid or hot and dry, as well as cold, temperate climates), and performance history in various rooftop conditions (e.g. exposure to high UV, high wind, and chemicals, oils and greases)
    b. The manufacturer has in place a formal program to train installers on proper handling and installation methods for the roofing product;
    c. The manufacturer can verify the viability of making repairs to maintain the product as it ages.

Stage 7: End of Life

The point at which the roofing product is no longer fit for its intended purpose.

Environmental Impact:
Products that no longer function can turn into landfill waste.

Examples of more sustainable end of life options:
For the past 20 years, companies have experimented with ways to recycle or reuse their roofing products to avoid clogging landfills. Over the past decade significant advances in the research and technology have enabled many companies to do so. Recycled roofing products are being transformed and used in complementary building applications, such as flooring, tiles and walkways. Some roofing products are actually being recycled and reused again as new roofing products.

Conclusion

Living in or manufacturing biodegradable thatch huts may, to some, sound environmentally romantic. But, it's really not practical, nor would it make good use of anyone's resources or time. Sustainability requires that there is balance between people, resources and the environment. In roofing, we must be cognizant of all the variables in our work that impact this balance. One product enhancement will not suffice.

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