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What It Means To Be Green

Greenhouse Gases, Architecture & Climate Change

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Greenhouse gasses (GHGs) are chemical compounds that are found in the Earth's atmosphere. They allow sunlight to freely enter the atmosphere and contact the Earth's surface. Some of this sunlight is reflected back toward space in the form of infrared radiation, or heat. The ability of GHGs to absorb some of this infrared radiation and trap heat in the atmosphere has enabled the temperature of the Earth's surface to remain relatively constant. While many of these gases are naturally occurring, others, such as those used for aerosols, are man-made. Concentrations of carbon dioxide in the atmosphere are regulated by natural processes such as photosynthesis. However, historical data has shown that there has been a 25% increase in the levels of several of these GHGs from pre-industrial levels roughly 150 years ago. The current (and growing) imbalance between the levels of emission and absorption of carbon dioxide is resulting in continued growth of GHGs in the atmosphere. A 2001 study from the National Research Council stated that as a result of an accumulation of GHG in the atmosphere, surface air temperatures and sub-surface ocean temperatures are, in fact, rising.

So what does this have to do with green design or construction? Consider the following facts. [1] The United States produces 25% of the world's greenhouse gas emissions. Americans produce twice as much per person than other industrialized nations. [2] Over the past 20 years alone, 75% of all human-generated CO2 emissions were the result of burning fossil fuels. [3] The U.S. Energy Information Administration states that almost half of all the GHG emissions in the U.S. come from the construction and operation of buildings. [4] There are over 76 million residential buildings in this country and current estimates of residential energy consumption as a percentage of the nation's total energy use are as high as 40%.

The majority of the energy consumed by buildings is directly attributable to operational factors. However, the embodied energy of the materials and components that create the building may also represent a substantial factor. Embodied energy is the energy used to harvest, produce, manufacture, and transport a particular building material or product. It is estimated that the embodied energy of building materials constitutes 15% to 20% of the energy used by a building over a 50 year period. There is also an embodied energy component to the operational aspects of a building. Delivering potable water, natural gas, heating oil and electricity requires tremendous amounts of energy. A study from the University of Michigan concluded that more that 90% of the operational energy in a typical home can be attributed to embodied energy.

By selecting and installing materials with low embodied energy, and reducing the operating energy through more efficient designs, homeowners can significantly reduce the amount of fossil fuel energy required for building and maintaining their homes, and consequently, reduce their building's carbon footprint.

One of the simplest and least expensive ways to improve a home's energy efficiency is to install proper insulation in the walls, roof and floors. Minimizing heat transfer

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will improve comfort and reduce utility costs.

Construct a tighter building envelope by sealing air leaks around doors, windows, attic scuttles, and elsewhere to further reduce heat transfer and result in lower heating and cooling costs. As the building envelope becomes more air tight, it is important to provide a healthy amount of fresh air in a controlled manner through equipment such as a heat recovery ventilation (HRV) unit.

In new construction, or major additions, consider the proper solar orientation and size roof overhangs accordingly to provide the considerable benefit of an energy-efficient passive solar design. Radiant heat from a thermal mass in the building that absorbed the energy from the winter sun through south-facing windows can eliminate the need for CO2 emitting mechanical equipment to heat the space.

The financial and ecological impact of electrical lighting can be reduced with sensible design and planning. A careful and deliberate placement of glazing can result in natural daylighting wherever it is desired. Glass technologies and shading devices should be used to minimize heat gain and control glare. Light reflecting tubes and diffusers can provide natural daylight in spaces where more traditional glazing is impractical.

Operable window location and floor plan layout can be creatively arranged to take advantage of prevailing wind direction and provide natural convective cooling and reduce or eliminate the need for additional mechanical equipment.

Energy efficient light bulbs, appliances, equipment, and other products can further reduce the home's reliance on fossil fuel energy and provide another cost savings as well. The Department of Energy's Energy Star product rating system is an easy way to begin to identify energy efficient products.

On a more regional level, the commitment to reduce carbon emissions is growing. The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort by 11 Northeastern and Mid-Atlantic states (including Massachusetts) to reduce their CO2 emissions to 1990 levels by 2014.

On a global level, there is the Architecture 2030 Challenge. This is an architecture and building community challenge to incrementally reduce greenhouse gas emissions through the improved design and construction of all new buildings, developments and major renovations. The fossil fuel reduction standard is 50% of the regional or country average for that building type. Reduction standards will be raised to 60% in 2010; 70% in 2015; 80% in 2020; 90% in 2025; and carbon-neutral in 2030 (uses no fossil fuel greenhouse gas emitting energy to operate).

According to Architecture 2030, the total U.S building stock comprises about 300 billion square feet. Each year, we will demolish about 1.75 billion square feet; we will renovate about 5 billion square feet; and we will build new about 5 billion square feet. According to this schedule of construction, by the year 2035, about 75% of the built environment in this country will have been newly constructed or renovated. This vast transformation will provide us with an unprecedented and precious

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opportunity to dramatically reduce our carbon footprint and stave off the imminent threat of climate change.

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