

Texas Senate Bill 5 - Reducing Pollution in Non-Attainment Areas: An Overview of the Legislation

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ABSTRACT

The Federal Clean Air Act of 1970 authorized the United States Environmental Protection Agency (EPA) to establish the maximum allowable concentrations of pollutants that are known to endanger human health, harm the environment or cause property damage. Senate Bill 5 was passed in the 77th Texas Legislature in 2001. Although reducing NO_x in mobile equipment (diesel) received the major emphasis, buildings also emerged as an important focus. Buildings consume approximately 21% of the energy used in Texas. Industry uses about 60% and mobile energy uses approximately 19% of the energy consumed in Texas. What caught legislative attention was that buildings consume approximately two-thirds of the electric energy used, and that Btu reductions at the building site resulted in “two-for-one” savings at the generating plant. To address buildings, Texas adopted a building energy code and also set a procedure in place to encourage municipalities to improve on the code and obtain emission credits from the EPA.

The EPA has designated four areas in Texas as non-attainment areas because ozone levels exceed the NAAQS maximum allowable limits, Beaumont-Port Arthur, El Paso, Dallas-Ft. Worth, and Houston-Galveston-Brazoria. Ozone is formed when oxides of nitrogen (NO_x), volatile organic compounds (VOCs), and oxygen (O₂) combine in the presence of strong sunlight. In hot and humid areas such as the Houston-Galveston-Brazoria area, up to 60 ppb (TIACT 2000) of the “baseline” ozone can be attributed to biogenic sources (i.e., plants, lightning, and down-mixing of the stratospheric ozone). The current EPA limit is 120 ppb (TIACT 2000). Hence, reducing manmade emissions of ozone in these regions becomes even more important.

This paper outlines the legislation, and responsibilities of the different government entities, the procedures that are being developed to encourage energy conservation in residential construction, and the method of determination of energy reductions. The effort to determine the emissions reductions resulting from the energy use reductions is still being developed. The models can be quite complex to tie the site energy reductions to source emissions reductions and goes beyond the intent of this paper.

Introduction

The Federal Clean Air Act of 1970 authorized the United States Environmental Protection Agency (EPA) to establish the maximum allowable concentrations of pollutants that are known to endanger human health, harm the environment or cause property damage. In response to this act the EPA established National Ambient Air Quality Standards (NAAQS), which describe the allowable maximum limits of the six primary pollutants: carbon monoxide, lead, oxides of nitrogen, ozone, particulate matter, and sulfur dioxide. In

Texas the Texas Natural Resource Conservation Commission (TNRCC) has the responsibility of measuring and reporting these emissions to the EPA.

The EPA has designated four areas in Texas as non-attainment areas because ozone levels exceed the NAAQS maximum allowable limits, Beaumont-Port Arthur, El Paso, Dallas-Ft. Worth, and Houston-Galveston-Brazoria. The El Paso area also violates the NAAQS maximum allowable limits for carbon monoxide and respirable particulate matter. These areas face severe sanctions if attainment is not reached by 2007. Four additional areas in the state are also approaching national ozone limits, including: Austin, Corpus Christi, San Antonio, and the Longview-Tyler-Marshall area. Ozone is formed when oxides of nitrogen (NO_x), volatile organic compounds (VOCs), and oxygen (O₂) combine in the presence of strong sunlight. Unfortunately, in hot and humid areas such as the Houston-Galveston-Brazoria triangle, 40 to 60 ppb of the ozone can be attributed to biogenic sources (i.e., plants, lightning, and down-mixing of the stratospheric ozone). Hence, reducing manmade emissions of ozone in these regions becomes even more important.

In 2001, the Texas Legislature formulated and passed Senate Bill 5 to further reduce ozone levels by encouraging the reduction of emissions of NO_x by sources that are currently not regulated by the TNRCC, including area sources (e.g., residential emissions), on-road mobile sources (e.g., all types of motor vehicles), and non-road mobile sources (e.g., aircraft, locomotives, etc.). An important part of this legislation is the evaluation of the State's energy efficiency programs, which includes reductions in energy use and demand that are associated with specific utility-based energy conservation measures, and implementation of the International Energy Conservation Code (IECC 2001). . This paper covers the actions taken in Texas to implement the code, outlines many of the procedures that are being developed to report the emission reductions associated with the adoption of the International Residential Code (IRC 2001) and the International Energy Conservation Code (IECC 2001) and covers lessons learned.

Background

The EPA has designated thirty-eight counties in Texas as non-attainment or affected areas. These areas are shown on the map in Figure 1 for non-attainment (dotted line) and affected (straight line) counties. The sixteen counties designated as non-attainment counties include: Brazoria, Chambers, Collin, Dallas, Denton, El Paso, Fort Bend, Hardin, Harris, Jefferson, Galveston, Liberty, Montgomery, Orange, Tarrant, and Waller counties. The twenty-two counties designated as affected counties include: Bastrop, Bexar, Caldwell, Comal, Ellis, Gregg, Guadalupe, Harrison, Hays, Johnson, Kaufman, Nueces, Parker, Rockwall, Rusk, San Patricio, Smith, Travis, Upshur, Victoria, Williamson, and Wilson County.

These counties represent different areas of the state that have been categorized into the different climate zones by the 2001 IECC as shown in Figure 2, namely, climate zone 5 or 6 (i.e., 2,000 to 2,999 HDD₆₅) for the Dallas-Ft. Worth and El Paso areas, and climate zones 3 and 4 (i.e., 1,000 to 1,999 HDD₆₅) for the Houston-Galveston-Beaumont-Port Author-Brazoria area. Note that the "2001 IECC" notation is used to signify the 2000 IECC (IECC 2000) as modified by the 2001 Supplement (IECC 2001), published by the ICC in March of 2001, as required by Senate Bill 5. Also shown on Figure 2 are the locations of the various weather data sources, including the seventeen Typical Meteorological Year (TMY2)

Figure 1. EPA Non-Attainment (Dotted Line) and Affected Counties (Straight Line)

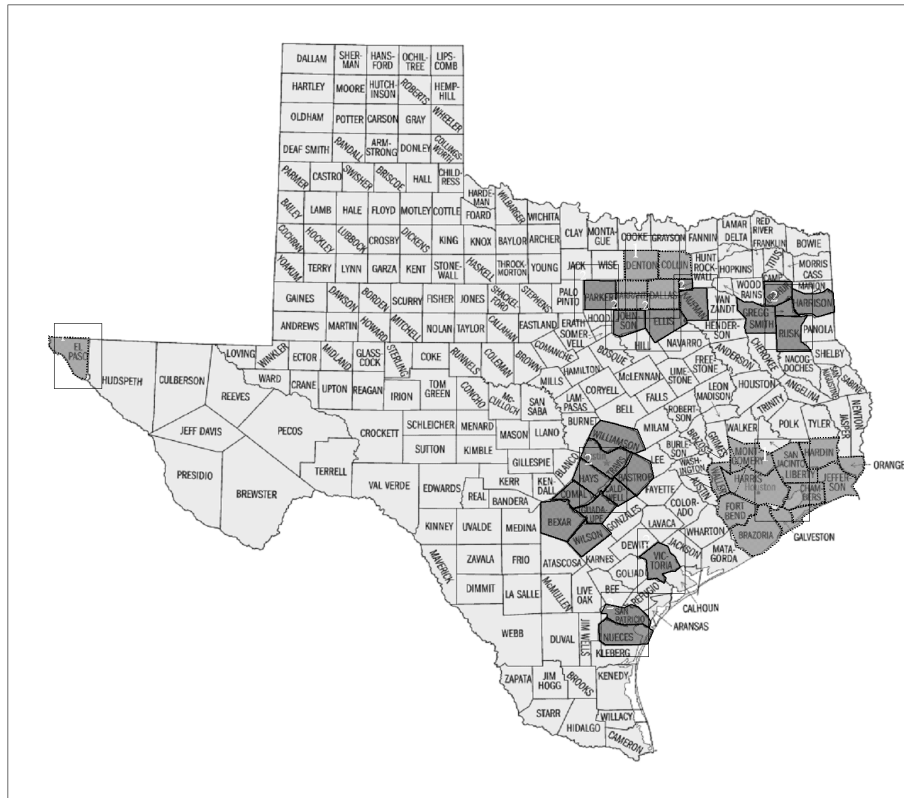
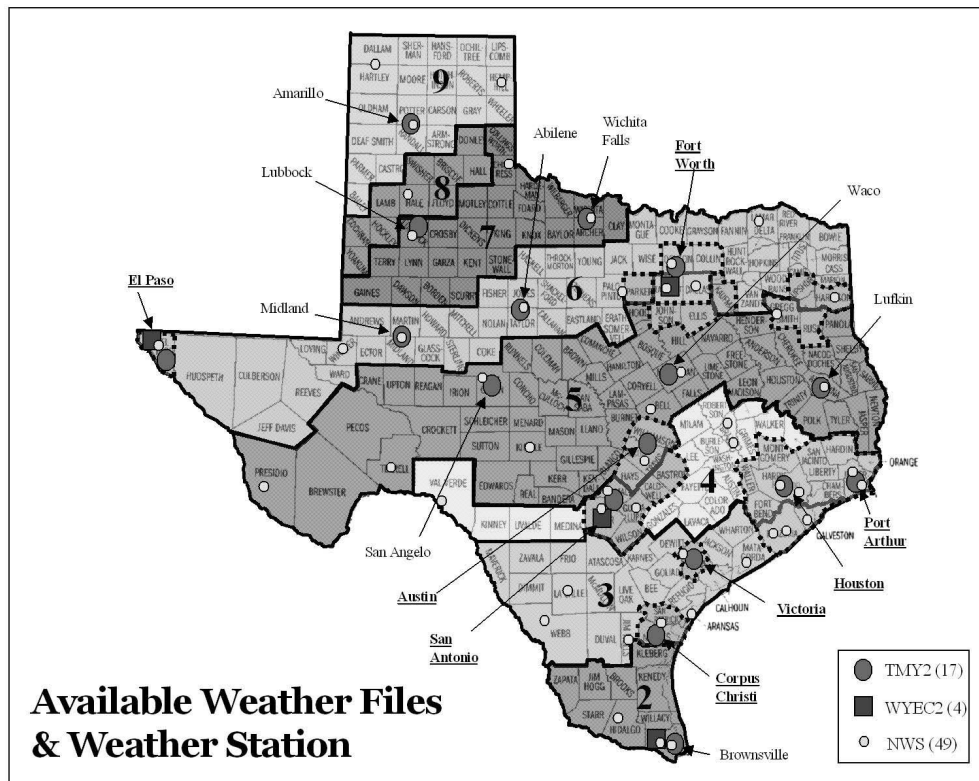


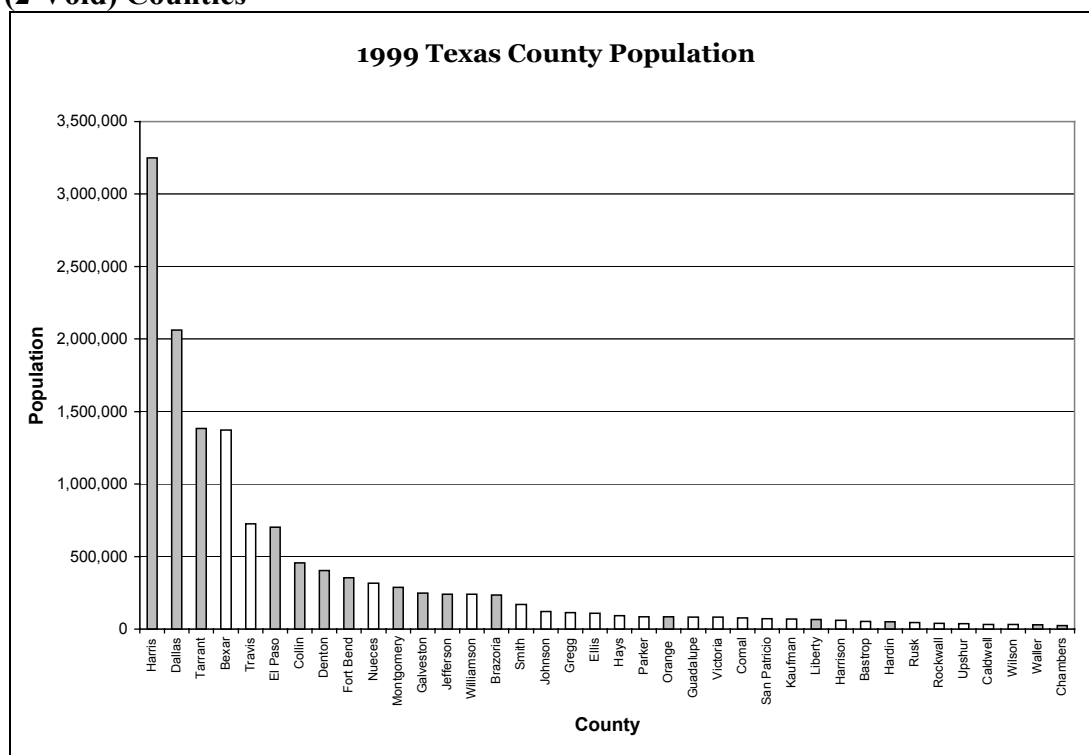
Figure 2. Available NWS, TMY2 and WYEC2 Weather Files Compared to IECC Weather Zones for Texas



(NREL 1995), and four Weather Year for Energy Calculations (WYEC2) (Stoffel 1995) weather stations, as well as the forty-nine National Weather Service weather stations, (NWS) (NOAA 1993).

These thirty-eight counties represent almost 70% of the population in Texas, or about 14 million people (U.S. Census 1999). As shown in Figure 3, three of these counties (i.e., Harris, Dallas, and Tarrant) are non-attainment counties. The fourth county, Bexar, is classified as an affected county. These four counties contain 8.0 million residents, or 40.0% of the state's total population. In the rankings of the remaining counties it is clear to see that the most populated counties also represent the majority of the non-attainment regions.

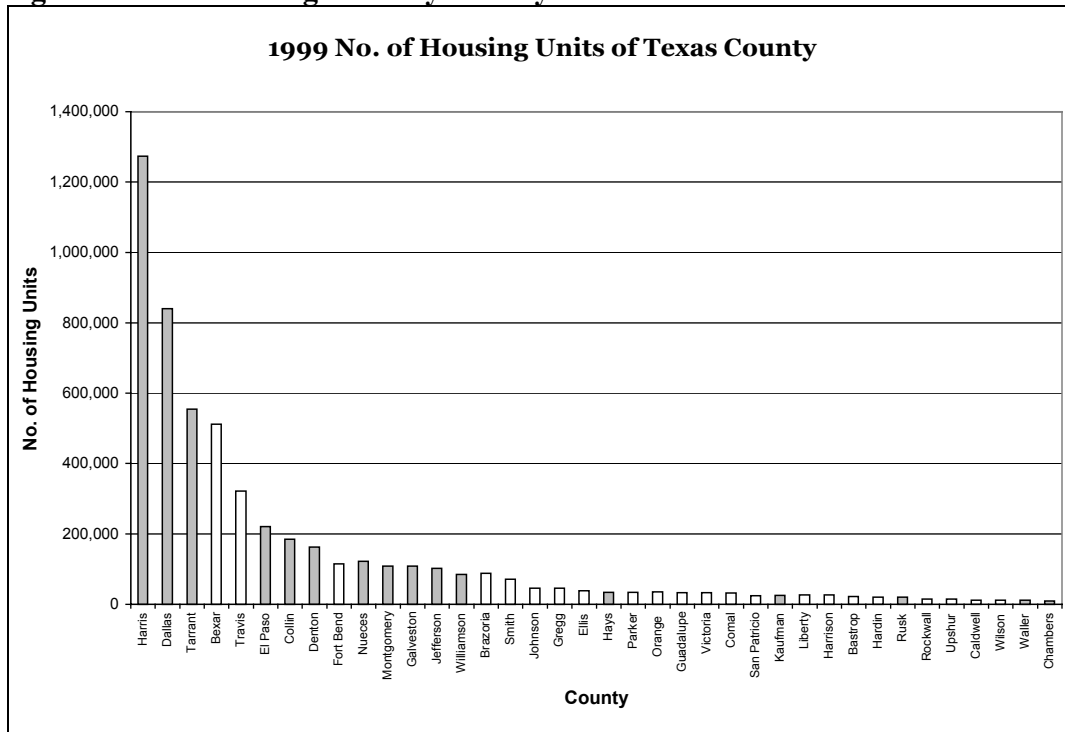
Figure 3. 1999 Texas County Population for Non-Attainment (1-Solid) and Affected (2-Void) Counties



Source: U.S. Census

Figure 4 shows the total housing units trends in the non-attainment and affected counties to closely follow the county populations, with Harris, Dallas, Tarrant, and Bexar counties containing 3.2 million housing units, or 40.0% of the state's total 8.0 million households (U.S. Census 1999). However, the 1999 residential building permit activity differs from the population and total housing unit trends, with the most activity occurred in Harris county (26,000 units), followed by significantly less construction in the five counties in the 10,000 to 15,000 unit range, including Dallas, Travis, Bexar, Collin and Tarrant counties. These six counties represented 89,000 housing starts, or 71% of the total 125,000 residential building permits in the 38 counties classified as non-attainment or affected.

Figure 4. 1999 Housing Units by County



Source: RECenter 2002

Texas Building Energy Performance Standards

SB 5 adopts the energy efficiency chapter of the International Residential Code, as it existed on May 1, 2001, as the energy code for single-family residential construction; and in all other residential, commercial, and industrial construction, adopts the International Energy Conservation Code as it existed on May 1, 2001 as the energy code in this state. This includes the Supplement to the International Codes that was published in March of 2001. The bill requires a municipality to adopt their own administrative and enforcement procedures no later than September 1, 2002 and authorizes a municipality or county to establish procedures to adopt local amendments (Sec. 388.003). Local amendments in non-attainment areas and affected counties may not reduce the stringency of energy code requirements. The bill also provides for the enforcement of energy standards for construction outside of a municipality (Sec. 388.004).

The bill requires affected counties or political subdivisions, other than school districts, in a non-attainment area or in an affected county to implement additional energy efficiency measures to reduce electricity consumption by the existing facilities of the political subdivision. The bill sets forth provisions regarding the goals and reporting and evaluation requirements relating to energy conservation measures of political subdivisions (Secs. 388.005 and 388.006). The bill requires that the Energy Systems Laboratory at the Texas Engineering Experiment Station of The Texas A&M University System provide supporting information and technical assistance. The bill requires the laboratory to develop a standardized report format to be used by providers of home energy ratings (Secs. 388.007-388.008).

Senate Bill 5 specific activities include the highlights below:

Number	Title	Explanation
388.001	Legislative findings.	Establishes policy purpose of energy code to reduce air pollutant emissions affecting health; moderate future peak electric power demand, assuring reliability; and controlling energy costs for residents and businesses in the state.
388.002	Definitions	Self-explanatory
388.003	Adoption of Building Energy Performance Standards	<p>Adopts energy efficiency chapter of the International Residential Code as an energy code for single-family residential construction, and the International Energy Conservation Code for all other residential, commercial and industrial construction in the state. Requires that municipalities establish procedures for administration and enforcement, and ensure that code-certified inspectors perform inspections. Provides that local amendments, in non-attainment areas and affected counties, may not result in less stringent energy efficiency requirements. Texas A&M Energy Systems Laboratory (ESL) to review local amendments and submit annual report of savings impacts to TNRCC. ESL is authorized to collect fees for certain of its tasks in Secs. 388.004, 388.007 and 388.008.</p> <p>Effective date is 9-1-01. The edition of referenced codes is the edition current at May 1, 2001. Deadline for local administration and enforcement procedures is 9-1-02. (SB 365 separately requires adoption of the International Residential Code by January 1, 2002.)</p>
388.004	Enforcement of Energy Standards Outside of Municipality	<p>Outside of municipal jurisdictions:</p> <ol style="list-style-type: none"> 1. A building certified through an energy efficiency (above-code) program is considered in compliance; 2. A building inspected by a code-certified inspector (warranty inspection) is considered in compliance; <p>otherwise, A builder may self-certify a building with a form to be provided by ESL.</p>

388.005	Energy Efficiency Programs in Certain Political Subdivisions	Each political subdivision, except a school district, in a non-attainment area or an affected county is to implement energy conservation measures to reduce electric consumption in its facilities by a goal of 5 percent per year for 5 years. Each political subdivision must report annually to the State Energy Conservation Office (SECO) on its progress under this section. Beginning 1-1-02.
388.006	State Energy Conservation Office Evaluation	SECO is required to report annually to TNRCC an evaluation of the effectiveness of state and political subdivision energy efficiency programs.
388.007	Distribution of Information and Technical Assistance	ESL is responsible for making available code implementation materials for use by building community. ESL may provide technical assistance to political subdivisions.
388.008	Development of Home Energy Ratings	ESL is responsible for developing a standardized reporting format for home energy ratings, and establishing a public information program about home energy ratings. Required by 9-1-02.

Methodology

The critical output of Senate Bill 5 becomes obtaining the emissions reduction credits for energy use and demand that are attributable to the adoption of the International Energy Conservation Code (IECC 2001) in non-attainment and affected counties. In order for the TNRCC to account for these countywide reductions in electricity use, the Laboratory must calculate the energy and demand reductions and then provide these to TNRCC in a suitable format for calculating emissions reductions. The planned methodology utilizes several procedures that will calculate and verify savings using several different sources of information. These procedures include:

1. Emissions reductions calculations from implementing the IECC 2001 in new residences in non-attainment and affected counties as compared against 1999 housing characteristics (IECC 2001 residential emissions reductions) using calibrated simulation.
2. Calculated energy use against the published average energy use found in the USDOE's Residential Energy Characteristics Survey (RECS 1999).
3. Calculated energy savings using a utility bill analysis method.

4. Verification and crosschecking of energy use with direct access of construction data using on-site visits.

Emissions Reductions Calculations

This is the primary procedure for calculating the emissions reductions from the adoption of the IECC 2001 in new residences. For each county, 1999 and 2002 residential housing characteristics will be ascertained. Using simulation, these characteristics will be entered into the DOE-2 simulation to calculate the annual energy use of two average-sized residences, one representing the house with the 1999 characteristics, and one representing the appropriate characteristics from the 2001 IECC. The annual energy use of the 2001 IECC simulation will then be subtracted from the annual energy use of the similarly sized 1999 residence to obtain the annual electricity savings, and peak electric demand savings. Natural gas savings associated with space heating and the heating of domestic hot water would be calculated for informative purposes. The electricity savings attributable to the 2001 IECC energy conservation options would then be converted to NO_x reductions per house using the appropriate conversion factors. Electricity, natural gas and NO_x reductions would then be scaled to represent the countywide savings by multiplying the annual permits for each county. Total NO_x reductions associated with the implementation of the 2001 IECC would then be calculated as the summation of all non-attainment and affected counties. This simulation using the actual number of houses constructed in each county will provide an estimate for 2002 and 2003. On-site measurements will be performed in each of the non-attainment and affected county weather zones to further refine the simulation model.

The procedure for calculating the 2002 baseline residential energy consumption begins with the definitions of the standard house found in Chapter 4 of the 2001 IECC. These definitions are used to create a standard input file for the DOE-2 simulation program (LBNL 2000). This standard input file is then adjusted to reflect the average 1999 construction characteristics for each county for type A-1 (single family) and type A-2 (all others) housing. The average 1999 construction characteristics represent the published data from several sources, including NAHB (2002), F.W. Dodge (2002), RECS (1999) and LBNL (1995).

The annual electricity and natural gas consumption for the average house is then simulated using the DOE-2 program and the appropriate weather data for each location. The average house size for each county is determined from published RECS (1995) data. The appropriate weather data for each county is the nearest TMY2 weather file that most accurately represents the 2001 IECC climate zone as shown in Figure 2.

The annual, countywide, baseline energy consumption for new houses built in 2002 with characteristics that reflect the 2001 IECC and 1999 published data is calculated by multiplying the annual simulated energy use for an average house times the projected A-1 and A-2 housing permits for 2002. The projected A-1 and A-2 housing permits for each county are projected using a multiple linear regression that utilizes countywide population growth and housing permits. This baseline represents the expected annual energy use of all new construction in each county had those houses been constructed with the 2001 IECC “standard house” and average 1999 characteristics.

The procedure for calculating the code-compliant 2002 residential energy consumption also begins with the definitions of the standard house found in Chapter 4 of the 2001 IECC. This code-compliant input file reflects the average 1999 house size for each

county and IECC Chapter 6 construction characteristics for type A-1 (single family) and type A-2 (all others) housing. This uses the same average house size for each county and is determined from published RECS (1995) data. These characteristics include insulation levels, glazing type, etc., as defined in Chapter 6 of the 2001 IECC or Chapter 11 of the 2001 IRC.

The annual electricity and natural gas consumption for a code-compliant house is then simulated using the DOE-2 program and the appropriate weather data for each location. The annual, countywide, code-compliant energy consumption for new houses built in 2002 with code-compliant characteristics is calculated by multiplying the annual simulated energy use for a code-complaint house times the projected A-1 and A-2 housing permits for 2002. This code-compliant use represents the expected annual energy use of all new code-complaint construction in each county. The total electricity savings, and the associated NO_x reductions for each county, which can be attributed to the adoption of the IECC 2001 are then calculated by comparing the difference in annual energy use of the baseline housing versus the code-compliant housing.

Calculated Energy Use Against Published Data

The procedure to crosscheck the calculated energy use of the baseline houses and code-compliant houses against the average energy use published by the RECS (1999) has been developed. It is important to note that this procedure is proposed for informative purposes, since exact agreement between the housing characteristics in the IECC 2001 and RECS is not anticipated, since the RECS data reflects actual average occupant behavior, and the IECC reflects a controlled occupant behavior. The procedure multiplies the expected number of A-1 and A-2 housing units times the average annual energy use per household published in RECS to obtain the county-wide annual energy use for all newly constructed houses. This value is expected to be useful in judging whether or not any adjustments are needed in the 2001 IECC Chapter 4 construction characteristics.

Energy Savings Using Utility Bill Analysis

The energy savings attributable to the adoption of the 2001 IECC will be reconciled with monthly utility billing data using the well-known Princeton Scorekeeping Method (PRISM) (Fels 1986; Fels et al. 1995). In general, the difference between average 1999 and 2002 utility bills should decrease by an amount that is similar to the calculated savings from 2001 IECC adoption for similar sized houses, with equal numbers of occupants, in similar neighborhoods.

For the housing crosscheck with utility billing data, the procedure begins by selecting a 1999 house (or a 2002 house) that has similar characteristics to the 1999 residential construction characteristics (or 2002 characteristics) that were used for the primary calculation. For each house selected, 12 months of utility billing data will be obtained and analyzed with PRISM. The resultant, valid parameters from PRISM are then normalized by conditioned area to obtain a weather-normalized, averaged energy use per square foot. The primary parameter of interest from the PRISM analysis is the Normalized Annual Consumption (NAC). The goodness of fit indicators used to determine a valid PRISM run include the CV(NAC), and PRISM's adjusted R². After the appropriate number of houses

have been analyzed that represent a statistically significant sample of houses constructed in 1999 for each county (or for 2002), the Normalized Annual Consumption (i.e., NAC_{1999} expressed as $kWh/yr-ft^2$) is compared against the similar parameter for houses constructed in 2002 (i.e., NAC_{2002} expressed as $kWh/yr-ft^2$) to obtain the average electricity savings per square foot of conditioned area. This difference is then multiplied by the number of houses constructed in 2002 and the average conditioned area of the houses constructed in 2002 to obtain the total annual electricity savings per county. This total, countywide, annual electricity savings calculated by utility bill analysis can then be compared to the total, countywide, annual electricity savings calculated by simulation. For each county, savings from the difference in 1999 versus 2002 utility bills are expected to be similar to savings calculated by simulation for similar houses, with similar household characteristics.

Verification And Cross-Checking Of Energy Use With Direct Access Of Construction Data Using On-Site Visits

Reconciliation will also be carried out to crosscheck selected parameters for both the 1999 and 2002 housing characteristics for each county. For the 1999 housing stock, on-site surveys of a statistically significant sample will be used to crosscheck the average building characteristics used to simulate the average house in each county. As previously mentioned the 1999 average building characteristics represent the average characteristics published by NAHB, F.W. Dodge and LBNL.

Adjustments can then be made to the average 1999 characteristics should significant differences be found.

A similar procedure will be carried out for houses constructed in 2002 to determine if the on-site housing characteristics meet, or exceed the 2001 IECC. However, differences found in the 2002 characteristics will be noted as to whether or not these differences represent characteristics that are less stringent or more stringent than code. Characteristics that are less stringent than code will be discussed with code officials to determine how procedures to the code need to be modified to better meet code requirements. Characteristics that are more stringent than code will be credited to the countywide energy savings as above code savings.

Summary

In 2001, the Texas State Senate formulated and passed Senate Bill 5 to reduce ozone levels by encouraging the reduction of emissions of NO_x by including area sources (e.g., residential emissions), on-road mobile sources (e.g., all types of motor vehicles), and non-road mobile sources (e.g., aircraft, locomotives, etc.). This paper has outlined the methodology that is being developed to report the emission reductions associated with the adoption of the International Energy Conservation Code (IECC 2001) in residential construction in non-attainment and affected counties.

This methodology is composed of several procedures that will calculate and verify savings using several different sources of information. These procedures include the calculation of emissions reductions from the implementation of the IECC 2001 in new residences in non-attainment and affected counties as compared using calibrated simulation; a cross-check of the calculated energy use against the published average energy use found in

the USDOE's RECS; a cross-check of energy savings using a utility bill analysis method, and a cross-check of construction data using on-site visits.

Similar methodologies are also under development for the calculation and reporting of emission reductions associated with the adoption of the International Energy Conservation Code (IECC 2001) in commercial construction in non-attainment and affected counties, and the calculation and reporting of emission reductions associated with Texas Public Utility Commission's (PUC) Standard Offer Programs (SOPs), and Market Transformation Programs (MTFs), funded under Senate Bill 5 and 1999 Senate Bill 7.

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