HOUSING AND HOME ENVIRONMENT NEWS
Department of Design and Environmental Analysis
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Articles & General Information

Healthy Homes Training

Cornell Cooperative Extension is partnering with the New York State Department of Health (DOH) and the National Center for Healthy Housing to provide two training sessions for those interested in developing expertise in healthy homes issues. These two-day events will be held May 5-6 at the offices of CCE Albany County in Voorheesville and May 19-20 in Rennselaer, New York at the East Greenbush Fire Training Center, 68 Phillips Road. These sessions will be offered to a limited number of Extension Educators free of charge. Travel expenses, including hotel and per diem, will be reimbursed by DOH. For more information, contact Joe Laquatra: JL27@cornell.edu.

Housing and Home Environment News (HHE News) is a quarterly publication of the Department of Design and Environmental Analysis at the College of Human Ecology, Cornell University. If you would like to contribute an article to a future publication please contact Mark Pierce (mrp6@cornell.edu).

Cornell University

Air Pressure and Energy-Efficiency Issues in Homes

Joe Laquatra

In recent years, a growing body of scientific evidence has indicated that the air people breathe inside their homes can be more seriously polluted with dangerous toxins than outdoor air, in even the largest and most industrialized cities. Now that homes are more airtight for energy efficiency, indoor air quality is growing in importance. Among other things, the quality of air inside a home is affected by the way it is built. Building materials; connections to the exterior environment; levels of airtightness; and types of installed heating, ventilation, and air conditioning equipment can all influence indoor air quality. In addition, careful attention to construction details that affect air leakage in homes, either through infiltration or exfiltration, will have impacts on air pressure inside these homes once they are occupied. Air pressure levels in homes can affect levels of moisture, carbon monoxide, soil gases, and other pollutants.

One cause of carbon monoxide pollution in a home is chimney backdrafting, a term that refers to the spilling of combustion gases into a home. In airtight houses with a number of combustion appliances that use house air to supply the fuel burners, chimney backdrafting can occur as a house becomes depressurized from exhaust fans or from competition for air among the combustion appliances. Exhaust fans can create the same situation, particularly those attached to kitchen islands and indoor barbeques. If these fans are not

attached to outside air sources, they can draw very large amounts of air out of a house, resulting in depressurization that overpowers a chimney.

Negative pressure does not always cause chimney backdrafting. In one case of high carbon monoxide levels in a home, extensive investigation revealed that cracks in the building shell between the house living space and the attached garage were pathways for automobile exhaust fumes, which were pulled into the living space by negative pressure.

As with other indoor air quality problems, source control is the most effective preventive strategy. In airtight houses, fuel-burning equipment can be controlled through aerodynamic uncoupling, which simply means that any piece of equipment that burns fuel is provided with the air it requires for the combustion process from outside the house. High-efficiency heating systems are designed to do just that, as are new fireplaces and woodstoves.

Because homes are more airtight than they were twenty years ago, an essential housing feature for air pressure control is a mechanical ventilation system. Mechanical ventilation can either be spot ventilation or whole-house ventilation. Spot ventilation removes contaminants from a particular location such as a bathroom, kitchen, or laundry room. Spot ventilation systems are acceptable when a pollutant source is known and concentrated in one location. Spot ventilation may be accompanied by a makeup air supply system that is comprised of air inlets or passive vents. These are grille-like openings through exterior walls that are usually located in bedrooms and main living areas. The negative pressure created by exhaust fans pulls fresh air in through the vents.
Without the vents, negative pressure can pull air in through cracks in the building shell, including the foundation, so that infiltrating air can contain radon and other soil gases. A study by Lawrence Berkeley Laboratory, however, cautioned spot ventilation with air inlets is a ventilation strategy that is appropriate only for small, energy efficient homes. Balanced ventilation is a better choice for large homes.

A balanced ventilation system uses both supply and exhaust fans to bring in and remove equal amounts of air into the house. Because this system does not rely on cracks or other openings in the building shell, it allows for better control of air flows and pressures. Balanced ventilation systems can incorporate heat recovery. This means that during the heating season, incoming air is heated by the exhaust air. And if the house is air-conditioned, the incoming air can be cooled by the exhaust air. An integrated ventilation system also features exhaust and supply air, but in this system the incoming air is directed to the furnace supply ducts, and that ductwork is used to distribute fresh air.

A clear implication for the home construction industry is to become familiar with building science. The Building America program of the U.S. Department of Energy (DOE) provides excellent examples of homes that are built to be durable, energy efficient, and free of indoor air quality problems (www.buildingamerica.gov). Building America is a housing industry-led, cost-shared partnership program that has the following goals:

- Reduce whole-house energy use by 40-70% and reduce construction time and waste;
- Improve indoor air quality and comfort;
- Integrate clean onsite power systems;
- Encourage a systems engineering approach for design and construction of new homes;
- Accelerate the development and adoption of high-performance residential energy systems.

Program goals are achieved through intensive builder training sessions that familiarize builders with principles of high performance housing. These principles are based in building science and focus on critical construction details which make homes resistant to problems like mold, radon infiltration, and others. Reduced warranty costs and fewer builder callbacks are documented impacts of the Building America program. Town and

Country Homes, for example, has reported that callbacks and warranty claims have been reduced by 70 percent since the firm began participating in the program in 1995. Visit the Building America website reference above for downloadable manuals and other materials designed to educate homeowners and builders about healthy, energy-efficient homes.

Reference

Roberson, J.A.; Brown, R.E.; Koomey, J.C.; Greenberg, S.E. (1998). *Recommended Ventilation Strategies for Energy-Efficient Production Homes.* Ernest Orlando Lawrence Berkeley National Laboratory. Available at: http://www.engext.ksu.edu/ventilation/LBNL-40378.pdf

The Regional Greenhouse Gas Imitative And the Debate over Cap and Trade versus a Carbon Tax

Mark Pierce

The very first cap and trade carbon market in North America just started operating in a ten state region in the eastern part of the United States. New York State is part of this imitative that is being called the Regional Greenhouse Gas Initiative (RGGI), The other participating states are Connecticut, Delaware, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, Rhode Island and Vermont.

Cap and trade programs are created to try to lower the amounts of green house gasses being emitted into the atmosphere, especially carbon dioxide (CO_2). RGGI has set an initial annual CO_2 cap of 188 million tons for the 225 electric generating facilities located in the ten state areas mentioned above. Each plant's output of CO_2 has been measured and an individual cap set for each plant. For each allowance a plant holds it is permitted to emit 1 ton of CO_2 into the atmosphere. The cap will decrease annually so that over time each generating plant will be permitted to emit less CO_2. Plants that emit less carbon due to investments in non-polluting technologies or switching to cleaner fuels do not need to purchase as many allowances and can sell previously purchased allowances to polluting firms that need to offset their higher emissions. This creates a market incentive for firms to pollute less, and punishes firms that pollute more by making them pay for that pollution.

The electric generating sector is not the only source of greenhouse gas emissions in the region. For example, agricultural firms and buildings also emit significant amounts of carbon. RGGI plans to address emissions from these sectors by awarding CO_2 allowances for carbon offset projects. Five offset categories have been created. They are:

Landfill methane capture and destruction

When organic matter in a landfill is buried and decomposes without the presence of oxygen, great amounts of methane gas are produced. Methane is a much more potent greenhouse gas than carbon dioxide. In fact, scientists estimate that methane gas is 21 times more potent than carbon dioxide. Since capturing and burning landfill methane can significantly reduce overall greenhouse gas emissions, RGGI awards allowances for doing that.

Reduction in emissions of sulfur hexafluoride (SF_6) in the electric power sector

SF_6 is the most potent greenhouse gas known at this time, with a global warming potential 22,200 times that of CO_2. Circuit breakers used in electrical transmission and distribution equipment use SF_6 as an insulating gas. While the intent is to keep the gas trapped inside the circuit breakers, leaks often occur as equipment grows old and seals begin to leak. The U.S. EPA estimates that over 604 metric tons of SF_6 are released into the atmosphere from electric power systems each year. RGGI awards carbon off-sets to electric utilities that capture, store, recycle, or destroy SF_6.

Sequestration of carbon due to reforestation

Only land that has ***not*** been forested for 10 years or longer is eligible for offset designation. Strict rules and oversight are also required to meet the requirements for reforestation offsets. For example native tree species are required and if any commercial timber harvest will occur at some future time, forest certification from an organization such as the Sustainable Forestry Institute must be obtained. The reforested land is also required to be maintained as forest in perpetuity.

Reduction or avoidance of carbon emissions from natural gas, oil, or propane end-use combustion due to end-use energy efficiency in the building sector

This applies to new and existing commercial and residential buildings. Improvements in the efficiency of heating appliances and measures that increase the thermal performance of the building envelope are examples of some of the items that are eligible for carbon offsets. Offsets are rewarded for performance only. Pre-improvement and post-improvement energy consumption of the building is measured by a neutral third party to determine actual annual CO_2 reduction. Offsets are awarded based on those annual reductions.

Avoided methane emissions from agricultural manure management operations

Carbon allowances are available for projects that capture and destroy methane from animal manure using anaerobic digesters. The offset project must be located in a state that has a market penetration for anaerobic digesters of *less than* 5% and must be located on a farm with 4,000 or fewer dairy cows.

To learn more about the details of setting up offset projects and acquiring necessary certification see the Regional Greenhouse Gas Imitative Model Rule at; http://www.rggi.org/docs/model_rule_corrected_1_5_07.pdf

Can RGGI make Significant Reductions in Greenhouse Gas Emissions?

Global climate experts point out that a regional carbon cap and trade initiative such as RGGI will not produce reductions of greenhouse gas emissions to levels low enough to head off climate change threats. A national initiative is needed to begin making the reductions in carbon emissions that will be required. And any national initiative should be integrated with a global-wide green house gas reduction effort.

Perhaps a larger issue with RGGI, or any cap and trade program is that it may not be as efficient at reducing greenhouse gas emissions as a carbon tax. With a carbon tax the government taxes each ton of carbon emitted into the atmosphere. By taxing fossil fuels at the point of sale, an incentive is created for all firms and individuals to burn less fossil fuel for any type of application, whether for generating electricity, heating a home or powering an automobile.

Most economists support a carbon tax as the most effective method for reducing human-generated carbon emissions. They point out that a carbon tax would provide the most predictable long-term pricing of carbon emissions and that government set tax rates would not be vulnerable to market manipulation. A carbon tax would also be much simpler to set up and administer than a cap and trade program.

British Columbia recently implemented a carbon tax of $10 per ton of carbon emitted from gasoline, diesel, natural gas, coal, propane, and home heating fuel. The tax will increase yearly by $5 per ton to $30 per ton in 2012. At that time policy makers will review the effectiveness of the tax at reducing carbon emissions and make adjustments as needed. The British Columbia carbon tax is designed to be revenue neutral, that is all tax revenue is returned back to taxpayers in the form of tax cuts and incentive payments to assist consumers in purchasing renewable energy systems.

The debate over global climate change is over. The cause is due to the huge amounts of carbon emitted

into the atmosphere from burning of fossil fuels by humans. Unless the global community begins to make huge reductions in the amount of carbon emitted into the atmosphere we are facing impacts to the global environment that could create significant problems for human societies, probably within the next few generations. The debate moves now to how best to reduce carbon emissions to safe levels. While most Americans resist the idea of more taxes, we should not dismiss using tax policy to create a disincentive to consume fossil fuels and provide incentives for making energy efficiency improvements to our buildings and vehicles. If we have learned anything this past year it is that government intervention is required in the form of regulation and wise tax policies to create incentives for humans to make choices best in line with the long-term well-being of our natural environment and human societies.

Architectural Styles of New York's Older Houses

Mark Pierce

Aesthetic beauty abounds across New York State, and not just in the state's beautiful and varied landscapes and natural vistas, but also its architecture. Many cities, villages and rural areas across New York State are treasure troves of beautiful buildings. As a way to introduce readers to some of New York's beautiful buildings HHE-News will highlight a different architectural style in each of the next several issues. And since this is a housing newsletter, we will focus on architectural styles of older homes.

The Greek revival is one of the oldest and most commonly seen examples of historic architecture seen across our State. The Greek revival style dominated U.S. architecture from the early 19th century to well past the mid-19th century. The style took its inspiration from the architecture of ancient Greece (see photo of the Parthenon of ancient Greece illustrated in Figure 2 to see the similarities in the architecture).

Figure 1: Greek Revival style house with full-height entry porch

Historians cite several reasons for the broad popularity of the Greek Revival style across a young United States. As a newly formed democracy the United States felt a connection to ancient Greece and its ideals of democracy that the founding fathers had based much of the constitution upon. In addition Greece was involved in a war for independence between 1821 and 1830. Americans, having just fought the British for a second time in the War of 1812, were feeling a great deal of empathy and interest in Greece. The Greek Revival style was so popular and widespread across the States that it was sometimes called the National Style.

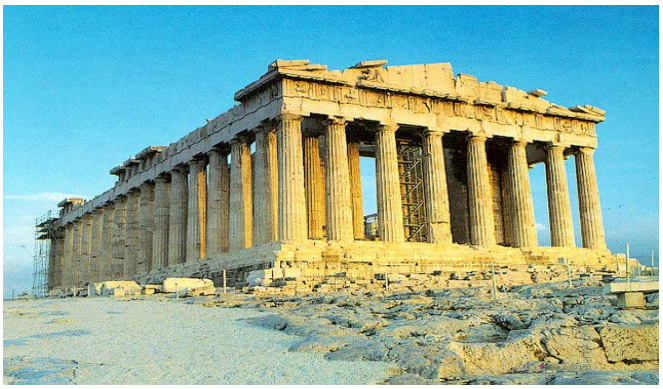

Figure 2: Parthenon

The style originated in Philadelphia with construction of large public buildings that were modeled after the ancient classic architecture of Greece. The style spread to houses due to the popularity of a book called *The Practical House Carpenter, The Builder's Guide*. It was a plan book that many small builders and owner builders obtained and used to build from. Also during this time a growing number of American architects were designing highly styled houses for wealthy clients that took their design inspiration from the architecture of ancient Greece. As these houses sprung up in cities and villages across the country, it created even more interest in the Greek Revival Style. Evidence of the widespread interest in Greek Revival style houses is still apparent when driving across rural areas of New York State (see Figure 3). While rural Greek Revivals were typically not as highly detailed as their urban cousins, they were also very beautiful buildings.

The Greek Revival Style remained popular into the 1860's when it started to be replaced by the Gothic Revival and Italianate style -- more on those styles in coming issues of HHE-News.

Figure 3: Simply styled Greek Revivial Home on a rural road in Tompkins County