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Texas Senate Bill 5 Legislation for Reducing Pollution in Non-Attainment and Affected Areas: An Overview of Legislative Responsibilities, Code Compliance Issues and Accomplishments

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Abstract

The 77th Texas Legislature, in 2001, established Senate Bill 5, SB-5, which addressed NOx emission reductions by establishing programs to reduce vehicle emissions and reductions due to energy efficiency and the use of renewable energy sources. The 78th Texas Legislature further expanded SB-5 into code certification for code officials and above code programs.

Using data available from the Texas Commission on Environmental Quality, TCEQ, the EPA and new procedures developed by the Laboratory, the annual energy savings calculated in 2003 from energy-code compliant new residential construction in non-attainment and affected counties were 252,238 megawatt hours of electricity and 887,564 million Btu of natural gas. The resultant annual NOx reductions were 473 tons. On a peak summer day in 2003, the NOx emissions were 2.44 tons.

SB-5 recognized Energy Efficiency / Renewable Energy, EE/RE, as a valid method to reduce emissions. The Energy Systems Laboratory was made responsible for achieving the following goals.

1. Quantify the NOx reductions from EE/RE by county.

2. Assist cities and counties determine the impact of code amendments that they planned to adopt.

3. Conduct training on the IRC / IECC, including ASHRAE 90.1.

4. Set up a certification program for code officials.

5. Assist cities and counties to achieve above code performance.

6. Translate the EE/RE savings into EPA acceptable emissions reductions which can be applied to the State Implementation Plan, SIP.

Background

The Texas Emissions Reduction Plan (TERP) established by the 77th Texas Legislature with the enactment of Senate Bill 5 (SB-5) states that energy efficiency and renewable energy (EE/RE) measures are needed to meet the minimum federal air quality standards. The 78th Legislature further expanded the use of EE/RE programs for meeting TERP goals by requiring the Texas Council on Environmental Quality, TCEQ, to promote the use of energy efficiency as a way of meeting the federal air quality standards and to develop a methodology for computing emissions reduction for the SIP from energy efficiency.

To achieve energy savings in new construction, SB 5 mandated statewide adoption of the energy efficiency chapter of the International Residential Code (IRC 2000) and the International Energy Conservation Code (IECC 2000, IECC 2001) for residential, commercial and industrial buildings. The Texas Legislature made the Energy Systems Laboratory, referred to as the Laboratory in SB-5 legislation, at the Texas Engineering Experiment Station of the Texas A&M University System responsible for determining the county by county energy savings from energy code adoption, for calculating the resulting NOx emissions reductions and for reporting these results annually to the TCEQ.

The forty-one counties represent some of the most populated counties in the state, and contained 14.1 million residents in 1999, which represents 70.5% of the state's 20.0 million total population (U.S. Census 1999). As shown in

Table 1, the three largest counties, by population, i.e., Harris, Dallas, and Tarrant, are non-attainment counties. The fourth county, Bexar County, 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 that the most populous counties also represent the majority of the non-attainment regions.

These forty-one (41) counties represent several geographic areas of the state, shown in Figure 1. These counties have been assigned to different climate zones by the 2000 IECC, shown in Figure 2, which are based primarily on Heating Degree Days (HDDs). These include, 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. HDD65 means the number of heating degree days above 65ºF. Also shown in Figure 2 are the locations of the weather data sources:

- Seventeen (17) Typical Meteorological Year (TMY2) weather stations (NREL 1995),
- Four (4) Weather Year for Energy Calculations (WYEC2) weather stations (Stoffel 1995),
- Forty-nine (49) National Weather Service (NWS) weather stations (NOAA 1993).

Progress in FY2003

Since September 2002, the Energy Systems Laboratory has accomplished the following major activities in fulfillment of its legislative requirements under SB-5:

- Estimated energy and resultant NOx reductions from implementation of the Texas Building Energy Performance Standards (TBEPS), which use the IECC/IRC codes, to new residential construction,
- Developed a web-based "Emissions Reduction Calculator" for determining emissions reduction from energy efficiency improvements in residential construction,
- Enhanced the ESL's IECC/IRC code-traceable test suite for determining emissions reduction due to code and above-code programs,
- Assisted builders, code officials, Councils of Governments and residents:
  - Provided 64 IECC/IRC/ASHRAE 90.1 energy code training sessions throughout the State of Texas,
  - Resolved several major issues for manufacturers and builders regarding new insulation requirements to all parties agreement,
  - Responded to hundreds of phone and email inquiries on code implementation and verification issues, and,
- Evaluated of proposed energy code changes requested by the North Central Texas Council of Governments, NCTCOG, and partially completed an evaluation of proposed energy code amendments requested by the City of Houston,
- Evaluated proposed 2005 IECC / IRC code changes and
- Recommended protocol for reporting SIP credits.

These activities were designed to enhance the impact of EE/RE measures contained in SB-5 and assist the TCEQ, local governments, and the building industry with effective implementation and reporting.

Energy Savings and Resulting Emissions Reductions

Using data available from the TCEQ and the EPA along with new procedures developed by the Laboratory, the annual energy savings and resultant NOx reductions calculated in 2003 from energy-code compliant new residential construction in non-attainment and affected counties were 252,238 megawatt hours of electricity and 887,564 million Btu of natural gas. The resultant annual NOx reductions were calculated to be 473 tons per year which include:

- 340 tons of NOx / year, which is 72.0% of the total, resulting from energy reductions of 237 GWh / year from single-family residential,

- 22 tons of NOx / year, which is 4.7% of the total, resulting from energy reductions of 15 GWh / year from multi-family residential, and
- 110 tons of NOx / year, which is 23.3% of the total, resulting from energy reductions of 888 GBtu / year from single-family and multi-family residential.

On a peak summer day in 2003, the NOx emissions were calculated to be 2.44 tons per day which represents:

- 2.13 tons NOx / day, which is 87.3% of the total, resulting from energy reductions of 1.5 GWh / day from single-family residential,
- 0.11 tons NOx / day, which is 4.5% of the total, resulting from energy reductions of 0.8 GWh / day from multi-family residential, and
- 0.20 tons NOx / day, which is 8.2% of the total, resulting from energy reductions of 1.6 GBtu / day from single-family and multi-family residential.

The comparative magnitude of the annual and peak-day NOx reductions from natural gas compared to the savings from electricity vary significantly. This is because the annualized savings include heating period NOx reductions, and the peak-day cooling season, natural gas savings include only those savings associated with the elimination of pilot lights and gas water heaters. Pilot lights are a major contributor to NOx emissions during a peak episodic day .

Previously, various agencies were submitting yearly savings so that the emissions reductions could be calculated. A significant error was found, in which the full emissions reduction credit was not being obtained. Figure 3 shows the difference between the emissions calculated using an annual calculation with eGrid and a peak episodic day calculation with eGrid. Approximately a 2:1 difference occurs in the electrical consumption. Natural gas reflects the opposite effect, as only the pilot lights and gas hot water heaters really contribute to a peak episodic day. Gas stove are mainly used in the evening and thus do not contribute to the peak period emissions. Likewise, gas furnaces are not typically used in the peak episodic months.

Web-based "Emissions Reduction Calculator"

The Laboratory has developed a prototype Emissions Reduction Calculator and the underlying technology for determining emissions from power plants that deliver the electricity to the residence. The Emissions Reduction Calculator is intended to be used to obtain SIP credits from energy efficiency programs in the TERP. The TCEQ and the EPA are currently reviewing the Laboratory's proposed technology and procedures for estimating NOx emissions from energy efficiency for inclusion in the SIP.

This proposed new technology addresses two major challenges:

- How to transform electricity reductions into spatial locations and time-of-day distributed emissions reduction from electric utility power plants.
- How to quantify and validate the persistence of energy savings from energy efficiency and renewable energy measures.

The Laboratory's Emissions Reduction Calculator uses the EPA's eGRID database to identify where air emissions are produced. A complete description of the technology and procedures for calculating emissions reduction is contained in the Laboratory's Annual Report (Energy Systems Laboratory 2003a and 2003b) to the TCEQ. In this report, the Laboratory requested continued input and critical analysis by all affected parties and federal and state regulatory agencies on this approach to help ensure accuracy and ease of use.

Enhanced the IECC/IRC Code-Traceable Test Suite

In 2002 the Laboratory developed a code-traceable DOE-2 input file for calculating energy savings and demand reductions from implementation of the IECC / IRC to single-family residences. These simulations are needed to analyze the energy savings from proposed municipality code amendments and the annual calculation of IECC / IRC state-wide savings. This code-traceable input file is also useful for comparing Home Energy Rating Scores to an IECC / IRC baseline. A view of the residential

one-story code compliant input file is shown in Figure 4. This illustrates the shading and other features of the house.

In 2003 the code-traceable DOE-2 input file was substantially enhanced to include an improved heat transfer procedure to the ground-coupling, improved National Fenestration Rating Council, NFRC, window R-value and SHGC procedures, and an improved calculation of furnace efficiency. Work has also been initiated to expand the 1-zone model into a 2-zone model with user selectable system types, which include selections from gas heating, gas DHW, electric heating, electric DHW, air conditioning, heat pumps, types of floors, i.e., crawlspace or slab floor, and user-selectable shading. Early versions of the multi-family model, commercial model have also been developed. These include models for solar thermal and photovoltaics (Energy Systems Laboratory 2003b). The solar thermal model is based on the FChart program and the photovoltaic model is based on the PVFChart program, both developed at the University of Wisconsin.

Assisted Builders, Code Officials, Council of Governments and Residents

The legislation requires the Laboratory to make code implementation materials that explain the requirements of the International Energy Conservation Code and the energy efficiency chapter of the International Residential Code available to builders, designers, engineers, and architects. Senate Bill 5 authorizes the Laboratory to develop simplified materials to be designed for projects in which a design professional is not involved. It also authorizes the Laboratory to provide local jurisdictions with technical assistance concerning implementation and enforcement of the 2000 International Energy Conservation Code and the energy efficiency chapter of the 2000 International Residential Code.

Since September of 2001, the Laboratory has provided sixty-four (64) IECC code training workshops at the locations throughout Texas. Forty-eight of these workshops were focused on Residential Code trainings, with 2,239 attendees. Seventeen of these workshops were focused on Commercial Code trainings, with 328 attendees. The Laboratory achieved this level of training by leveraging resources from the US DOE State Code Training programs through the Texas State Energy Conservation Office with SB-5 funding.

The Laboratory also responds to about 40 to 60 phone calls per week. These include questions about the 2000 IECC from builders, HVAC contractors, window manufacturers, door manufacturers, duct manufacturers, code officials, and homeowners. A high percentage of these questions relate to needing a general understanding of the codes and also differences that have occurred between the 2000 IECC/IRC and the 2000 IECC/IRC with 2001 Amendments. SB-5 specifies the code as including all amendments as completed by May 2001.

A database tracks questions and responses. A set of frequently asked questions (FAQs) feature is in the process of being established for the Laboratory's Senate Bill 5 web page.

Evaluated Proposed Energy Code Amendments

The TERP requires that all local energy code amendments not result in less stringent energy efficiency requirements in non-attainment and affected counties than the unamended IECC/IRC and that the Laboratory may determine, upon request, if the proposed code changes are substantially equal to or less stringent than the code. The Laboratory reviewed proposed local amendments in 2002-2003 for the North Central Texas Council of Governments (NCTCOG) and the City of Houston.

The Laboratory determined that the proposed NCTCOG window glazing shading requirements were substantially equal to the IECC/IRC by using the code traceable test suite to verify the annual consumption. The Laboratory was also informed that the NCTCOG region leads the State in the use of high-performance, low-emissivity (low-e) glass for new residential construction.

The Laboratory conducted an extensive review of the proposed energy code changes for the City of Houston. These were driven primarily by the local concern over mold and mildew formation in Houston's hot and humid climate. During the detailed review, we found that several proposed changes were substantially less stringent than the IECC/IRC requirements. These were withdrawn by the City of Houston

and alternates were proposed. These alternative changes were reviewed and the initial determination is that, as a whole, the proposed changes are substantially equivalent. Final determination is pending the receipt of the revised amendment request from the City of Houston.

Evaluated Proposed 2005 IECC / IRC Code Changes

In the Spring of 2003, the USDOE published a proposal for changes to the 2000 International Energy Conservation Code (IECC 2000), which is planned to be included in the 2005 version of the IECC / IRC. In general, DOE's intention with the new IECC / IRC is to simplify the code to make it easier for builders and code officials to enforce. The Laboratory was asked to review the proposed code changes to ascertain if the changes would be more or less stringent than the current IECC / IRC.

The Laboratory completed a preliminary review of the proposed changes (Haberl 2003). This analysis was performed on a single-family residence in the climate zones for Harris County and Dallas County, with standard characteristics, and can be summarized by the following:

- The proposed 2005 IECC / IRC would have fewer climate zones for Texas, which will simplify the analysis of code compliance for the state, as shown in Figure 5.
- The proposed 2005 IECC / IRC contains fewer prescriptive tables that do not include increased stringency for increased window-to-wall areas. This simplification will allow houses to be built that are less stringent than the current IECC / IRC, as amended by the 2001 Supplement, if the houses have more than 20% window-to-wall area.

Recommended Protocol for Reporting Energy Savings And Emissions Reduction Acceptable To The EPA For SIP Credits

At the request of the TCEQ the Energy Systems Laboratory has developed the following recommendations to the TCEQ for reporting energy savings and emissions reduction that are intended to be acceptable to the EPA for SIP credits. These recommendations include the development of standardized methods for reporting energy savings that utilize the USDOE's International Performance Measurement and Verification Protocols (USDOE 2001) and the calculation of the resultant NOx emissions reduction using the EPA's eGRID program. In general, the nationally accepted procedures include the protocols of the International Performance Measurement and Verification Protocols (USDOE 2001), and ASHRAE Guideline 14-2002 (ASHRAE 2002). Extension of the IPMVP and Guideline 14 procedures are necessary to improve the accuracy of the calculation of peak-day emissions, which are required by the EPA for SIP credits.

The 2001 IPMVP covers Options A, B, C and D, which were updated from the 1997 IPMVP. Volume II, published in March 2002, covers indoor environmental quality. Volume I which contains four M&V methods: Option A: partially measured Energy Conservation Measure, ECM, isolation, Option B: ECM isolation, Option C: whole-building comparisons, and Option D: whole-building calibrated simulation.

Monthly utility bills can be used the energy efficiency measures contain weather dependent savings, such as building energy efficiency measures and water / waste water measures. Note that both the IPVMP and ASHRAE Guideline 14 require 12, 24 or even increments of utility bills to perform this analysis. A method was developed which allows the monthly consumption calculations to yield the peak day reductions. If yearly data were used, a significant loss of reportable reductions would occur.

Street lights, traffic lights and other weather independent constant load energy efficiency measures only require a before and after measurement, with a specified level of after checks, depending upon the persistence of the retrofit. Utilities often do not meter city lighting, they generate the utility bill based on a count and consumption.

Metering usually accompanies major wind and solar photovoltaic system installations. These large systems can be monitored using the monthly bill to get an acceptable measure of the generated output during peak episodic days.

Small systems, where metering is not practical, can be spot measured. The peak episodic day and yearly generated power can then be calculated. Periodic spot checks need to occur.

Solar thermal systems are usually aimed at domestic hot water and other lower Btu output systems. Since metering thermal systems is expensive, basic measurements such as the panel orientation and temperatures need to be spot checked for specified operation at installation. Calculations using FChart (developed at the University of Wisconsin for the DOE) with the manufacturers parameters can then be used to determine the savings. Periodic spot checks on these systems needs to occur.

Summary

Previously, the EPA has not allowed voluntary emissions reductions to be counted in a State Implementation Plan for reducing emissions. To apply to SIP credits, these reductions must be retired, that is to say, they may not be traded. These credits must also be sustained, which generally means that some level of monitoring must also be implemented. With the methods describe in this paper and in the final report (Energy Systems Laboratory 2003a and 2003b), Texas will be the first to have an approved methodology. This will open the opportunity nationwide to utilize energy efficiency programs to generate SIP credits.

County	Population	Housing Unit	Permits (Single)	Permits(Multi)	Total Permits
Harris	3,250,404	1,273,565	16,055	9,807	25,862
Dallas	2,062,100	840,374	8,392	6,545	14,937
Tarrant	1,382,442	554,145	8,785	1,969	10,754
Bexar	1,372,867	512,381	7,117	5,007	12,124
Travis	727,022	321,612	6,742	6,314	13,056
El Paso	701,908	221,244	3,472	724	4,196
Collin	456,612	184,781	7,704	4,396	12,100
Denton	404,074	162,280	5,222	1,511	6,733
Fort Bend	353,697	114,678	1,148	12	1,160
Nueces	315,469	122,102	694	308	1,002
Montgomery	287,644	108,573	4,493	426	4,919
Galveston	248,469	108,802	1,627	480	2,107
Jefferson	241,332	101,465	581	54	635
Williamson	240,892	84,634	3,984	1,621	5,605
Brazoria	234,303	88,543	1,717	266	1,983
Smith	169,693	71,158	440	90	530
Johnson	122,594	45,604	514	358	872
Gregg	113,155	46,189	194	144	338
Ellis	107,580	38,095	481	8	489
Hays	92,755	33,919	754	256	1,010
Parker	85,427	33,802	242	52	294
Orange	85,240	34,607	218	3	221
Guadalupe	82,808	33,112	628	0	628
Victoria	82,087	32,778	196	2	198
Comal	76,770	31,586	926	20	946
Hunt	75806	32423	97	32	129
Henderson	72080	35820	139	18	157
San Patricio	71,636	24,369	248	0	248
Kaufman	68,065	25,803	178	184	362
Liberty	67,161	26,146	310	52	362
Harrison	59,797	26,243	22	42	64
Bastrop	52,561	22,106	143	2	145
Hardin	49,684	19,815	33	2	35
Rusk	45,819	19,854	18	0	18
Hood	39969	19072	64	14	78
Rockwall	39,489	14,396	761	22	783
Upshur	36,541	14,917	14	0	14
Caldwell	32,820	11,844	81	0	81
Wilson	32,504	12,099	7	0	7
Waller	28,070	11,668	29	40	69
Chambers	23,993	10,027	213	0	213
TOTAL	14,093,339	5,526,631	84,683	40,781	125,464

Table 1 – 1999 Texas County Population for Non-Attainment and Affected Counties

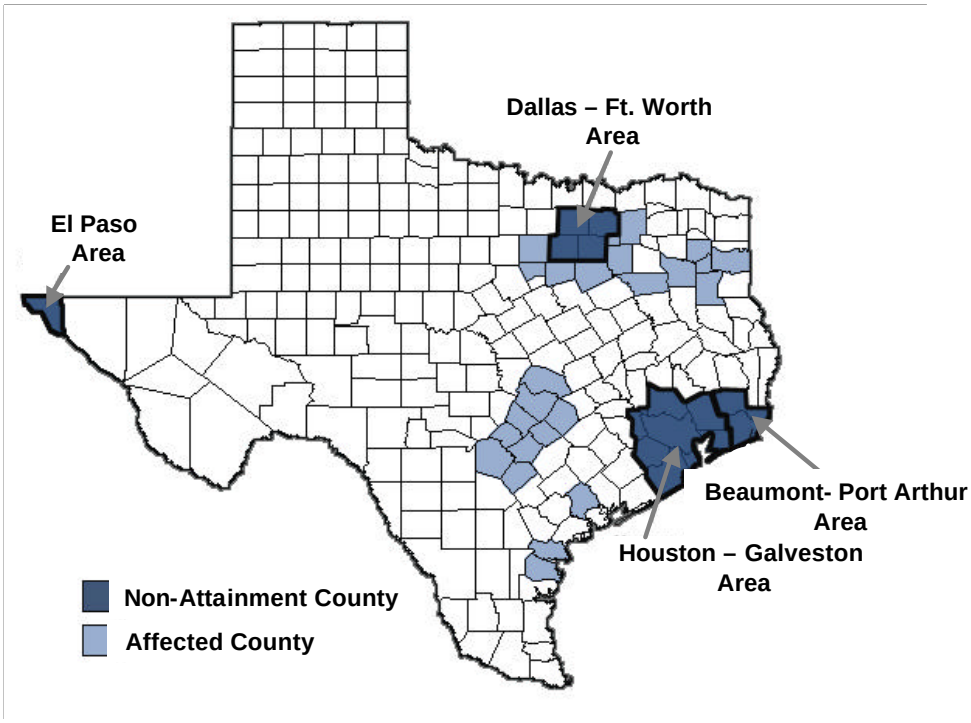

Figure 1: EPA Non-Attainment (Dark Shade) And Affected Counties (Light Shade).

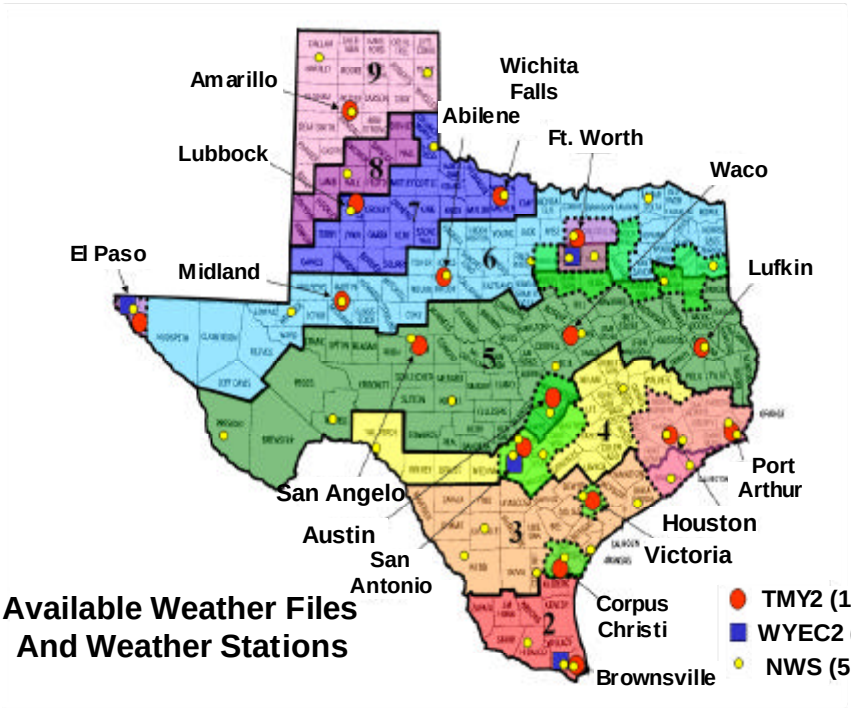

Figure 2: NWS, TMY2 and WYEC2 Weather Files Compared To IECC Weather Zones For Texas.

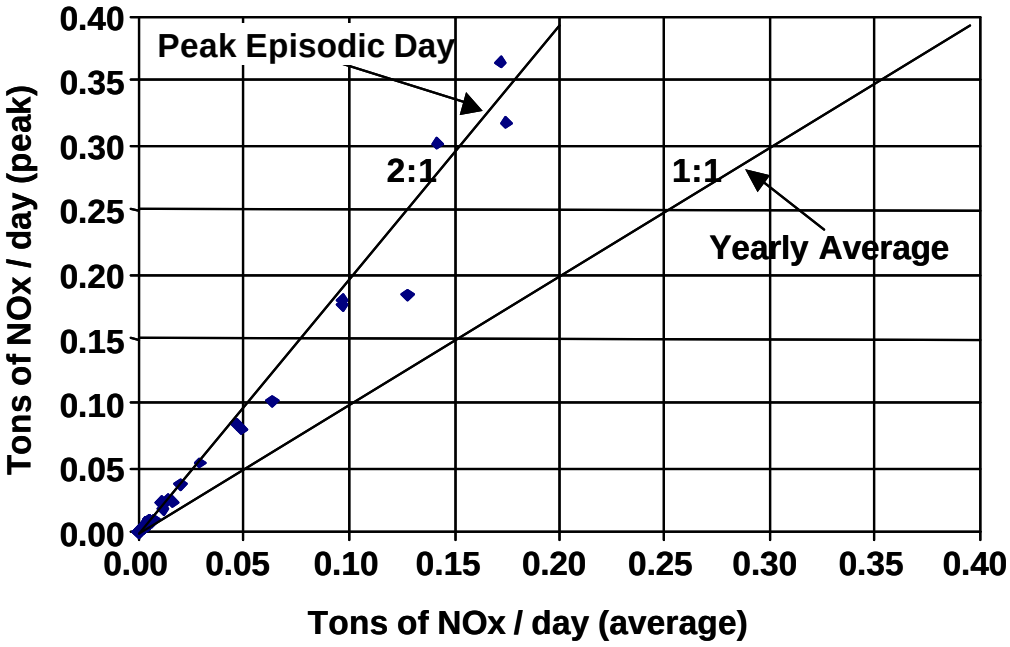

Figure 3 – Comparison of Peak Day Vs Average Daily NOx Reduction

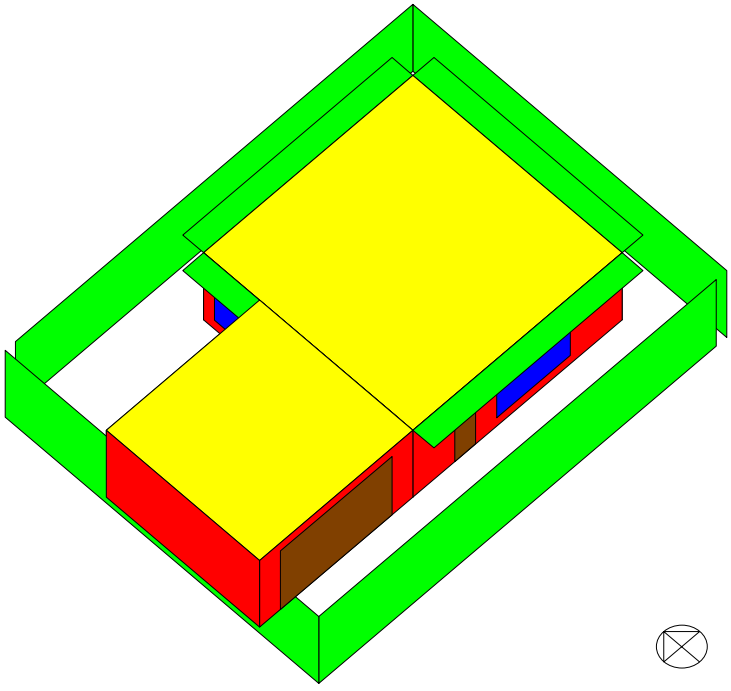

Figure 4. Code Compliant Residential House

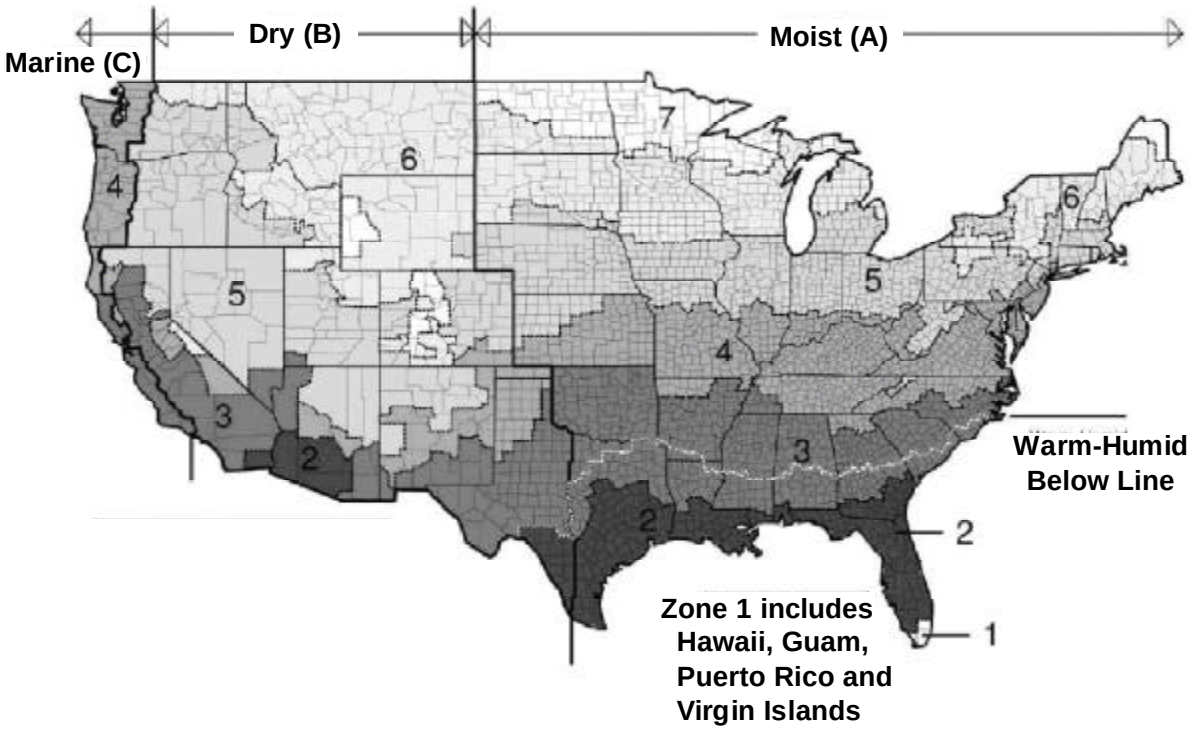

Figure 5: Proposed New Climate Zones for ICC 2003/2004 Climate Zones

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