"What's Going On Out There?" A Baseline Survey for the LCRA's Good Cents Home Program

Tom Knutsen Conservation Analyst LCRA Austin, Tx

Abstract

The question, "What constitutes your baseline?" always challenges Demand-Side Management program staff. This study answers that question for the Lower Colorado River Authority's Good Cents Home Program.

The Lower Colorado River Authority (LCRA) has based its engineering estimates of program savings on baseline construction practices identified in 1986. LCRA updated its survey in 1993, and this study details the project's findings and methodology.

LCRA learned that it has two distinct markets. One, greater Austin, has a high level of efficiency, driven by the City of Austin's energy code and energy-efficient new home program, E-Star. The other is Central Texas, with lower thermal and equipment was lower.

The study employed site surveys of houses under construction, computer simulation of building shells and equipment operation, and statistical analysis of data. New savings calculations have put the program on a more conservative and reliable footing as a result of the findings.

I. Introduction

This report summarizes the Lower Colorado River Authority's (LCRA) 1993 Good Cents Baseline Survey. The survey's purpose was to determine whether building practices have changed since the LCRA introduced Good Cents in 1986.

A generation and transmission utility, the LCRA provides its demand-side management (DSM) programs to homeowners and businesses through its 44 wholesale customers. Much of the LCRA's service area is unincorporated. The absence of building or other codes is one of the reasons that the LCRA opted for the Good Cents Program as its standard for energy-efficient new construction. Good Cents provides a uniform performance standard that is as applicable to rural, custom building as it is to production building in the suburbs of Austin or San Antonio.

Baseline standards are used for estimating energy and demand savings. The idea is to find out what kinds of thermal envelope and HVAC equipment builders use where no energy-efficient home program is in place. The question posed is, "What kind of houses would be built in our service area if we weren't operating Good Cents?"

This study answers that question. Its methodology replicated the field survey carried out in 1986 by the corporation that manages Good Cents, Southern Electric International (SEI). It was

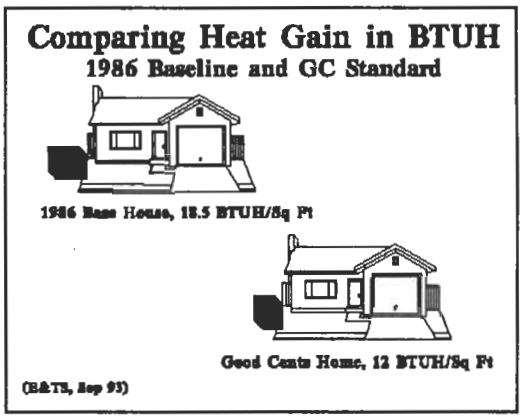
the same kind of survey SEI had undertaken in designing Good Cents programs for approximately 50 utilities across the United States.

What prompted this second study was the concern that the gap between baseline and Good Cents construction practices had shrunk since 1986, reducing the program's actual demand and energy savings. An analysis of the billing records of 166 Good Cents Homes raised that question. By comparing actual to projected energy consumption, the analysis found that the Good Cents software, RBEP, predicted energy use reliably with two exceptions. It appeared that RBEP overestimated both for savings in all-electric homes and for energy usage in the spring and fall or "shoulder" months.

This review of baseline construction, then, is a continuation of the evaluation begun with the billing analysis. It raised issues about thermal performance and energy usage that need answers.

The thermal envelope characteristics of a house are important to distinguish because they determine the rate of heat gain or loss. The rate of heat gain, measured in Btus per square foot per hour (BTUH/sqft), is the unit of measurement used by the air conditioning industry to calculate the cooling load of a house. Since LCRA targets its Good Cents Home Program primarily at reducing summer cooling load, we required a baseline survey to ascertain the rate of heat gain common to non-Good Cents houses.

Heat gain in BTUH/sqft determines the size of the air conditioner, whose purpose is to keep a house's occupants comfortable by removing heat. A cooling system operates at optimum efficiency when its size is matched to a dwelling's load. The rate of heat gain drives energy consumption, for the higher the heat gain, the more energy required to maintain indoor comfort. The comparison between the Good Cents standard of 12 BTUH/sqft and the 1986 baseline practice is illustrated below. The "baseline" house, with its greater heat gain, will require more energy for cooling and heating. Its larger air conditioner will demand more power for operating. The results are higher bills for the consumer and the need to provide more power at peak demand times for the supplier of electricity.



Energy savings for the Good Cents Home Program have been quantified by subtracting the estimated usage for a Good Cents Home from the estimated usage of a non-Good Cents or "baseline house." Current estimates have been based on the construction practices identified as baseline in 1986. If builders have improved the thermal envelopes of their houses

since then, the program's savings projections are too high.

In addition to the concern that thermal envelopes had improved, equipment was expected to have become more efficient for two reasons -- the influence of utility rebate programs and the law.

In 1986, even though the LCRA and its neighboring utilities had been paying rebates for high-efficiency cooling equipment since the early 1980s, electric furnaces still dominated the market where plumbed natural gas was not available. Rebate programs had not been encouraging heat pumps which were unpopular with builders. Since then, LCRA and its neighbors adjusted their rebate schedules to encourage heat pumps and discourage the use of electric furnaces. For that reason, we expected to find an increase in the heat pump share of the new home market.

We also expected to find that the Seasonal Energy Efficiency Ratio (SEER) of new units would exceed the legal minimum. The National Appliance Energy Conservation Act (NAECA) required that after January of 1992, air conditioning manufacturers could produce no central cooling systems with a SEER lower than 10.0. So, we anticipated that average SEER would be above that level overall.

II. Methodology

A. Sample Design

The survey sample for 1993 included 73 houses built by 14 different production builders in Central Texas. The sample was selected by LCRA and wholesale customer staff, following the same procedure used by SEI in 1986. In the letter explaining how to plan the 1986 baseline survey, SEI asked LCRA to arrange visits to "low, medium, and high segments of the market...a sufficient number of people and job sites to cover the spectrum of ideas and practices in your market area." Having never been in the new home market, LCRA proceeded with only anecdotal information. For the current survey, sites were selected based on housing start information and program participation records.

Equipped with a map of where to look, the LCRA staff then made cursory assessments of construction sites. During these brief calls, staff gathered promotional information from builders and interviewed the personnel on site about energy efficiency features. From those visits, LCRA prepared a list of subdivisions and developments, streets with steady new construction, builders, and builder contacts.

Second, LCRA staff looked for an area with building activity and no energy code or new home program. San Antonio fit the description. It offered neither an energy code nor a new home program. Yet many San Antonio builders construct houses in LCRA's service territory.

B. Data Collection

Having identified the areas with new home construction, LCRA sent energy auditors employed by Planergy, Inc., of Austin to gather data at those sites. Planergy offered two levels of valuable experience. First, its crew was familiar with LCRA's service area from performing energy audits in it for about two years. Second, Planergy had completed a similar baseline survey for another Good Cents utility, Public Service of Oklahoma (PSO).

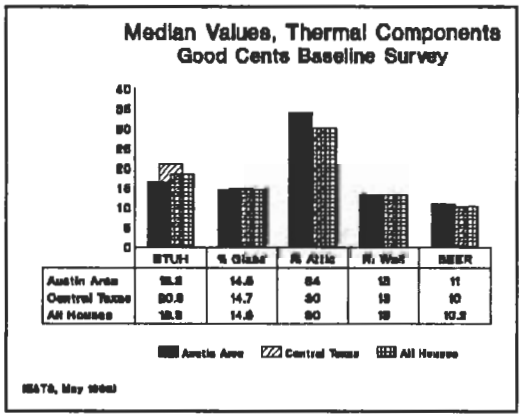
Planergy's auditors recorded more detailed information than SEI had in 1986. SEI recorded its observations on a simple, descriptive form. Planergy used two kinds of record sheets. One was designed specifically for this project. On it auditors recorded information about the house's location, builder, utility area, water heating fuel, HVAC system, insulation values for walls and ceilings, and the window and door schedules. The other form was the load calculation sheet used in the Cooling Efficiency Program (CEP). It contained both the thermal values for each component and the dimensions of the entire house and its components. These details were necessary for modelling houses in the Good Cents software.

C. Data Analysis

After Planergy completed each file, the dimensions and data from that file were entered into the Good Cents software, RBEP2. Again, this step conformed to the pattern laid down by SEI in 1986. Each house was modelled for the purpose of determining its heat gain and estimated energy consumption.

RBEP2 is based on the Air Conditioning Contractors of America (ACCA) Manual J, Load Calculation for Residential Winter and Summer Air Conditioning. The program is for modelling the performance of building components and HVAC equipment.

Next, the building data were converted into a SAS data set for statistical analysis. The set contained values for each building component, cooling system SEER, heat gain in BTUH, square footage of conditioned space, and square footage of glass. From that set median values were calculated for major components, ratio of glass to floor area, and square feet per ton of installed cooling. The following table illustrates the results:



III. Basic Findings

A. Two Markets

The primary finding of this updated survey is that LCRA's Good Cents Home Program competes in two distinct markets. One is the extra-territorial jurisdiction of Austin, or Austin ETJ. The other market is the rest of the service territory.

For the purposes of identifying the two, the Austin ETJ market is called "Austin." It represents building practices in the Austin-influenced area. The other is called "Centex." It represents building practices in the unincorporated areas and municipalities outside of Austin.

The difference stems from Austin's energy code, which establishes a strict standard for residential construction. It prohibits the use of electric furnaces, limits the use of electric water heaters, and requires some kind of shading protection for windows. That standard can be met with either double pane windows or solar screens.

The city also operates the E-Star, energy-efficient home program. It has a sliding scale of requirements but is essentially a prescriptive program that awards points for increasing thermal resistance and other features. Austin's major builders participate in it.

B. More Efficient Materials

A second discovery is that more efficient materials and practices have displaced less efficient ones in the construction market. This is particularly true in wall insulation but applies to window styles and attic insulation.

In 1986 the most common wall insulation was a batt rated at R-11 faced with kraft paper. That kind of insulation is fitted between wall studs and is supposed to be stapled in place using the paper extending beyond the edges of the fiberglass. Commonly installers compress it so that the sheetrock crews can see the studs clearly. The compressed insulation has less thermal resistance than its rating.

In 1993, the most common wall insulation was a batt rated at R-13. About half the builders used unfaced batts, which are fitted into the spaces between studs, so the insulation is not compressed and gives full value.

Interviews with builders or their sales staff revealed that
R-13 batts have supplanted R-11. Even so, the primary difference in wall insulation between standard practice and Good Cents is exterior sheathing. None of the houses surveyed had the insulating sheathing common in Good Cents construction.

Double-pane windows or some kind of shade were found in Austin, another improvement over 1986. And in attics, where R-19 was the standard insulation in 1986, common practice now is R-30.

One area that showed little change was the control of air infiltration. While Good Cents builders seal primary seams with foam sealants and rely on an interior or exterior air infiltration barrier, the

baseline builders use only foam sealant. And in most cases it was applied haphazardly. Used that way, it adds to cost but not to the value of a home.

C. HVAC Equipment

The study indicated that heat pumps have increased their market share, as hypothesized. They represented less than one third of the electric heating systems counted in 1986. In the current study, heat pumps were the electric heating system of choice; electric furnaces were found only in Kerrville and in a pocket between Cibolo and San Antonio.

Not surprisingly, builders consistently installed HVAC equipment whose efficiency met the minimum requirements for the area where they built. Specifically, in developments where a utility paid a rebate, HVAC efficiency met the minimum requirement for a rebate -- 11 SEER in Austin or Texas Utilities. Where no one paid a rebate, as in San Antonio, the HVAC system's SEER was no higher than the 10 set by the National Appliance Energy Conservation Act (NAECA).

NAECA required manufacturers to produce cooling systems with a minimum SEER of 10.0 after January 1, 1991. One home-builder northeast of San Antonio installed mid-9 SEER cooling systems in conjunction with electric furnaces.

D. Total BTUH

The following table lists the findings for individual building components and practices. It also illustrates the comparison between the results of the 1993 and 1986 surveys.

Table of Building Practices and Component Thermal Values by Baseline Region

Component	Centex, 93	Austin, 93	SEI, 86
Wall Insulation	13	13	11
Doors*	W & M	W & M	Wood
Window Type	Sgl/Clr	Dbl/Clr	Sgl/Clr
% Glass	14.7	14.5	15
Ceiling Insulation	30	34	19
Floor	Slab	Slab	Slab
SqFt/Ton	508	494	500
SEER	10.0	11.0	9.0
BTUH	20.9	16.3	18.5

* Doors: Wooden door in 1993 is the main entry door and made of solid wood. The back and side doors are insulated metal.

The total heat gain of new houses has dropped 12 percent in the Austin area and risen 13 percent in the Central Texas area since 1986. In spite of the improvements in thermal components discussed above, the total heat gain of non-Good Cents houses remains high. In Austin, it was 16.3 BTUs per square foot per hour (BTUH); outside, it was 20.9 BTUH. Largely this factor can be explained by the amount and location of glass.

Home designers plan windows and other characteristics to give a house "curb appeal," to make it look attractive to the prospective buyer. That means that windows are set on the fronts and backs of houses with no regard for their orientation to the sun. Essentially, even in the small lot lines of modern developments, builders choose light and view over thermal performance. Furthermore, popular designs afford windows scant protection from direct sunlight, for current style uses roofs with almost no eaves.

IV. Conclusion

The six-year span between the original SEI study and LCRA's baseline study was far too long. Although in basic construction practices had changed very little, equipment had improved significantly. That improvement can be attributed in part to the effect of NAECA, but the trend in the HVAC industry has been toward more efficient equipment. Such changes as the replacement of R-11 by R-13 batts for wall insulation should have been noted when they occurred.

This kind of study ought to be carried out every two or three years to keep abreast with markets. The recent building boom in Central Texas may have had more impact on building practices than any other factor. We will know only by looking again in a year.

V. Illustrations

The following graphs illustrate the relative differences between the 1993 Baseline Houses and their Good Cents upgrades. The relative savings should remain constant irrespective of house size.