Cooling Load Reduction

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I'm confident that in many homes in Phoenix, I can reduce the cooling load by 25% to 50%. It is not a difficult task, given that there are so many lost opportunities to cost effectively reduce a home's cooling load. Simply reduce the heat flow through the thermal pressure / envelope and the cooling load is reduced. This article will provide specific examples of how to achieve major cooling load reductions.

I'll focus on "envelope" strategies because the most efficient AC unit is the one that doesn't have to run. I am a big believer in high SEER cooling equipment, but I'm a bigger believer in reducing the cooling load. My goal is to make the building so energy efficient that the unit's overall run time, regardless of its efficiency, is dramatically reduced.

There is tremendous potential in Phoenix to reduce utility bills by reducing cooling loads. According to APS, the average cooling load contributes to 39% of the energy use in a Phoenix residence. Based on the Alliance to Save Energy's 2008 Arizona Household Energy Expenditures, the average home in Arizona spends $1746 on energy per year. Based on this research, I estimate that air conditioning costs run about $680 a year for an average home in Phoenix. I'll show how it is conceivable to cut this cost in half.

Let's face it, the contracting community does a poor job of keeping the heat out of homes in Phoenix. The most common problems encountered, in no particular order of importance, are lack of solar control, duct leakage, missing insulation, air barrier issues and door closure in single return homes. It is my observation that there are few contractors who are clearly assessing the whole house and coming up with comprehensive solutions specific to a customer's home.

Why do the trades do such a poor job keeping the heat out? The answer is obvious; we all suffer from tunnel vision. The HVAC community views every problem as a mechanical problem: "upgrade the unit." Insulation contractors view every problem as an insulation problem: "add more insulation." The solar control contractor believes every problem is a solar control problem: "let's install shade screens." Everyone is trying to sell their particular solution because they are trying to make living and they know their trade the best. On top of this, there are contractors in the marketplace who try to sell consumers radiant barriers, attic fans and other questionable strategies. Subsequently, few houses get a comprehensive treatment and thus don't achieve their full efficiency potential.

The most cost effective envelope strategies are shade screens, tight duct work, quality insulation, quality air barriers and solutions to deal with room pressurization in single return homes. Successfully apply these solutions to a home and a homeowner will achieve a level of efficiency and comfort most homeowners are not accustomed to.

The potential for cooling load reduction all depends on the individual house and magnitude of the problems a comprehensive energy audit reveals. The bigger the problems, the bigger the potential return on investment. Some homes have air distribution systems that are so leaky we can't reach our test pressure when we perform a duct blaster test. Other homes have major insulation problems or no solar control. By testing, we can focus on the biggest and most appropriate problem first.

For anyone who is genuinely committed to cost effectively reducing their cooling load, the first step is to have a comprehensive energy audit performed. Find an experienced auditor who is certified by BPI (Building Performance Institute) or RESNET (Residential Energy Services Network). Besides having these certifications, a professional auditor will use blower doors, duct blasters, infrared cameras, etc. This diagnostic equipment provides the auditor measurable information.

Most likely, the biggest opportunity to reduce your cooling load is with solar control strategies. When a house is insulated correctly and the duct system has minimal leakage, unwanted solar heat gain can account for 40% - 50% of the cooling load. In Phoenix, solar heat gain must be controlled for a house to be energy efficient.

I could easily argue that having clear dual pane windows without solar control is the equivalent of having an un-insulated attic. Placing shade screens over clear dual pane windows on the east or west side of a house reduces their heat gain by 53%. The evidence to support this is readily available in Manual J Residential Load Calculation. The heat transfer multiplier (HTM) is an actual measure of energy performance for a building component. The lower the HTM the better. For a clear East or West facing window the HTM is 78. Add a 90% shade screen over the window and the HTM drops to 37.

The savings potential with solar control strategies are too large to ignore. According to a University of Texas at Austin study on solar control, "the annual energy cost savings for the top strategy (solar screens with the best properties) range from 10% - 14%." This study corresponds with the savings projected by SRP in a typical two thousand square foot home. According to SRP the average savings during the summer months is $275. On their web site, APS states "you could reduce the size of your air conditioning unit by ½ to 1 ton with properly applied window shading techniques."

Another opportunity for cooling load reduction is to eliminate the insulation defects that undermine R-value. What is important to realize about insulation is that small problems can seriously undermine the overall R-value of an attic. Most people are not aware that 5% missing insulation in an attic drops the overall R-value of the insulation by 52%.

At Advanced Insulation we routinely perform infrared scans and see missing insulation. Where insulation is missing or poorly secured to kneewalls, it is not unusual to see interior sheet rock temperatures approach 95°F and 112°F. Bare sheetrock has a HTM of 50. Ten inches of cellulose insulation (R-38) has an HTM of 1. The key to getting great insulation value is to not focus on the rated value, but more on the quality of the installation. This is why we know that a quality R-30 will outperform a poorly installed R-38.

The last opportunity involves controlling unwanted infiltration. Weather stripping of windows and doors is the first thing that comes to mind when we mention air leakage in a home. However, while helpful, these measures are actually insignificant when compared to duct leakage and door closure in single return homes. A research paper by Proctor Engineering Group found that, "duct leakage and existing duct insulation levels reduce overall cooling efficiency. Reasonable improvements can save 16% of the cooling energy for about $140" a summer.

Our comprehensive energy audits also deal with door closure and indoor air quality issues. Pressure imbalances in single return homes can drive up utility bills and impact indoor air quality. The American Lung Association says, "build it [the house] tight and ventilate it right". Our auditors are familiar with minimum ventilation guidelines. They know when to stop air sealing or when to employ a controlled ventilation system.

By implementing the strategies mentioned in this article, I'm confident that I can reduce cooling loads by 25% to 50%. Of course the rate of savings depends on the individual home, but many homes are not nearly as energy efficient as they could be. Not only are my targets for cooling load reduction possible, but the return on investment on these efficiency upgrades will be 10%, possibly more, depending on the magnitude of the problems. With rebates and tax credits the ROI could be much greater.