

# Texas HERO – Final Position Paper

**Date:** April 22, 2005

**To:** RESNET and the Environmental Protection Agency – ENERGY STAR Homes Program

**From:** Texas HERO – This document is a compilation of the discussions and outlook of all the member of Texas HERO. It was discussed in the April 20, 2005 HERO Board meeting approved by a unanimous vote of the Directors with the support of all companies.

**Re:** Discussion regarding the technical merits of the 2006 ENERGY STAR EPA proposal and the future of ENERGY STAR in Texas and across the country.

## Executive Overview:

*After much discussion, Texas HERO has developed the attached position paper with comments, thoughts and ideas as to how the industry can best move forward and continue the momentum built on the successful ENERGY STAR homes program. The scope of the changes to the regional, state and national energy environment is huge. The potential exists for unintended consequences that could negatively impact the progress that we have all collectively worked so hard to make. A delay gives time for all parties to address the technical, marketing and business impacts and for the appropriate parties to develop win/win solutions that provide for the best possible national and statewide outcomes.*

## Key points of the overview:

- We respectfully request a **delay in the implementation until January 1, 2007** of the 2006 changes to the HERS reference home and to the EPA 2006 proposed guidelines. The purpose of the delay is to allow time for understanding of the issues, discussion of alternatives and implementation of a revised proposal that best meets the needs of all the stakeholders in a timeframe that allows for communication and planning. We hope for a delay of at least 12 months from the original January 2006 implementation date. This request is duplicated from our previous communication, which explained some of the reasoning along with supporting information. Our utility partners have specifically shared their desire for a significant delay in the implementation of the program. They need time to plan and implement programs to meet their energy efficiency goals and do not see how they can meet their requirements with the current timetable.
- We respectfully request that the involved parties **find a way to include or otherwise keep the “score”/ HERS rating**. We believe that the rating has value for builders, raters, utility companies, homeowners (of both new and existing homes) and, likely, the EPA. We believe that the score has value for the EPA as part of the EPA mission for prevention of pollution. The scores accurately count for energy savings and can be directly translated to pollution prevented. In addition, a scoring mechanism provides incentive and mechanisms that help get more pollution prevention.
- **We value the time and the discussion:** We applaud the EPA for working very hard to intensely analyze changes to the energy landscape and presenting a draft of a proposed future standard for discussion. It is a bold draft. It is an interesting and challenging proposal based on extensive analysis of the outstanding issues and their best vision of the real world impacts of the code and NAECA changes. The time issue is difficult for all.

The fact that we were able to see and discuss a draft prior to the RESNET convention was a major benefit. We appreciate and value the EPA's listening ear, the open mind and the open comment period. Our hope is to provide valuable insight during this comment period that will help lead to a new answer that provides the most benefit to the collective people and organizations that care about energy efficiency in the home.

- **Seek a “third right answer”:** The purpose of this document is to do our absolute best to respond to as many of the issues as possible *allowing the EPA and RESNET to work together for appropriate solutions* – a third right answer / not just a compromise – that benefits all the stakeholders of energy efficiency in new homes.
- **A new vision for the future of energy efficiency in homes:** We believe that somewhere within this discussion the third right answer gives a new vision of how energy performance in homes will be captured, measured, reported and compared in the future. With improved home energy performance, it may seem like we have reached the value limits of rating. But,
  - There is value in the score in the existing home market. Perhaps the long-term value of the score is for comparison of new homes to existing homes and for capturing the improvements in the existing home market. This may give impetus to the Home Performance with ENERGY STAR program and help other programs that focus on the existing home.
  - There is value in the precedent we set with this action. ENERGY STAR is successful. ENERGY STAR is far ahead of other national voluntary programs. It is the model on which many programs are built. This is an emerging truth at both State and Federal legislative levels. This is true for utility performance programs. The total impact of the final decision about the integral nature of the “score” is wide ranging. We encourage all parties to visualize the long-term implications of this decision and create the future that best moves the cause forward.

## **General Requirements: Commentary and Suggestions**

- I. Ratings have Value!
  - a. The HERS score has value for both new and existing homes. The next big market opportunity is the existing home. With a “score”, we can compare the current and future performance of an existing home with the ENERGY STAR standard. If there is no score, then there is no standard of comparison for the existing home market. A standard of comparison allows homeowners to value improvements, to market and sell the improvements when they sell their property and helps people understand and compare the energy cost difference between the existing and new homes. This is also essential for utility programs to accurately account for the interaction between savings and to track the savings for homes.
  - b. **The value of Texas HERO is getting the Program from specifications to Certification!** We see the score issue as the major thrust of what we should be working to establish and confirm as valuable. You eliminate the score you jeopardize the entire HERS industry. If the HERS industry is jeopardized, the ability of all institutions to produce verifiable results will be limited. A new verification industry will have to be built.
  - c. In the future, there will be programs from various sources (Green building, EPA, NAHB, etc...) and they will all need verifiers - which is what the HERS industry

brings to the table. Eliminate scores as a central element and you eliminate the basic tool, systems and people to verify.

- d. We see endless opportunities to capture the trade off between energy options. See the discussion on R-8 duct, which is a clear and easy way to evaluate the benefits of some measures with the lack of benefits from others. These benefits are allowed by the power of the trade off measures inherent in the score.
- e. Potential Problem with the 2006 proposal and “batch” homes: A home that qualifies as a “batch” home without any “rating” will just become an ENERGY STAR batched house will not have even a projected rating. It will not be anything tied to the HERS industry. It will be just an ENERGY STAR home. Look 3-5 years down the road. The next logical step for ENERGY STAR in the future is to upgrade. That would then establish the next ENERGY STAR level based on the 2006 ENERGY STAR level. So, for instance in 2009 the ENERGY STAR level would be 10% better than ENERGY STAR 2006? There is no reference home calculation in the ENERGY STAR 2006 Proposal or there are an infinite number of reference homes. This is a big issue. There is no standard for comparison.
- f. We believe that there are opportunities to significantly improve the performance method as presented in the 2006 proposal. The EPA’s intent is to set the ENERGY STAR reference level for the performance method at the HERS score achieved by the same home if it were built to the prescriptive specification. The fundamental issue is that there are too many conditions for the initial analysis that are not specified for the proposed ENERGY STAR “reference home”. This makes the “reference home” too variable to be effective at establishing baseline efficiency. We are concerned that this would invite gaming, reward inefficient design decisions, and penalize good design.
- g. In Texas, the IECC reference home should be based on the IECC 2001. There will be no statewide implementation of the 2003 changes or the IECC 2004 amendments. The plan for Texas is to adopt the 2006 IECC and that cannot happen by legislation until spring of 2007 with implementation dates following by a significant length of time.
- h. We think that whatever reference home is chosen, it should follow that the particular home the software makes “that home an 80 score”. Then the ENERGY STAR Home or the Efficient home has to be an 83 (15%) more efficient than that or 82 (10%). The point here is that instead of having the reference home travel up the HERS scale - the reference home (Code Home) stays at 80 and the threshold for the scoring an ENERGY STAR Home changes. This would be much simpler to sell and/or prove, even though the Reference Home would fluctuate between years of impact in more code changes. It would allow for the HERS score to be proven through Plan Analysis and not just a BOP.
- i. In Texas, there has been a huge ENERGY STAR effort by utility companies, rating companies and builders. All efforts have centered around the HERS score and the builder’s ability and desire to meet this score with an appropriate value proposition to new homebuyers. Even if no HERS score is required/needed in the long run, the short run effort will be set back by moving to a prescriptive list. Builders, many who are skittish about energy offerings, will be confused and concerned about the lack of a HERS score. They have put so much effort into understanding the score and building to exceed the score that we risk increasing

their frustration level. Depending on the eventual outcome of the decision regarding the integral nature of HERS scores, it would be prudent to allow a 24 to 36 month time frame for such a dramatic switch in qualification criteria. This would allow builders time to plan and adjust. This would give Raters time to process the changes and develop strategies to create value. This would give utilities and the Public Utility Commission of Texas (PUCT) time to create appropriate templates that can reward emissions reductions. All are relevant to the short, mid-term and long-term success of the ENERGY STAR program and of the companies that support and promote this program.

- j. We believe that our utility partners utilize the “score” to calculate and report energy and emissions savings. A lack of score complicates their efforts and may reduce the value of the ENERGY STAR homes program to them. Since they are a prime driver in the rapid escalation of the program in Texas, this must be an important consideration to all stakeholders.
- k. The day we make 2 or 3 different homes to reference to; is the day the confusion would start. We make our reference home the reference home that the code books states. We keep the capability for a rater to prove how much more efficient this home is compared to the reference home. That is the only way raters and providers can prove the savings impacts to the mortgage companies, which are in need of providing savings amounts for qualifying impacts.
- l. We believe that homes that are designed with poor performance choices should have to make up for those poor choices by adding improvements elsewhere, but EPA’s current proposal appears to give many of them a free ride. By basing the HERS score threshold of the rated home on the prescriptive spec, there will be real disparities in that threshold score depending on several choices made in the home’s design. If these parameters are not specified in the ENERGY STAR base-case calculation, then the base score will be lower for homes that meet the ENERGY STAR spec but which otherwise have energy-wasting features, effectively lowering the threshold of ENERGY STAR compliance for that home.
- m. As one proposed compromise, is there room for a HERS score for 2006, an equivalent HERS score and a BOP for 2007 and 2008 and a time frame for discussion about what might happen to the score and the program as other factors impact the real world of energy improvement in new and existing homes.
- n. Another potential solution: We can keep the score on a regionalized basis. The North has one HERS score and the South another – following along the lines of the EPA/ICF research submitted at the RESNET Conference. Adopting a HERS score-based threshold by climate zone (instead of one threshold for the nation) would be the simplest way to set a stable baseline and avoid gaming opportunities, while keeping the ENERGY STAR Qualification Standard a simple and straightforward document.

## II. **Potential Trade Offs:**

- a. We ask for this program and all future program changes be initiated on starts as of a certain date rather than closings as of a certain dates.
- b. Keep the HERS Score, which reflects the percentage over IECC. The tradeoff mechanism approach in our proposal will give us what we need for the builder participation.
- c. We have to be willing to give as well as get.

- d. Supporting the prescriptive list is also a compromise, with noting exceptions as we are doing so through this process. But we should also be prepared to be flexible on the whole rating issue.
- e. While it is important to offer ratings as an option for the builder, we should also be prepared for making the rating the sole issue on EPA's draft.

### **How do these new changes affect compliance in Texas?**

- Utility Companies have strongly supported ENERGY STAR because it is a program allowed by PUCT to generate Kw and Kwh savings that support the state implementation plan (SIP) for reduced power plant emissions. A change in the program that does not account for the % above code requirements could dramatically impact the support at the state level and at the utility level. This has implications well beyond the impacts of the program and must be carefully evaluated at the EPA enforcement level, the PUCT, the ESL, the utilities themselves – all in addition to the ENERGY STAR LABELED HOMES program and the rating community.
- Problems with rating against an ENERGY STAR Reference Home and the IECC reference home: In the Proposed ENERGY STAR 2006 there would be no Reference Home. At least with the NAHB Green Building Guidelines the reference house is a home built to IECC 2003. By diverging away from a true Reference Home-ENERGY STAR is setting a standard for no standard.
- Since the Energy Systems Laboratory has allowed ENERGY STAR to be used as a vehicle to code compliance in the State, we have spent countless hours training building officials to accept and understand REM Rate reports. Do we now have to train them to accept a checklist if no rating is done? Will ESL accept this as documentation that the house meets the code requirements or will they require us to go back to running RES Checks too? One would also assume that if a rating is performed that it be measured against the current code, not the IECC 2004 which has not been adopted by Texas.
- Texas House bill 2129 (passed in House on April 13, 2005, sent to Texas Senate) will require an estimate of the cost, energy savings to consumers and the related emissions reductions. This requirement (if it passes the Senate) will mandate some type of rating (why not a HERS rating) and it has implications for the future of ENERGY STAR as we have a clear example that we have taught our legislators the same rating lesson we have taught the builders. So, ratings may be key in Texas regardless of the eventual outcome and wouldn't it be best if they remained aligned.

### **Specifics Requirements: Commentary and Suggestions**

#### **Hot Climate:**

- I. Cooling Equipment (Right Sized AC)
  - The selection of 14 SEER as the suggested minimum for the program is appropriate. But, as previously explained, the 14 SEER requirement should be delayed while the builders and the HVAC manufacturers and installers adjust the significant changes already in

place. To do otherwise would be to put burdens on the channel that threatens participation levels from those who would otherwise participate.

- Our utility partners are concerned with annual and peak energy usage. One of their primary goals is to shave peak demand. At present, they visualize a 14 SEER/12 EER unit that helps shave summer peak. It is unclear that the product that meets the 14 SEER requirements will (in a timely basis) also hit the 12 EER goals that help them shave peak load. This is particularly difficult in larger tonnages that are today's 14 SEER equipment offering. So, in part, this is another argument for "delay".
- "Sizing to Manual J" remains very different than "right sizing". The goal of energy usage reduction is centered around picking the size of air conditioning unit that comes closest to meeting the design requirements for temperature and removes sufficient water to keep the home comfortable. That goal is not met by "sizing to Manual J" because the load is determined by the factors selected by the HVAC designer. So, loads on the same home can vary widely – and thus violate the goal of "sizing to Manual J". The goal may and should be listed. But, until more clear standards of what is "right sizing" and how to "confirm" this should not be a "program requirement". However, ...
- The new RESNET standards will also penalize a builder for over sizing the HVAC system. The new ENERGY STAR 2006 Proposal states the HVAC must be sized to Manual J. Where is the verification component in this sizing requirement? RESNET and its members are a verification mechanism and may be the ultimate answer for this question.
- While the statements, "Heating and cooling equipment should be sized according to ACCA Manual S specifications", "ducts should be sized to Manual D specifications", and "both should be based on Manual J load calculations" are reasonable and proper, until more clear standards are developed of what "right sizing" is and how to "confirm" it, this should not be a "program requirement". Our concern is that HVAC contractors by and large do not fully understand and agree this process and that there is no protocol to verify if an HVAC contractor has properly determined the load, selected equipment based on ACCA Manual J indoor and outdoor conditions and correctly sized the duct system. If this process "should" be done this way it "should" be verified.

## **II. Heating Equipment**

- In promoting a right sized minimum standard furnace in climate zones 1-3 the EPA has made an intelligent and effective decision.

## **III. Thermostat**

- The program should disallow "mercury bulb" thermostats – thus having a positive impact on the environment by allowing less mercury in landfills in the future.
- Another suggestion would be to add ENERGY STAR thermostats to the proscriptive list of products that help identify a home as ENERGY STAR. So, now a thermostat could be added to lighting and appliances.
- All digital thermostats should be acceptable.

## **IV. Ductwork:**

- It is unclear the value of changing the duct leakage standards from % of fan flows to the new standard proposal. It is clear that the new standards are tighter than the current 10% rule. We question the value of tighter standards when the majority of the system leakage now comes from the furnace or air-handling unit. The real argument, it appears to us, needs to exist at the design / price level of the equipment manufacturer and how much leakage makes sense based on the real product performance in the field. The argument for this standard is that the HVAC contractor should “tape” or otherwise seal the unit in the field. But, this is not a permanent solution and is likely to cause problems for homeowners and HVAC service technicians in future years. If the argument against CFL’s is that they will not be guaranteed as permanent, then that argument should go in equal measure on furnace “taping”.
- What is the rationale for the switch in methodologies? It seems to penalize “volume” and limit the design freedom of the ENERGY STAR builder.
- We should enforce Mastic connections on all Energy Star Homes.
- The 2004 IECC calls for R-8 ducts. What impact does this have on the builders, performance, etc.?
- IECC 2004-Section 803.2.8.... when located in unconditioned spaces and with a minimum of R-8 insulation when located outside the building. This issue with the IECC2004 is one of the reasons we want to keep scores as part of the ES program. Without a HERS score you cannot trade off this requirement. The Proposed ENERGY STAR 2006 does not allow for a HERS Score.
- This R-8 tradeoff would be a huge advantage for ENERGY STAR. The R-8 ductwork requirement in the IECC makes little sense from an energy conservation perspective. R-8 ductwork will be significantly harder to properly install (see comments re the transition from R-8 to R-6). The R-8 ductwork is going to be resisted and is a huge value point for an intelligent “trade off” with the ES program showing smart efforts.
- R-8 with a connection to R-6 at the chase levels is going to create another leak point. Another duct leak point makes the acceptable duct leakage tightness more problematic. To tighten the requirements in the face of what we know will be an additional leak point creates conflict within the program that adds no real value.
- The R-8 duct requirement would impose significant impacts on the builders in a number of areas. Specifically the impact is cost, because this requirement would force builders to perform major re-design of their houses to accommodate the size of the ducts in floors systems and attic areas. The other cost impact would be due to the lack of supply of this product and the premium builders would have to pay in order to use it. Have you seen the increase in insulation costs in the last 15 months? Also, demand would most likely exceed the supply based on current production, which could lead to shortages and delays in construction. All of these cost impacts would obviously be passed on to the homeowner causing a rise in home prices. These are problems presented by the code that could be reduced or eliminated by addressing this issue within the ENERGY STAR rules. It would create a separate driver for builders to want to build to ENERGY STAR.

- Being able to trade off for R-8 is important. We all know that if a builder is forced to use R-8 in the unconditioned spaces that the R-8 will connect to an R-6 at the chase location. Builders are not going to change their architectural plans to accommodate an extra 2-4 inches in chase size if they do not have to. We have attached a chart which was provided in an article posted on the Energy Conservatory website from Berkley Laboratory. It shows that the gained efficiency from an R-6 to R-8 is very minimal. The creation of a transition between the R-8 in the attic to the R-6 going into the home at the chase location will create more leakage than the 1-2% efficiency savings. Without a HERS score this cannot be traded off and Most Raters and Builders will not be able to achieve the reduced leakage threshold, which is required in the 2006 ENERGY STAR Home.
- Some preliminary analysis shows the new targets bring the duct leakage down to 4-5% of high-speed fan flow, compared to the standard default used in the marketplace of 10%. This lower percentage may be harder to achieve for builders using higher efficient equipment. Although we realize that higher efficient equipment will produce lower leakage levels, Texas HERO does not feel that the efficient equipment will allow for this much reduction in leakage to accommodate the testing requirement.

## **V. Envelope**

- Many homes perform significantly better than .35NACH. Is this a potential area for builder trade off that a “score” would allow for a builder to reap the value?
- Insulation inspections: the prescriptive approach should explicitly specify “Inspected to a "Grade I" installation according to the 2006 RESNET standards” to allow qualification. Otherwise, the building envelopes will not actually meet code (which specifies insulation installation according to manufacturer’s instructions), and would result in fewer savings for the prescriptive approach. Those participants unwilling to meet that requirement or unable to allow an insulation inspection could use the performance path.

## **VI. Windows**

- According to the EPA, the window standards for North Texas have to be less than 0.40 for both U-Factor & SHGC coefficient. For the production builders in North Texas that we work with, getting below 0.40 SHGC is not difficult. However, the lowest U-Factor that we see in the field is .51 in operable metal-frame window products. It’s not a matter of getting below 0.40 U-Factor on a window, but rather a cost and availability question. Even if it costs the builder on average \$20 more per window for U-Factors less than 0.40, that translates to around \$300 added costs per house. Adding this to the other incremental costs in 2006 (i.e. 13 SEER), this might be enough reason for North Texas production builders to pull out of ENERGY STAR.
- Another issue arises on window specification when you exceed 21% WFA. Builders in climate zones 1-3 would have to use windows with a SHGC as low as .32 and U values below .40. Potentially, this again forces the builder toward vinyl/wood windows. According to local manufacturers this is a price increase of at least 30% for production builders and 50% for custom builders.

- Availability- The increase in the purchases and reductions in cost of low-E windows have been nothing short of stupendous in the last 4 years. It is unclear at this time exactly how fast the fenestration folks are able/prepared to move. Their world has dramatically changed and they have risen to the challenge. But, can they rise again. At present, no one has the answer and perhaps there is no answer available until the market calls.
- It seems prudent to phase window improvement in over a period of time. This way, window manufacturers and distributors can see what is coming and react in advance on the designs and materials that meet the needs of the program. Even with a “delay” in implementation, we are likely asking for too much – too quickly.

## **VII. Water Heater**

- Has anyone spoken with the water heater manufacturers? Is this requirement “doable” within the time frame and cost / value proposition of the ENERGY STAR offering? What data is available? One Rating Company confirms that this will not be a supply limitation. There is however, a cost impact of anywhere between \$75-\$300. Is this true through out the state and throughout the country?

## **VIII. Lighting and Appliances**

- An ENERGY STAR light fixture does not require an ENERGY STAR bulb to be placed in it. I think we need to embrace the RESNET proposal to use the Expanded Score as a basis for calculation of any fixtures. Can you imagine a rater climbing up in the attic- pushing around the insulation to determine if the builder had used ES lighting fixtures-as opposed to the rater verifying what wattage lamp was being used-irregardless of the fixture?
- This may be a good place to add the ENERGY STAR thermostat to the requirements as an option for a builder.
- CFL bulbs should be counted on as part of meeting this requirement.
- One very knowledgeable builder indicates that “ENERGY STAR ceiling fans do not exist!” Is this true? If yes, is it problematic for the program requirements? Some respond that there are ENERGY STAR ceiling fans, but that they are hard to find. Hard to find translates to “costly” and is a consideration in the allowable selections.
- What is the value proposition of the allowance of ENERGY STAR appliances in new homes? Is this a “no brainer”? Or, is this a significant cost without commensurate value?
- Are their estimates for the additional costs to production builders of this and the other requirements?

## **Thermal Bypass: Commentary and Suggestions:**

The thermal BY-PASS inspection MUST be performed by a Certified Rater through an accredited HERS Rating Provider. Everything else in the checklist looks good and should be done on all houses.

In some cases, we support the use of the checklist by IECC code certified inspectors if quality controlled by HERS Rating Provider.

**I. Shower/Tub at Exterior Wall – no commentary submitted.**

**II. Insulated Floor above Garage – no commentary submitted.**

**III. Attic Knee Walls – no commentary submitted.**

**IV. Attic Hatch/drop down stair**

- Please demonstrate how a builder cost effectively covers a pull down staircase with insulation that is attached and fits snugly within the framed opening. If it is not cost effective, does it make sense to keep this in the requirements for the future of the program?
- What intelligent accommodations that could be made to address this issue with a different pull down stair design?

**V. Cantilevered Floor - no commentary**

**VI. Duct Shafts**

- The question of concern is #6 Flashing at the chase location. Most chases are at the ceiling and if flashed the direction of water if any would just move and divert to the ceiling sheetrock. The only way for condensation to form is when hot air mixes with cold air in a solid. You can be assured that if you connect an R-8 duct to an R-6 duct with minimal leakage. You will need not only flashing but a drain line as well. #8 needs to be reworded. All piping cannot be foamed as normal. Some piping will require fireproof caulking to comply with code and seal the air. We should suggest that a new line be added for floor blocking. All exterior edges of a floor system are to be sealed by an air barrier. This includes Brick Cantilevers blocked at the floor joist location, all perimeter edges of the floor system that attach to unconditioned air.
- Adding, “fire caulk” is not a good idea. It adds cost and complications and we doubt that there is evidence that fire caulk at duct shafts would prevent or reduce damage to home or home occupants in the event of a fire. This is and should remain a code safety issue.

**VII. Flue Shaft – repeat the questions and concerns related to duct shafts.**

- Adding, “fire caulk” is not a good idea. It adds cost and complications and we doubt that there is evidence that fire caulk at duct shafts would prevent or reduce damage to home or home occupants in the event of a fire. This is and should remain a code safety issue.
- Foam is not likely to meet with the acceptance of building code officials.
- Flue shafts should be sealed with an acceptable air barrier material.

**VIII. Piping Shaft/Penetrations – no commentary.**

**IX. Dropped Ceiling/Soffit- no commentary.**

**X. Fireplace Wall – no commentary.**

**XI. Staircase Framing at Exterior Wall/Attic – no commentary.**

**XII. Whole-House Fan Attic Penetration – no commentary.**

**General Question regarding all the Thermal Bypass issues:**

- With regard to the entire “thermal bypass” check list: Photos showing both acceptable and non-acceptable applications would be of huge value in determining if there are potential issues that are not clear from words alone. It is quite possible that there are significant unforeseen issues with how these specific requirements can be applied and either approved or red tagged. Like other issues, these need to be vetted in the field for a period of time (not just in Texas but around the country) to determine precise wording and what is appropriate in terms of real world applications.

**Addendum: R-8 Duct Requirement Analysis**

Based on research obtained from a study done for the State of California Energy Commission, dated August 27, 2003 and Authored by Bruce Wilcox, PE at Berkeley Labs on the Cost Effectiveness of Increased Duct Insulation, the study showed that the increase in cost for labor and materials associated with installing R-8 duct insulation averaged \$600 per house. (See table below)

Revised cost estimates for increasing flex duct insulation including additional labor costs are shown in Table 1, the original cost estimates are shown for comparison.

**Table 1 -- Cost of Increased Duct Insulation**

Insulation Increased Cost to Home buyer for 1761 ft2 prototype			
R-value	Original Estimate	Revised Estimate	
R-6	\$65	\$100	
R-8	\$108	\$600	

Based on their extensive research and cost analysis, it was determined that installing R-8 duct insulation was only cost effective and beneficial in Climate Zones 14, 15 and 16 which are the Northern Climates. (See table below)

*Revised Residential Duct Insulation Cost Effectiveness Analysis 6  
August 27, 2003*

**Table 3 -- Life Cycle Energy Cost Savings for Upgrade from R-4.2 to R-8 Duct**

TDV LCC Approach			
CTZ	Gas	Elect	Total
1	222	0	\$222
2	263	94	\$357
3	151	26	\$176
4	181	26	\$207
5	166	18	\$184
6	59	26	\$84
7	56	13	\$69
8	66	41	\$107
9	82	102	\$184
10	102	194	\$296
11	230	212	\$441

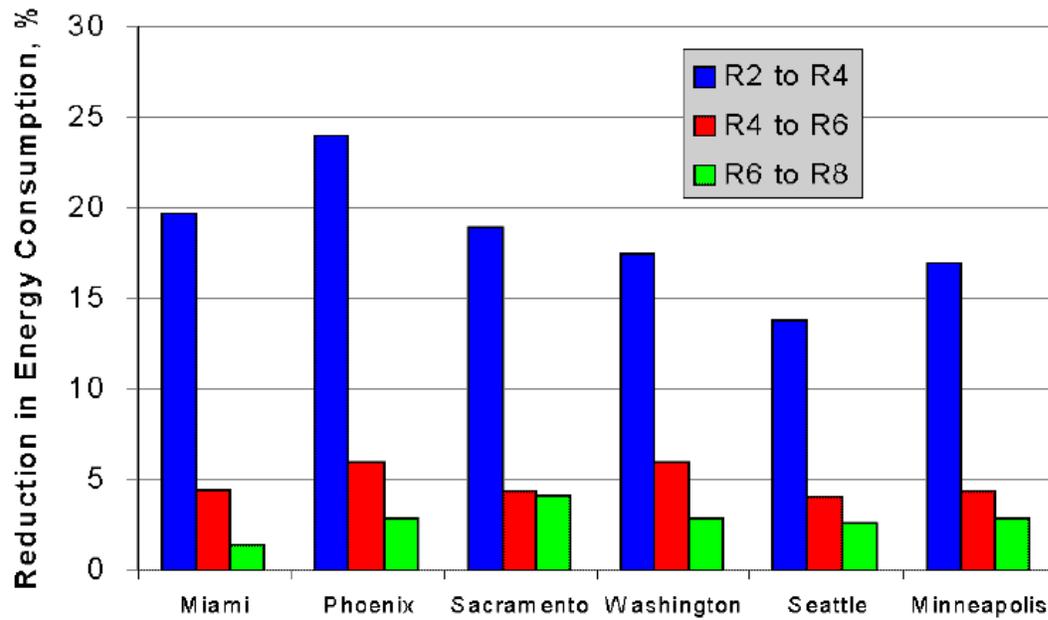
12	207	133	\$339
13	163	263	\$426
14	278	334	\$612
15	38	824	\$862
16	594	79	\$674

In another comparison study done by Lawrence Berkley National Labs, the attached chart shows as insulation is added in steps from R-2 to R8 there are minimal returns with additional insulation beyond R-6. The average increase in efficiency, is less than 2.6%, with the highest being 4% and the lowest being 1.5%. The lowest percent of increase was in Miami, FL with 139 HDD 65 / 4157 CDD 65 and the highest was in Sacramento, CA with 2361 HDD 65 and 1491 CDD 65. Sacramento is considered a very mild climate in comparison to Minneapolis, MN and Miami, FL, which would be considered to be the harsher of climates.

The study states, the term "duct efficiency" indicates how much energy entering a duct system is provided to the house, thus, higher efficiency ducts are better. To evaluate the effects of duct losses, LBNL has been involved in the development of ASHRAE Standard 152P "Method of Test for Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems" (ASHRAE 1999). Using the calculation procedures in the standard allows us to estimate the effects of duct insulation on duct system efficiency. Note that only the seasonal efficiencies from 152P are discussed here because they are the most appropriate for estimating energy consumption in buildings. The effects at peak conditions will be greater than those shown here due to the more extreme weather conditions, and therefore more extreme duct location temperatures. Examples are given here for typical systems in six cities chosen to represent a wide range of weather conditions. The maximum benefit gained by insulating ducts is when the ducts are in locations that have acute temperatures. These effects are highly variable - being greater for more extreme climates and duct locations, so it is necessary to take these variables into account when assessing the cost-effectiveness and other benefits of duct insulation.

If we also include practical space considerations (R8 adds about six inches (150 mm) to the duct diameter) a couple of optimum options appear. For new installations that can be more flexible about duct size, R6 ducts are good for most cases. Similarly, if decisions are being made about adding insulation to ducts, and the ducts already have R4.2 – R6 or greater insulation, then it is unlikely to be a practical and cost-effective measure to add insulation. Below this level however, ducts do receive considerable benefit from the added insulation. Lastly, in some cases the added insulation is of very little benefit particularly when the ducts are in locations where temperature differences between air in the ducts and their surroundings are negligible.

### Effects of adding insulation to attic ducts for a typical house and duct system in the summer



Note: Since it appears that other regions of the country are neutral to negative on raters, we suggest that the industry work with other regions to improve the QC and business offering of those raters so that they add more value.