ESL-TR-02/11-01

DETAILED DESCRIPTION OF DATA FOR TEXAS' SENATE BILL 5 LEGISLATION FOR REDUCING POLLUTION IN NON-ATTAINMENT AND AFFECTED AREAS:

Project for Texas' Senate Bill 5 Legislation For Reducing Pollution in Nonattainment and Affected Areas

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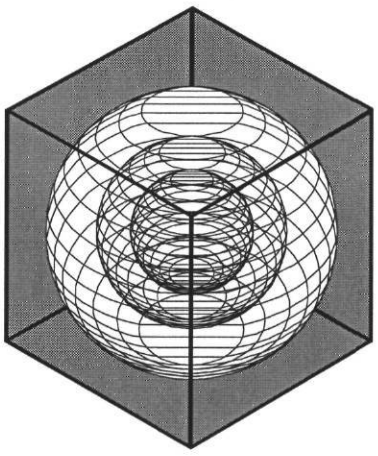

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1 INTRODUCTION

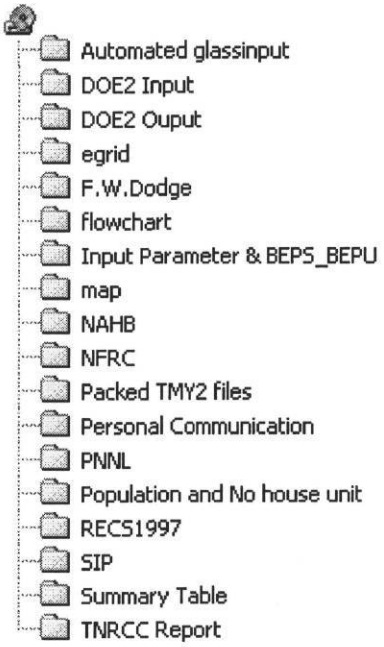
This is the report for detailed description of data what was used in the research for Senate Bill 5: Texas Emissions Reduction Plan (TERP). Basically this report is a manual for attached CD-ROM. The attached CD-ROM contains all data, documents, figures and spreadsheets that were used for this research. All files were categorized and divided into several folders in the CD-ROM. The detailed accomplishments and progress to date for the project are also able to access from the annual report to the Texas Natural Resource Conservation Commission which is included in the CD-ROM.

Each file in the CD-ROM can be accessed by two ways. One way to access a file is using this document. Each file in the CD-ROM is linked with this report. User can click the linked file in the report, then linked file will be run automatically. Another way to access a file is running from the CD-ROM directly. User can open window explorer and open a file from the CD-ROM.

TABLE OF CONTENTS

2 STRUCTURE OF THE CD-ROM

Below is the structure of CD-ROM.



3 DESCRIPTION OF THE CD-ROM

This chapter presents detailed description of the files in the CD-ROM. Each file is linked in the report.

3.1 Automated Glass Input Spreadsheet

Folder Name: Automated glassinput

automated glassinput.xls

CONVERSION OF WINDOW U-VALUE TO GLASS CONDUCTANCE AND SHGF TO SHADING COEFFICIENT:

The DOE-2 simulation software allows window to be entered in the following ways:

1. Shading Coefficient
   Username = GLASS-TYPE
   SHADING-COEFF =

PANES =
GLASS-CONDUCTANCE =
VIS-TRANS =
FRAME-CONDUCTANCE =
FRAME-ABS =

2. Glass-Type-Code ≤ 11
   Username = GLASS-TYPE
   GLASS-TYPE-CODE =
   PANES =
   GLASS-CONDUCTANCE =
   VIS-TRANS =
   FRAME-CONDUCTANCE =
   FRAME-ABS =

3. Window Library (Glass-Type-Code ≥ 1000)
   Username = GLASS-TYPE
   GLASS-TYPE-CODE =
   FRAME-CONDUCTANCE =
   FRAME-ABS =

The second of input restricts the user to the predefined U-values and SHGF of the window library while in the third type there is a choice to use windows already defined in the library or add new windows to the DOE-2 library following a certain method explained in the DOE-2.1e reference manual.

For the purposes of the project, which requires the user to input window U-value and Solar heat gain coefficient, the first method is feasible. It requires Shading Coefficient and Glass Conductance as input to the simulation program, while the general practice is to define the Solar Heat Gain Factor and the U-factor. To convert the U-factor and Solar Heat Gain Factor to Glass Conductance and Shading Coefficient, the following steps are required which have been incorporated in a spreadsheet for the ease of calculations.

- A generalized spreadsheet has been created which requires the following inputs for the calculation of the shading coefficient and glass conductance.

House dimensions:
Length
Width
Height of the interior wall

Glazing Properties:
U-Factor
Solar Heat Gain Factor

Window to wall ratio (%)

- Two separate sections in the spreadsheet calculate the glass-conductance and the SHGF to be input in the DOE-2 input file.

- In DOE-2 there is a choice of 5 types of frames, so in the spreadsheet there are five different rows, which calculate the glass conductance and SHGF for the different frame types.

- Next the total Wall or Floor area of the house is defined, which will be used to determine the area of window on each wall.

- The frame is taken to be a standard 11/2" for Aluminum and 2 ½" for Wood and Vinyl.

- The value of frame conductance is taken from the DOE-2.1e manual.

The rest of the calculation in the spreadsheet are explained below:

1. Calculation of the Frame U-value:
   The following formula is from DOE-2.1e Supplement (p. 2.116)
   Assumption: None

   $$\text{Frame U-value} = [(\text{frame conductance})^{-1} + 0.197]^{-1}$$

2. Calculation of Area of Window on each wall:
   Assumption: window area is equal on all sides

   $$\text{Window area on each wall} = \frac{\text{Total wall area x Window to wall ratio (\%)}}{4}$$

3. Calculation of the number of Windows on each wall:
   Assumption: Each window is 3x5 (15 ft^2)

   $$\text{Number of windows} = \frac{\text{Window area on each wall}}{\text{Area of one window (15 } ft^2\text{)}}$$

4. Calculation of Glass Area:
   Assumption: Frame width is 0.125 ft, window height is 5ft and width is 3ft.

Glass area = (Height of Window - 2x Width of frame) x (Width of Window – 2x Width of frame)

5. Calculation of Frame area:
   Assumption: None

   Frame area = (Window area on each wall) – (Glass Area)

6. Calculation of Window width if one equivalent window:
   Assumption: Window height is 5ft and house is rectangular

$$\text{Window Width} = \frac{\text{Window to wall ratio(\%) x Total wall area}}{\text{No. of exterior walls x window height}}$$

7. Calculation of equivalent frame width
   Assumption: Window height is 5ft.

$$\text{Equivalent frame width} = \frac{\text{Frame area}}{\text{2x (equiv. Window width + window height)}}.$$

8. Calculation of center of glass U-value:
   The NFRC 100 is used for this calculation
   Assumption: Edge of glass U-value is neglected
   No dividers are considered

$$\text{Center of glass U-value} = \frac{\text{(Total U-value x Total area) – (Frame U-value x Frame area)}}{\text{Glass Area}}$$

9. Calculation of the Glass Conductance:
   Assumption: None

   $\text{Glass Conductance} = [(\text{Center of glass U-value})^{-1} - 0.197]^{-1}$

This value is finally input into the code and this can be checked against the output since the output gives out the total U-value of the Window, which shows that the window is being simulated according to the U-factor provided.

The following two steps are used to calculate the shading coefficient when the solar heat gain coefficient is provided as the input.

10. Calculation of the Center of glass SHGF
    The following formula is from NFRC 200

Assumption: Edge of glass is neglected
No dividers are considered
Frame has zero SHGF

$$\text{Center of Glass SHGF} = \frac{\text{Total SHGF x Total Area}}{\text{Area of Glass}}$$

11. Calculation of Shading Coefficient
The following formula is from NFRC 200
Assumption: None

Shading Coefficient = (Center of glass SHGF)/0.87

Sample Calculation:

Assuming the following Input values for the spreadsheet:

House dimensions:
Length = 50 ft
Width = 50 ft
Height of the interior wall = 8 ft
Window to wall ratio = 15%

Glazing Properties:
U-Factor = 0.75
Solar Heat Gain Factor = 0.4

Assuming an Aluminum frame without thermal break:

From the spreadsheet

Conductance of Aluminum w/o thermal break = 3.037

Frame U-value = $[(\text{frame conductance})^{-1} + 0.197]^{-1}$

$= [(3.037)^{-1} + 0.197]^{-1}$

$= 1.9$ Btu/hr ft^2 °F

Frame-width = 0.125 ft

Total wall area = (2x width x height) + (2x length x height)

$= (2 \times 50 \times 8) + (2 \times 50 \times 8)$

$= 1600\ ft^2$

Total area of a single window = $\frac{\text{Total wall area x Window to wall ratio (\%)}}{4}$

$= \frac{1600 \times 15\%}{4}$

$= 60\ ft^2$

Number of windows = $\frac{\text{Window area on each wall}}{\text{Area of one window (15 } ft^2\text{)}}$

$= 60/15$

$= 4$ windows

Glass area = (Height of Window - 2x Width of frame) x (Width of Window – 2x Width of frame)

$= [(5 - 2 \times 0.125) \times (3 - 2 \times 0.125)] \times 4$

$= 52.25\ ft^2$

Frame area = (Window area on each wall) – (Glass Area)

$= 60 - 52.25$

$= 7.75\ ft^2$

Equivalent width of a single window = $\frac{\text{Window to wall ratio (\%) x Total wall area}}{\text{No. Of exterior walls x window height}}$

$= \frac{15\ \% \times 1600}{4 \times 5}$

$= 12$ ft.

Equivalent frame width for a single window

$= \frac{\text{Frame area}}{\text{2x (equiv. Window width x window height)}}$.

$= 7.75/ [2 \times (12 \times 5)]$

$$= 0.23 \text{ ft.}$$

$$\text{Center of glass U-value} = \frac{(\text{Total U-value} \times \text{Total area}) - (\text{Frame U-value} \times \text{Frame area})}{\text{Glass Area}}$$

$$= \frac{(0.75 \times 60) - (1.9 \times 7.75)}{52.25}$$

$$= 0.58 \text{ Btu/ hr ft}^2 \text{ °F}$$

$$\text{Glass conductance} = [(\text{Center of glass U-value})^{-1} - 0.197]^{-1}$$

$$= [(0.58)^{-1} - 0.197]^{-1}$$

$$= 0.65 \text{ Btu/ hr ft}^2 \text{ °F}$$

The second part of the spreadsheet is similar to the first one except for the following:

$$\text{Center of glass SHGF} = \frac{\text{Total SHGF} \times \text{Total Area}}{\text{Area of Glass}}$$

$$= \frac{0.4 \times 60}{52.25}$$

$$= 0.459$$

$$\text{Shading Coefficient} = \text{Center of glass SHGF}/ 0.87$$

$$= 0.459/0.87$$

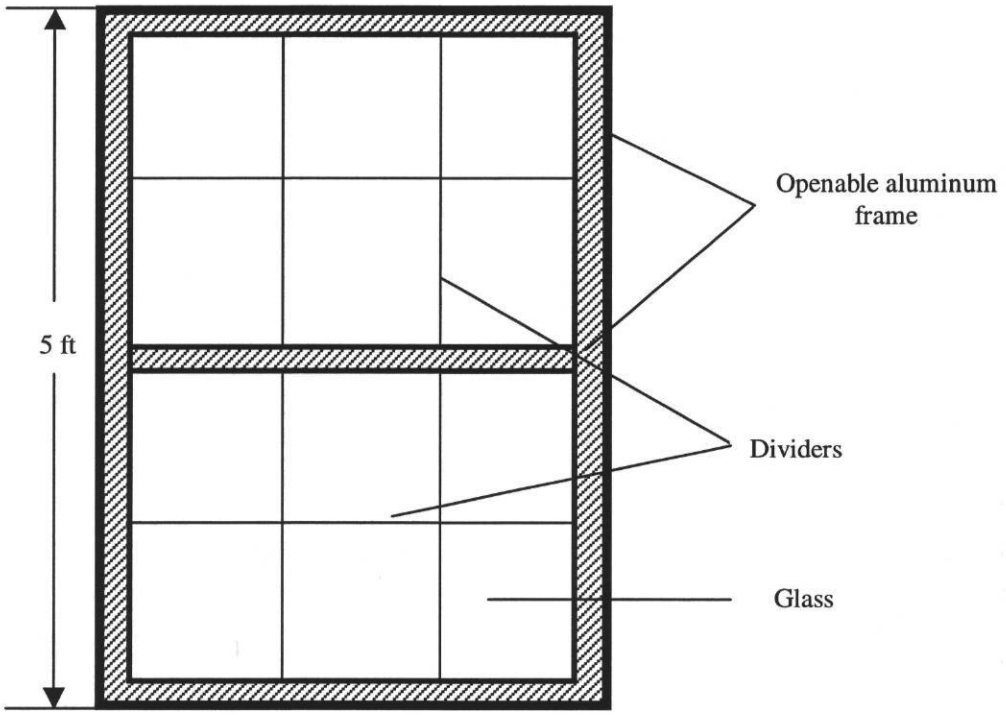
$$= 0.528$$

The spreadsheet is attached for the better understanding of this calculation procedure.

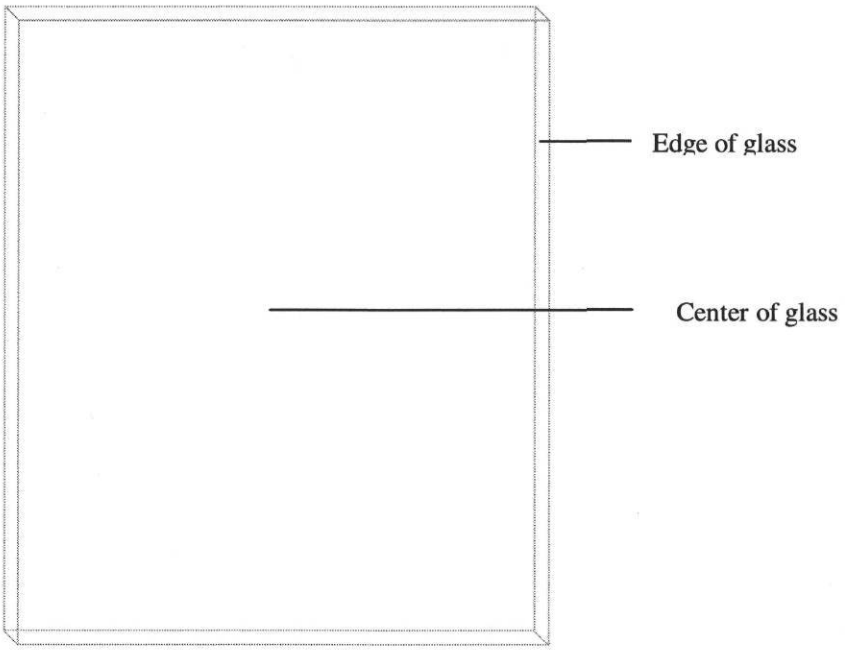
TYPICAL WINDOW CONSTRUCTION:

The following window construction and size is considered for all calculations. The frame is openable and can be of the materials already mentioned. The dividers and the edge of glass U-value are neglected. The height of the window is fixed at 5ft while the width depends on the window to wall ratio.

Complete glazing System



3D of Glass



3.2 DOE2 Input

Folder Name: DOE2 Input

This folder presents all DOE-2 input files for all 38 nonattainment and affected counties. The format of file name is

"County Name_1999 or IECC.doc"

"County Name" represents the name of County, "1999" represents the input file for 1999 standard house, "IECC" represents the input file for 2000 IECC Standard house.

Below is the list of the files.

Bastrop_1999.inp
Bastrop_IECC.inp
Bexar_1999.inp
Bexar_IECC.inp
Brazoria_1999.inp
Brazoria_IECC.inp
Chambers_1999.inp
Chambers_IECC.inp
Collin_1999.inp
Collin_IECC.inp
Dallas_1999.inp
Dallas_IECC.inp
ElPaso_1999.inp
ElPaso_IECC.inp
Gregg_1999.inp
Gregg_IECC.inp
Harris_1999.inp
Harris_IECC.inp
Hays_1999.inp
Hays_IECC.inp
Nueces_1999.inp
Nueces_IECC.inp
Rusk_1999.inp
Rusk_IECC.inp
Victoria_1999.inp
Victoria_IECC.inp

3.3 DOE2 Output

Folder Name: DOE2 Output

This folder presents all DOE-2 output files for all 38 nonattainment and affected counties. The format of output file is same to the format of input file name. Below is the list of all output files.

Bastrop_1999.out
Bastrop_IECC.out
Bexar_1999.out
Bexar_IECC.out
Brazoria_1999.out
Brazoria_IECC.out
Chambers_1999.out
Chambers_IECC.out
Collin_1999.out
Collin_IECC.out
Dallas_1999.out
Dallas_IECC.out
ElPaso_1999.out
ElPaso_IECC.out
Gregg_1999.out
Gregg_IECC.out
Harris_1999.out
Harris_IECC.out
Hays_1999.out
Hays_IECC.out
Nueces_1999.out
Nueces_IECC.out
Rusk_1999.out
Rusk_IECC.out
Victoria_1999.out
Victoria_IECC.out

3.4 EGRID

Folder Name: EGRID

This folder contains E-Grid manual, program and spreadsheets.

EGRID Users Manual: EGRID00v2UM.pdf
EGRID Spreadsheet for 1996: EGRID96.xls
EGRID Spreadsheet for 1997: EGRID97.xls
EGRID Spreadsheet for 1998: EGRID98.xls
Install EGRID Program: EGRID2000pc.exe

The Emissions & Generation Resource Integrated Database (E-GRID) is a comprehensive source of data on the environmental characteristics of all electric power generated in the United States. An integration of 23 different federal data sources, E-GRID2000 provides information on air pollutant emissions and resource mix for individual power plants, generating companies, states, and regions of the power grid. The data are expressed in terms that allow direct comparison of the environmental attributes of electricity generation at any level.

3.5 F.W. Dodge

Folder Name: F.W. Dodge

These F.W. Dodge reports contain information about total residential and nonresidential building construction activities. Available year includes 1997, 1999, 2000 and 2001.

Tx1997.pdf	F.W. Dodge MarkTrack 1997 data
Tx1999.pdf	F.W. Dodge MarkTrack 1999 data
Tx2000.pdf	F.W. Dodge MarkTrack 2000 data
Tx2001.pdf	F.W. Dodge MarkTrack 2001 data

3.6 Flow Chart

Folder Name: Flowchart

This folder contains all flowcharts used in this project. Each flowchart shows the methodology of research. Two files are in the folder; flow1.doc, flow2.doc.

flow1.doc includes following flowcharts;

1. Calculate 2002 Emission Reductions from the Implementation of IECC-2001 in Nonattainment & Affected Counties (Residential)
2. Estimated Residential Energy Consumption for Buildings Constructed in 1999 by Texas County
3. Calculated Residential Energy Consumption for Buildings Constructed in 2002 by Texas County Using IECC-2001 Chap. 4,5 & Average 1999 Building Characteristics
4. Calculated Residential Energy Consumption for Buildings Constructed in 2002 by Texas County Using IECC-2001 Chap. 4,5 & 6

flow2.doc includes following flowcharts;

1. Reconciliation-onsite visit
2. Reconciliation-utility bill

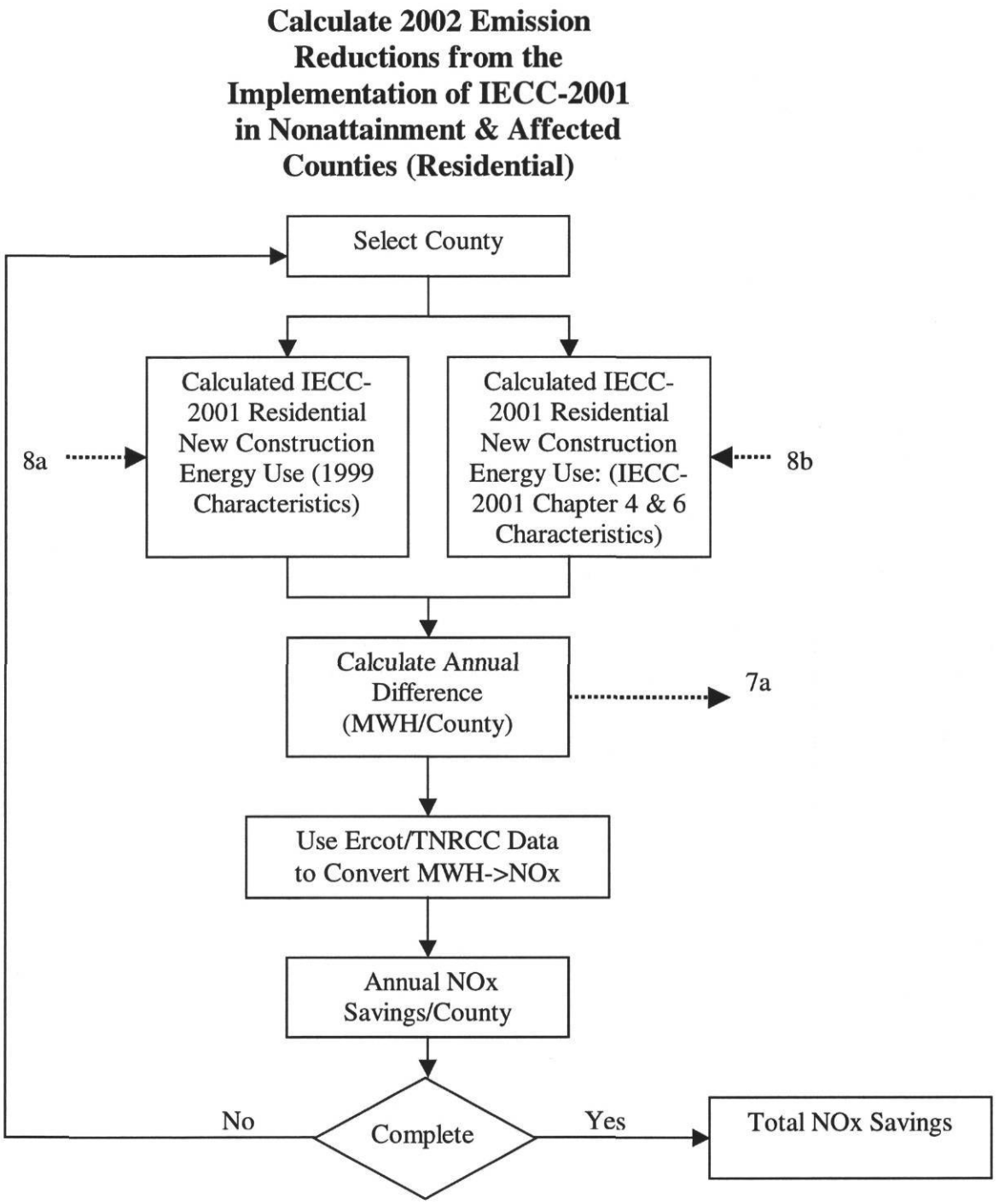


Figure 1: Overall flowchart for calculation of emission reductions from implementation of IECC/IRC 2001 in residential construction in non-attainment and affected counties.

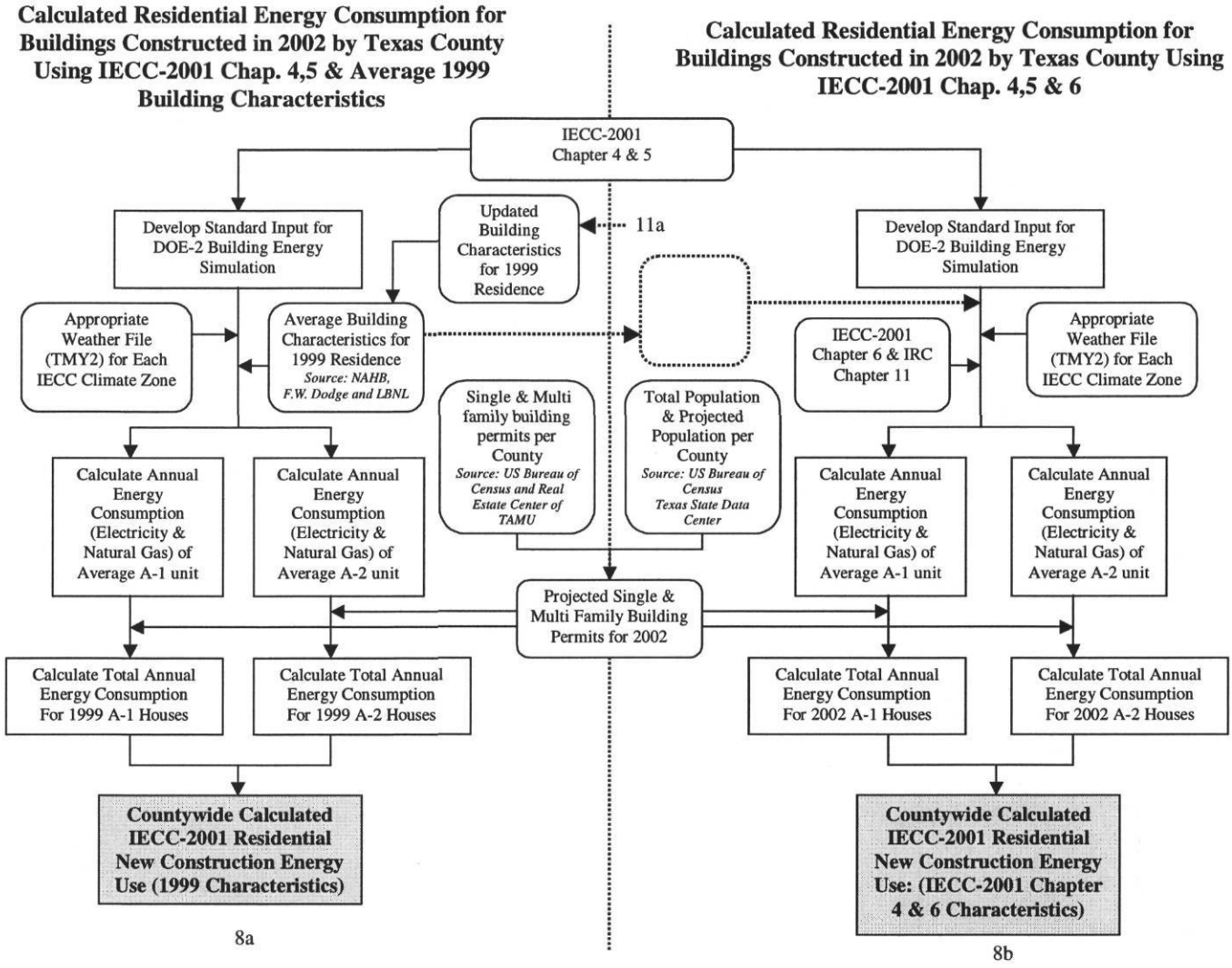


Figure 2: Calculation of countywide residential new construction energy consumption (1999 characteristics and 2001 IECC/IRC)

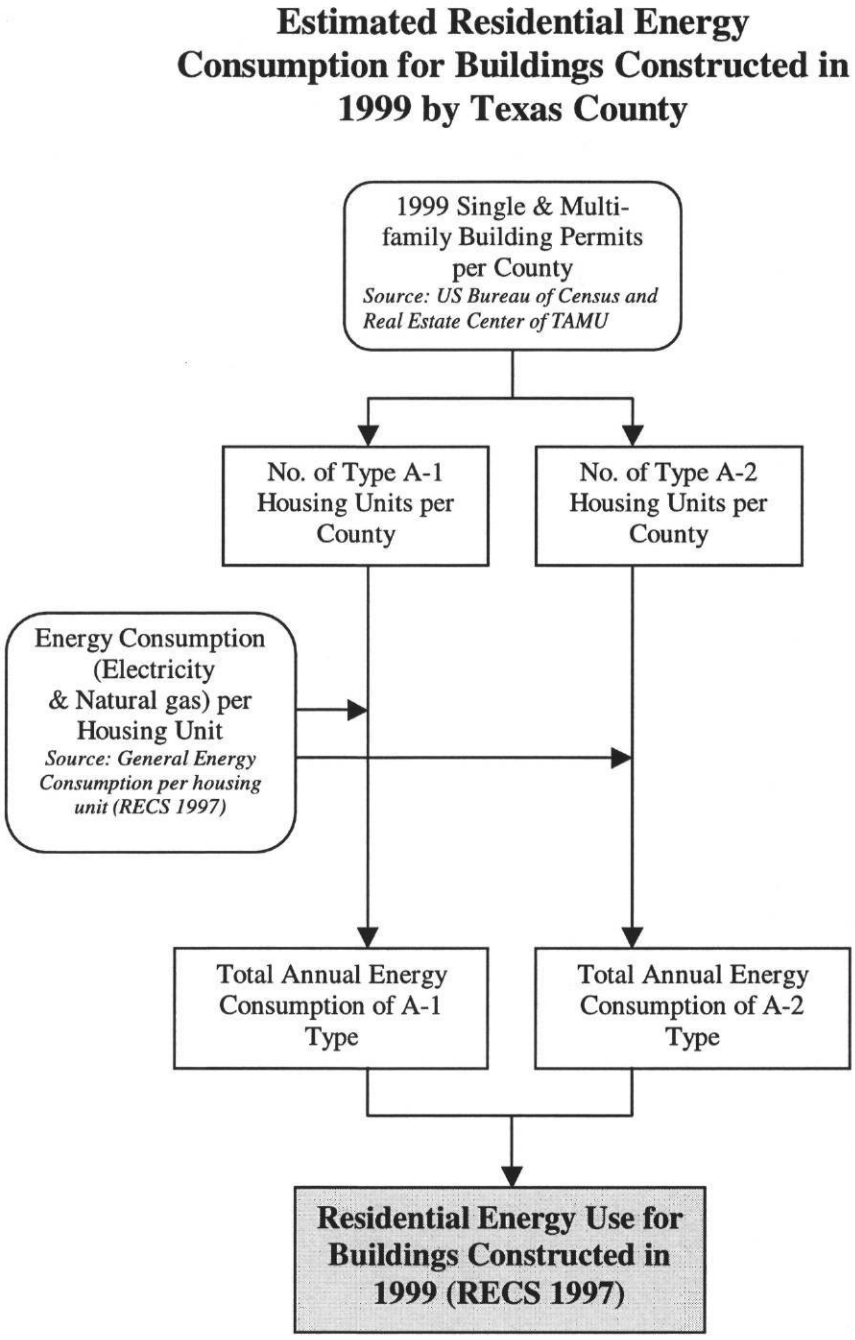


Figure 3: Estimated residential energy consumption for buildings constructed in 1999 by Texas county

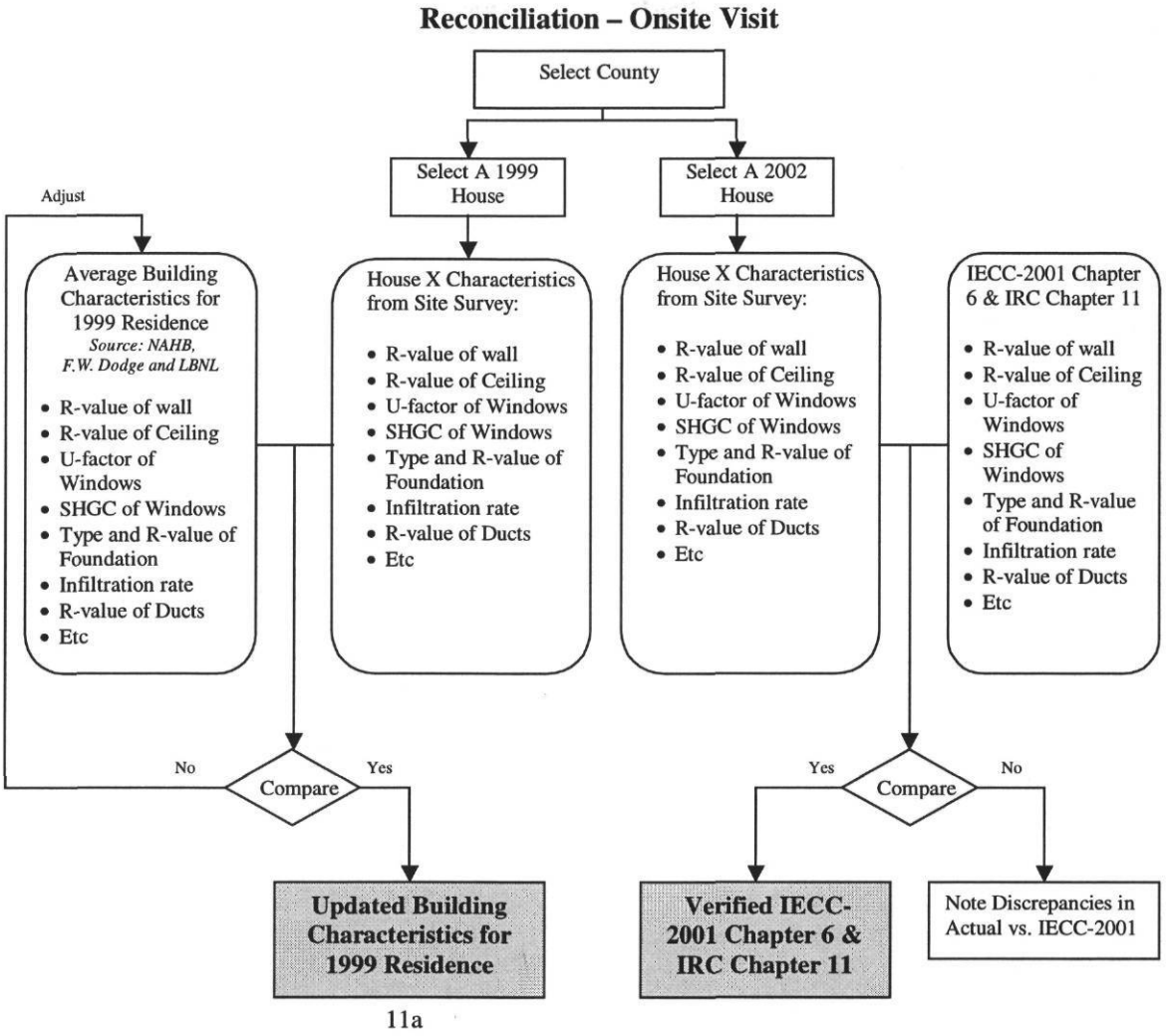


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Figure 4: Reconciliation residential housing characteristics using on-site surveys.

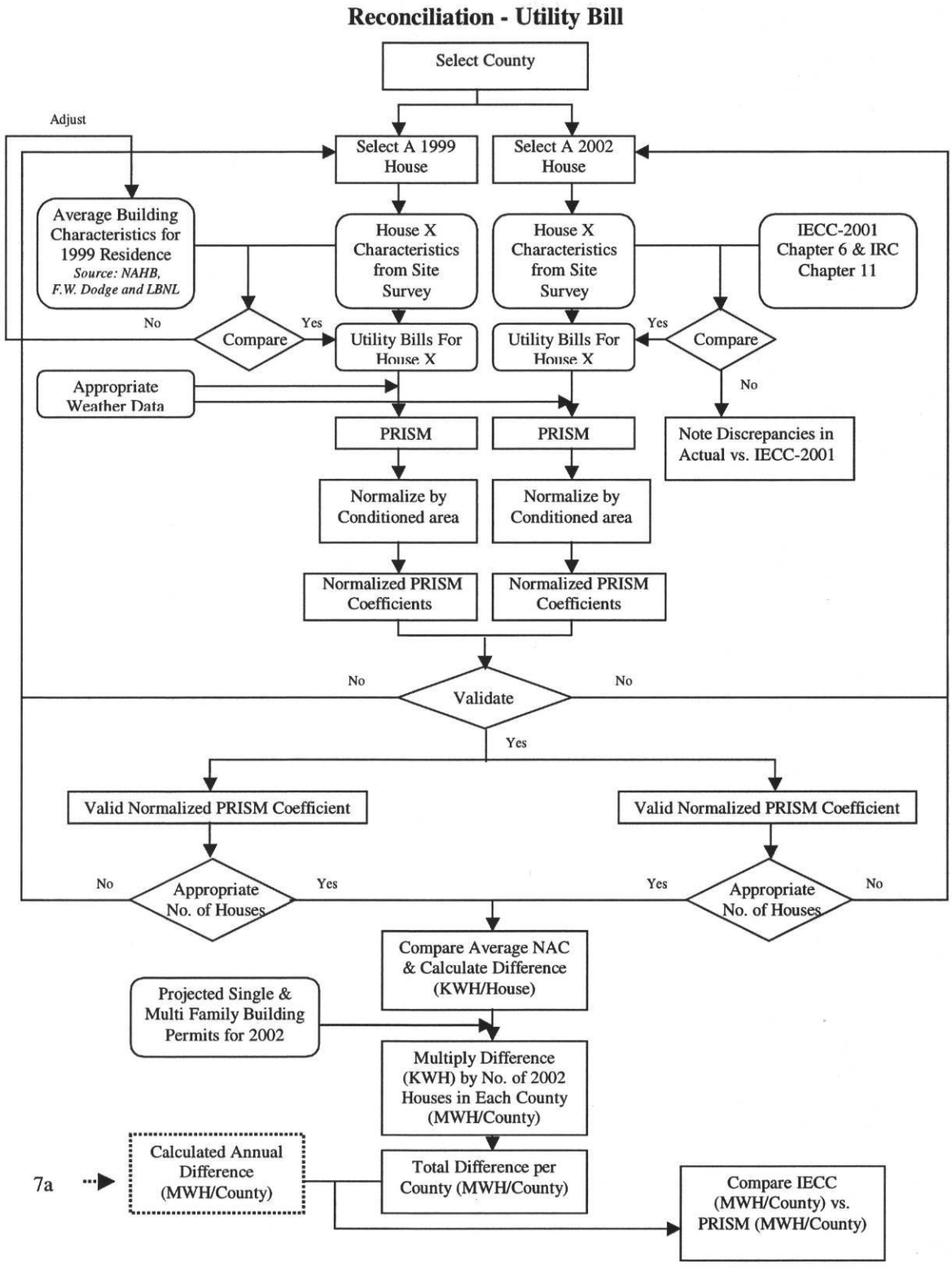

Figure 5: Reconciliation of residential energy savings using utility bill analysis.

3.7 Input Parameter & BEPS,BEPU

Folder Name: Input Parameter & BEPS_BEPU

This folder contains all input parameters, BEPS, BEPU report and Peak day hourly report from DOE-2 output report for all 38 counties. Because one representative county running can be used for several counties, only representative 13 counties are shown in this folder. The format of file name is same to the format of input file name.

Bastrop_1999
Bastrop_IECC
Bexar_1999
Bexar_IECC
Brazoria_1999
Brazoria_IECC
Chambers_1999
Chambers_IECC
Collin_1999
Collin_IECC
Dallas_1999
Dallas_IECC
ElPaso_1999
ElPaso_IECC
Gregg_1999
Gregg_IECC
Harris_1999
Harris_IECC
Hays_1999
Hays_IECC
Nueces_1999
Nueces_IECC
Rusk_1999
Rusk_IECC
Victoria_1999
Victoria_IECC

3.8 Various Map

Folder Name: Map

This folder contains all maps used in this project. These files could be shown and edited by Microsoft Power Point. Four files are in this folder; Map1.ppt , Map2.ppt, Map3.ppt and Map4.ppt.

Map1.ppt shows Nonattainment & Affected Counties in Texas
Map2.ppt shows 1999 Texas County Residential Building Permit Activity
Map3.ppt shows Available Weather Files & Weather Station in Texas
Map4.ppt shows NAHB Division of East & West Texas

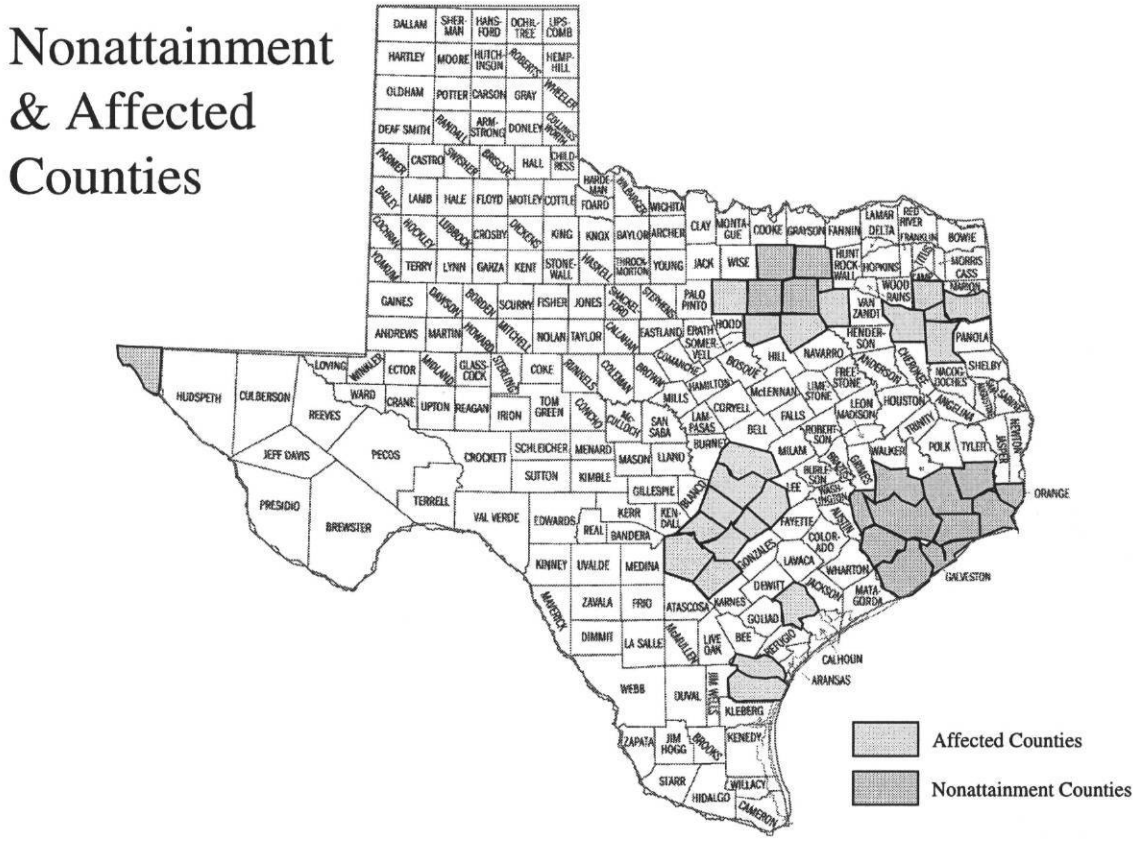

Figure 6: EPA Non-attainment and affected counties

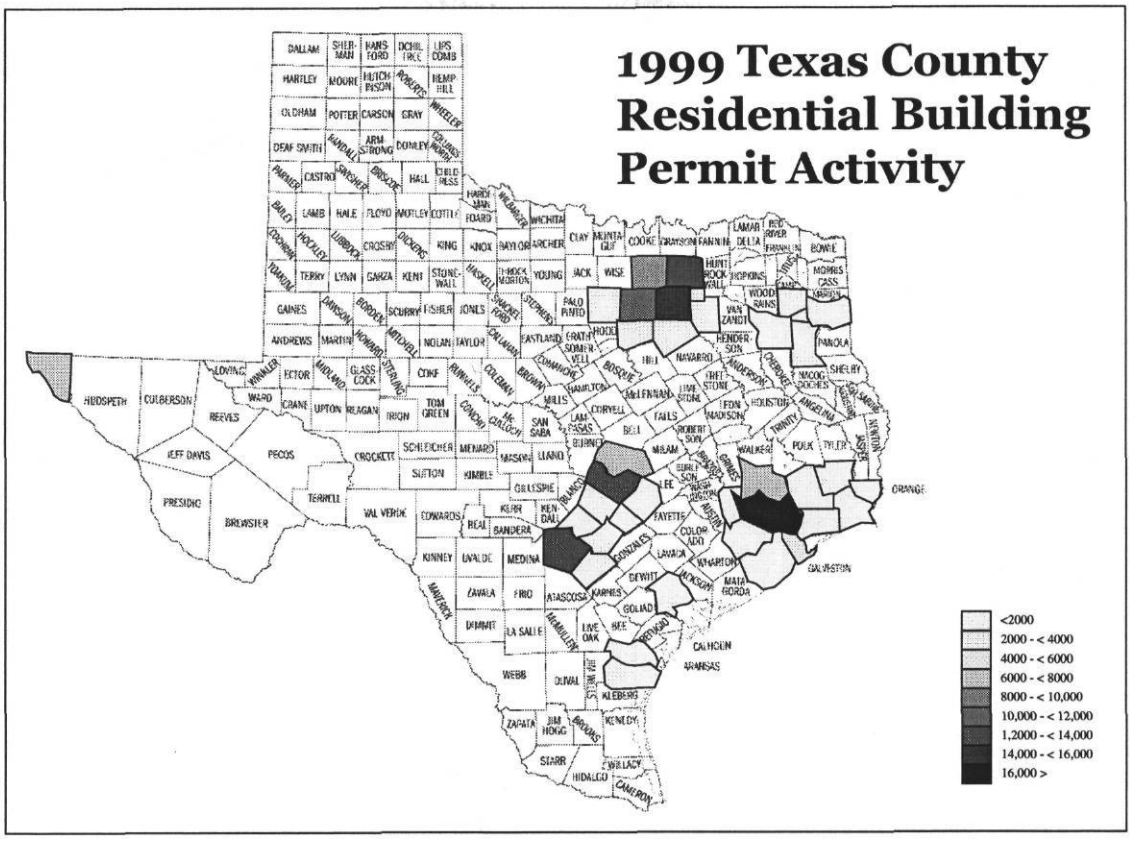

Figure 7: Map of 1999 residential building permits by county (Source: Real Estate Center, TAMU).

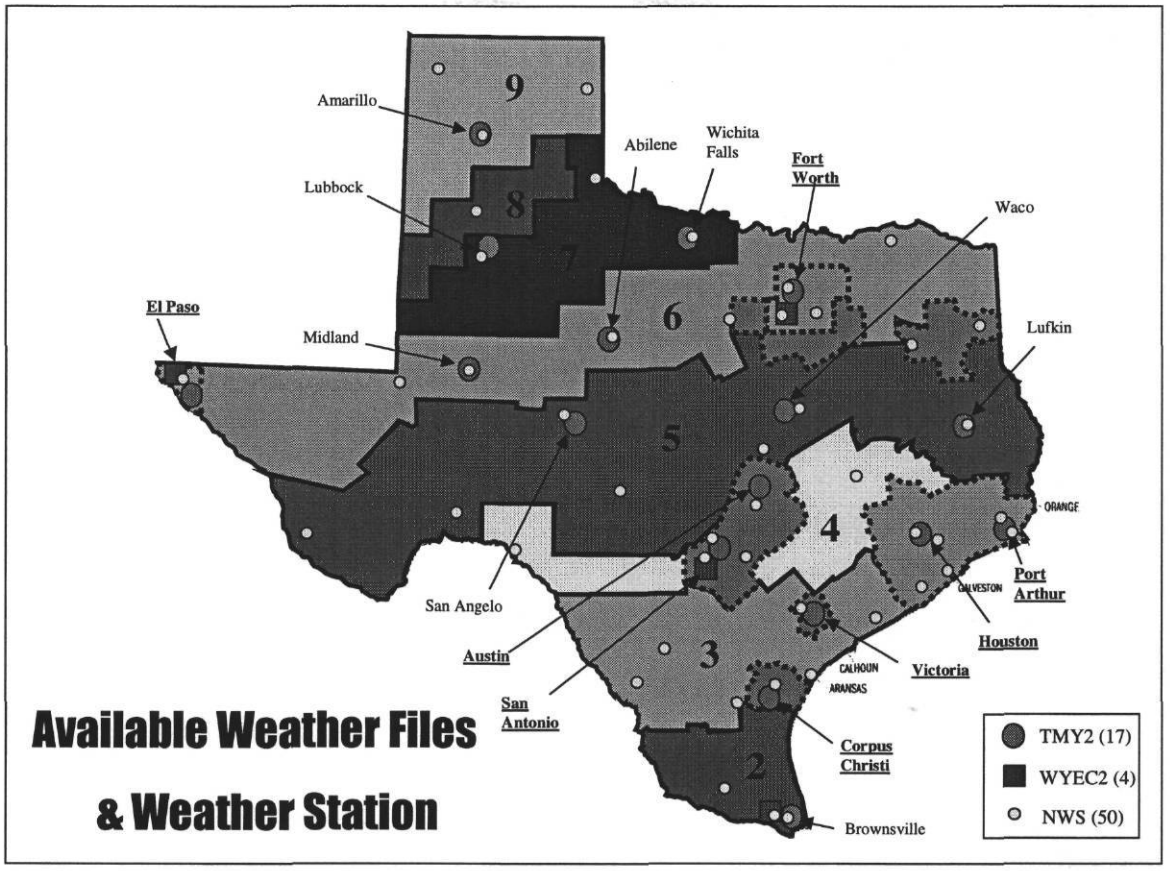

Figure 8: Available NWS, TMY2 and WYEC2 weather files compared to IECC weather zones for Texas.

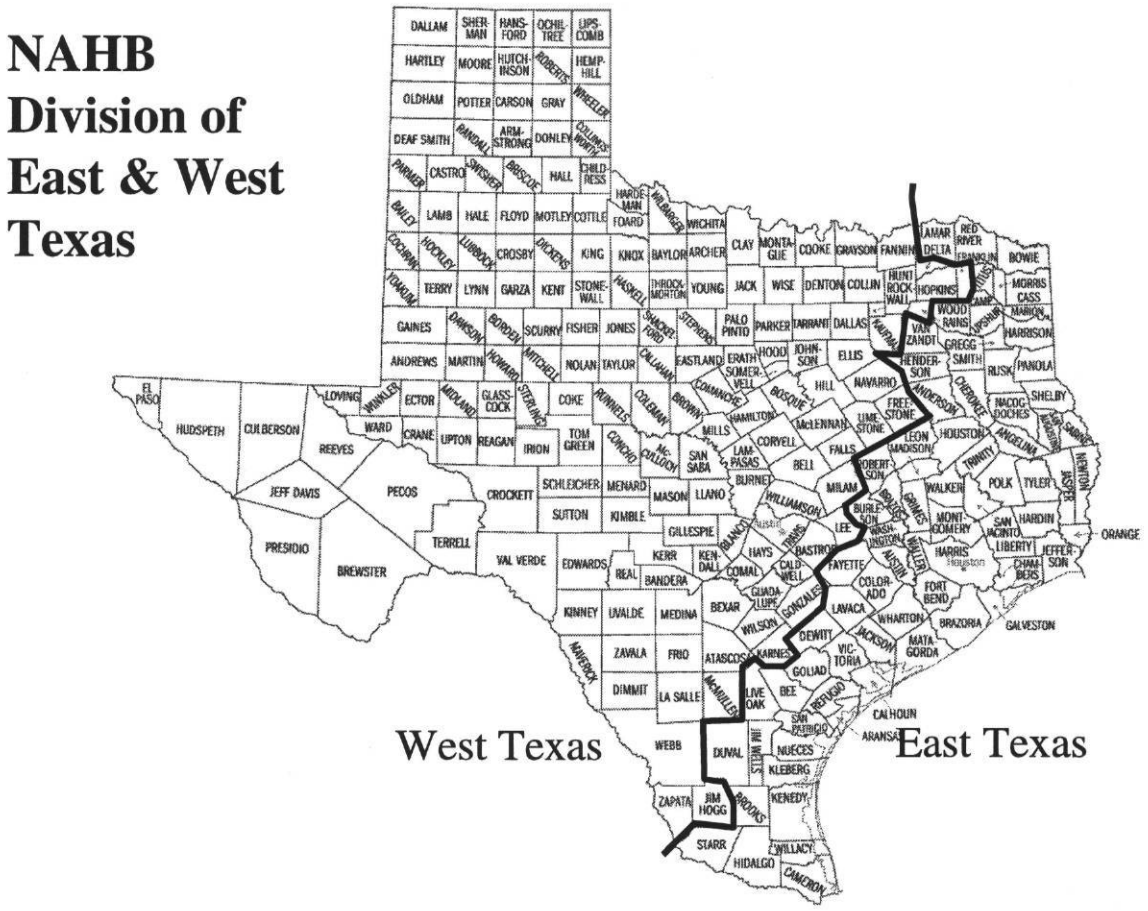

Figure 9: NAHB Division of East & West Texas

3.9 Building Characteristics from NAHB

Folder Name: NAHB

This folder contains NAHB survey data. The source of the data is Builder Practices Survey Reports published by NAHB Research Center in September 1, 2000. These data sets were used to decide the characteristics of 1999 single family base case house in our project. We contacted a person in NAHB, Ed Hudson (ehudson@nahbrc.org), and received three data sets. Each data spreadsheet is composed of several worksheets.

1999 Single Family Detached House Characteristics for East and West Texas (SFD reports 1999.xls)
1999 Multi Family House Characteristics for West South Central Area (MF reports 1999.xls)
1999 County Housing Starts, Texas (Texas_starts.xls)

From 1999 County Housing Starts, Texas, we can know the division of each county, i.e. east & west Texas. Division of each county can see from this map (Map4.ppt)

Table 1 and 2 show the summary information of these data sets.

SUMMARY TABLE FOR NAHB SURVEY DATA

Single Family Detached

	Required Data	NAHB (East Texas)	NAHB (West Texas)
Year		1999	1999
Envelope	Floor Area (ft^2)	2548.01	2426.4264
	Wall height(ft)	8.8	9.2
	Wall R-value	13.99 (Combined R)	14.18 (Combined R)
	Roof/Ceiling R-value	27.08	26.75
	Window area (%)[1]	13.8% (16.4 units of windows)	20.6% (24.9 units of windows)
	Glazing U-factor [2]	1.11	0.87
	SHGC [3]	0.714	0.66
Building Mechanical Systems and Equipment	AFUE (Gas-fired or oil-fired furnace < 225,000 Btu/h)	80%	80%
	SEER (Air-cooled air conditioners and heat pumps cooling mode < 65,000	12	12

1. Window area: Assume average window size is 3x5.

Total window area for east Texas house: 3x5x16.4 =246 ft2
Total wall area for east Texas house: 50.5 (length of house)x4x8.8(height of house) = 1777.6 ft2
Total window area for west Texas house: 3x5x24.9 =373.5 ft2
Total wall area for wast Texas house: 49.3 (length of house)x4x9.2(height of house) = 1814.2 ft2

2.Calculation of U-factors

	Aluminum Without Thermal Break	SHGC
Single Glazing (1/8 in glass)	1.27	0.75
Double Glazing (1/4 in air space)	0.87	0.66

Source: 2001 ASHRAE HANDBOOK FUNDAMENTALS

U-factor for east Texas: 60% of single pane and 40%of double pane glass
: (0.6 X 1.27) +(0.4 X 0.87) = 1.11
U-factor for west Texas: 100% of double pane glass
: 0.87

3.Calculation of SHGC

SHGC for east Texas: 60% of single pane and 40%of double pane glass
: (0.6 X 0.75) +(0.4 X 0.66) = 0.714
SHGC for west Texas: 100% of double pane glass
0.66

Table 1: Summary Table for NAHB Single Family Detached House Survey Data

SUMMARY TABLE FOR NAHB SURVEY DATA

Multi Family

	Required Data	NAHB (West South Central)
Year		1999
Envelope	Floor Area (ft^2)	1009.3402
	Wall height(ft)	8.441 (1st) 8.342 (2nd)
	Wall R-value	21.414 (Combined R)
	Roof/Ceiling R-value	36.083
	Window area (%)[1]	7.5% (5.326 units)
	Glazing U-factor [2]	0.7535
	SHGC [3]	0.605
Building Mechanical Systems and Equipment	AFUE (Gas-fired or oil-fired furnace < 225,000 Btu/h)	80%
	SEER (Air-cooled air conditioners and heat pumps cooling mode < 65,000	12

1. Window area: Assume average window size is 3x5.

Total window area for West South Central house: 3x5x5.326 = 79.89 ft2
Total wall area for West South Central house: 31.76 (length of house)x4x8.4(height of house) = 1067.14 ft2

2.Calculation of U-factors

	Aluminum Without Thermal Break	Wood/ Vinyl	SHGC
Double Glazing (1/4 in air space)	0.87	0.55	0.66(Aluminum) 0.55(Other frames)

Source: 2001 ASHRAE HANDBOOK FUNDAMENTALS

U-factor : 100% double pane, 50% of aluminum and 50%of vinyl frame
: (0.5 X 0.87) +(0.5 X 0.55) = 0.7535

3.Calculation of SHGC

SHGC : 100% double pane, 50% of aluminum and 50%of vinyl frame
: (0.5 X 0.66) +(0.5 X 0.55) = 0.605

Table 2: Summary Table for NAHB Multi Family House Survey Data

3.10 National Fenestration Rating Council (NFRC) Documents

Folder Name : NFRC

This folder contains several documents from NFRC. These documents were used to develop the spreadsheet for automated glass input which is included in this CD-ROM.

NFRC100.pdf
NFRC 100: Procedure for Determining Fenestration Product U-Factor.

NFRC100B.pdf
NFRC 100 Section B: Procedure for Determining Door Systems Product Thermal Properties (Currently Limited to U-Factor).

NFRC100SB.pdf
NFRC 100-SB: Procedure for Determining Site-Built Fenestration U-Factors and Thermal Performance Characteristics.

NFRC200.pdf
NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence.

3.11 Packed TMY2 files

Folder Name: Packed TMY2 files

This folder contains 17 weather files for 17 cities in Texas. File format is TMY2 and these files can be used in the DOE-2 building energy simulation program. Below is the list of 17 cities in Texas

Abilene
Amarillo
Austin
Brownsville
Corpus Christi
El Paso
Fort Worth
Houston
Lubbock
Lufkin
Midland
Port Arthur
San Angelo
San Antonio

Victoria
Waco
Wichita Falls

3.12 Personal Communication

Folder Name: Personal Communication

This folder contains several data from personal communication. These communications were done to get information about average residential building system characteristics. The included files and description is below.

File name: GAMA.doc
Contact: Mark A. Kendall (GAMA)
Date: April 11, 2002
Information: Shipments of Gas Furnaces (AFUE) in Texas (1995-2000)

File name: Trane.doc
Contact: Crawley, Dick (Trane,CO.)
Date: March 29, 2002
Information: 1999 average SEER of air conditioning systems for homes in Texas.

File name: Trane2.doc
Contact: Crawley, Dick (Trane,CO.)
Date: June 25, 2002
Information: 2000,2001 average SEER of air conditioning systems for homes in Texas.

3.13 Several Reports from Pacific Northwest National Laboratory (PNNL)

Folder Name: PNNL

This folder contains several reports from Pacific Northwest National Laboratory (PNNL).

Impact of 2000 IECC on Dallas and Houston NOx- Boulin.doc
:Impact of 2000 IECC on Dallas and Houston NOx- Boulin

Conner-Why are NOx savings decreased from a yearago.doc
:Conner-Why are NOx savings decreased from a yearago2-6-01

Conner et al-NCTCOG comparison- draft.doc
:Conner et al-NCTCOG comparison- draft 1-26-01

Texas current practice your request.doc
:Texas current practice your request

Texas Energy Code - PubCit white paper.doc
:Texas Energy Code - PubCit white paper

3.14 Population and No. of Housing Units

Folder Name: Population and No house unit

This folder contains several spreadsheets that present each county's population, no. of housing units and building permit.

SB5_Population_Housing Unit_Non-residential_table.xls

: This spreadsheet contains each county's population, number of existing housing units and building permits.

housing unit_all counties.xls

: This spreadsheet presents number of existing housing units for all counties in Texas

3.15 Residential Energy Consumption Survey 1997 (RECS 1997)

Folder Name: RECS1997

This folder contains the 1997 Residential Energy Consumption Survey (RECS) by Energy Information Administration (EIA). The Residential Energy Consumption Survey (RECS) provides information on the use of energy in residential housing units in the United States. This information includes:

- the physical characteristics of the housing units,
- the appliances utilized including space heating and cooling equipment,
- demographic characteristics of the household,
- the types of fuels used, and
- other information that relates to energy use.

The RECS also provides energy consumption and expenditures data for:

- natural gas,
- electricity,
- fuel oil,
- liquefied petroleum gas (LPG), and

- kerosene.

In this report, RECS was used as a cross-check of the calculated energy use. Included files are;

- The full report (Full_Report.pdf)
- Detailed tables for the four most populated states (CA, FL, NY, and TX). See the Table 3 and 4.

Characteristics and Percent Tables for the Four Most Populated States (CA, FL, NY, and TX)	
Characteristics (Million U.S. Households)	**Percentages (Percent of U.S. Households)**
Table HC1-7a. Housing Unit Characteristics (Includes: *housing type and ownership, year of construction, number of rooms, number of floors, heated floorspace, fuels used.*)	Table HC1-7b. Housing Unit Characteristics (Includes: *housing type and ownership, year of construction, number of rooms, number of floors, heated floorspace, fuels used.*)
Table HC2-7a. Household Characteristics (Includes: *household income, age, race, household size, number of vehicles household owns.*)	Table HC2-7b. Household Characteristics (Includes: *household income, age, race, household size, number of vehicles household owns.*)
Table HC3-7a. Space Heating (Includes: *space heating fuel, equipment used, equipment age, amount of heated floorspace, etc.*)	Table HC3-7b. Space Heating (Includes: *space heating fuel, equipment used, equipment age, amount of heated floorspace.*)
Table HC4-7a. Air Conditioning (Includes: *households using air-conditioning equipment, age of air-conditioning equipment, type of air-conditioning equipment.*)	Table HC4-7b. Air Conditioning (Includes: *households using air-conditioning equipment, age of air-conditioning equipment, type of air-conditioning equipment.*)
Table HC5-7a. Appliances (Includes: *ovens, stoves, refrigerators, freezers, microwave, dishwashers, clothes washers and dryers, ceiling fans, TV's, heaters, heat pumps, water heaters.*)	Table HC5-7b. Appliances (Includes: *ovens, stoves, refrigerators, freezers, microwave, dishwashers, clothes washers and dryers, ceiling fans, TV's, heaters, heat pumps, water heaters.*)
Table HC6-7a. Usage Indicators (Includes: *indoor temperature settings, usage of appliances, usage of personal computers, household activities affecting energy usage.*)	Table HC6-7b. Usage Indicators (Includes: *indoor temperature settings, usage of appliances, usage of personal computers, household activities affecting energy usage.*)
Table HC7-7a. Home Office Equipment (Includes: *personal computers, modems, laser printers, FAX machines, copiers, office equipment indicators (personal, business, telecommuting.*)	Table HC7-7b. Home Office Equipment (Includes: *personal computers, modems, laser printers, FAX machines, copiers, office equipment usage indicators--personal, business, telecommuting.*)

Table 3. Characteristics and Percent Tables for the Four Most Populated States (CA, FL, NY, and TX)

Source: EIA, 1997 Residential Energy Consumption Survey

Energy End-Use Tables for the Four Most Populated States (CA, FL, NY, and TX)	
Consumption (Usage)	**Expenditures (Costs)**
Table CE1-7c. Total Energy Consumption in U.S. Households (Includes: *number of households and fuels used, all households and per household consumption in both Btu and physical units.*)	Table CE1-7e. Total Energy Expenditures in U.S. Households (Includes: *number of households and fuels used, total and per household expenditures by fuel and average price per Btu by fuel.*)
Table CE2-7c. Space-Heating Energy Consumption in U.S. Households (Includes: *number of households and fuels used, all households and average per household Btu consumption, and heated square footage by fuel.*)	Table CE2-7e. Space-Heating Energy Expenditures in U.S. Households (Includes: *number of households using space-heating and fuels used, all households and average per household expenditures for space heating.*)
Table CE3-7c. Electric Air-Conditioning (AC) Energy Consumption in U.S. Households (Includes: *number of households using AC, all households and average per household AC consumption (in Btu and KWh), cooled square footage and cooling degree-days.*)	Table CE3-7e. Electric Air-Conditioning (AC) Energy Expenditures in U.S. Households (Includes: *number of households using AC, all households and average per household AC expenditures, cooled square footage and cooling degree-days.*)
Table CE4-7c. Water-Heating Energy Consumption in U.S. Households (Includes: *number of households with water heating, fuels used, all households and average per household water-heating consumption.*)	Table CE4-7e. Water-Heating Energy Expenditures in U.S. Households (Includes: *number of households with water heating, fuels used, all households and average per household water-heating expenditures for water heating.*)
Table CE5-7c. Appliances Energy Consumption in U.S. Households (Includes: *number of households with appliances; all households and average per household appliances consumption in Btu and physical units , and appliances fuel used .)*	Table CE5-7e. Appliances Energy Expenditures in U.S. Households (Includes: *number of households with appliances, fuel used, all households and average per household appliances expenditures.)*

Table 4: Energy End-Use Tables for the Four Most Populated States (CA, FL, NY, and TX)

Source: EIA, 1997 Residential Energy Consumption Survey

3.16 State Implementation Plans

Folder Name: SIP

This folder contains "Revision to the State Implementation Plan for the control of air pollution."

0204asip_pro.pdf Revision to the SIP for the control of air pollution (2002)
appa052902.pdf Appendix A

3.17 Summary Table

Folder Name: Summary Table

This folder contains the summary table of the result of this project. The table shows energy consumption before and after adopting IECC 2000 to new single family houses in 38 counties in Texas. Also, NOx emission reduction of 38 counties from adopting IECC 2000 is presented. In addition, building characteristics of 1999 standard and 2000 IECC compliant house in 38 counties are shown in this table.

Summary Table.xls

	County	Power Control Area[1]	Climate Zone[2]	No. of projected units[3]	Floor Area (ft2)[4]	1999 Average Energy Use (KWh)[5]	IECC 2001 Energy Use (KWh)[6]	1999 Peak Day(KWH/House)[7]	IECC Peak Day(KWH/House)[8]	Savings per house (kWh)[9]	Total Savings (MWh) 1999-IECC w/ 20% T&D Loss[10]	lb-NOx/MWh[11]	Total Savings		
													Tons/Year[12]	Tons/Day[13]	Peak Tons/Day[14]
Affected County	Bastrop	ERCOT	4	146	2,426	16,545	13,310	77.98	59.56	3,235	566.77	2.69	0.7623	0.0021	0.0036
	Bexar	San Antonio Public Service Bd	4	7,168	2,426	16,681	13,332	71.48	55.66	3,349	28,806.76	3.24	46.6669	0.1279	0.1837
	Caldwell	ERCOT	4	101	2,426	16,545	13,310	77.98	59.56	3,235	392.08	2.69	0.5274	0.0014	0.0025
	Comal	ERCOT	4	1,111	2,426	16,681	13,332	71.48	55.66	3,349	4,464.89	2.69	6.0053	0.0165	0.0236
	Ellis	TXU	5	649	2,426	15,465	12,448	82.47	61.45	3,017	2,349.64	3.34	3.9239	0.0108	0.0228
	Gregg	SWEPCO	6	194	2,548	13,139	11,258	65.34	52.74	1,881	437.90	2.68	0.5870	0.0016	0.0033
	Guadalupe	ERCOT	4	478	2,426	16,681	13,332	71.48	55.66	3,349	1,920.99	2.69	2.5837	0.0071	0.0102
	Harrison	SWEPCO	6	33	2,548	13,139	11,258	65.34	52.74	1,881	74.49	2.68	0.0999	0.0003	0.0006
	Hays	ERCOT	5	737	2,426	16,662	13,160	76.83	58.28	3,502	3,097.17	2.69	4.1657	0.0114	0.0184
	Johnson	TXU	5	629	2,426	15,465	12,448	82.47	61.45	3,017	2,277.23	3.34	3.8030	0.0104	0.0221
	Kaufman	TXU	6	218	2,426	15,725	12,419	78.10	58.40	3,306	864.85	3.34	1.4443	0.0040	0.0072
	Nueces	CRI	3	841	2,548	14,354	12,651	63.46	56.11	1,703	1,718.67	2.68	2.3039	0.0063	0.0083
	Parker	TXU	6	302	2,426	15,725	12,419	78.10	58.40	3,306	1,198.09	3.34	2.0008	0.0055	0.0099
	Rockwall	TXU	6	1,111	2,426	15,725	12,419	78.10	58.40	3,306	4,407.56	3.34	7.3606	0.0202	0.0366
	Rusk	SWEPCO	5	17	2,548	13,139	11,253	65.34	52.97	1,886	38.47	2.68	0.0516	0.0001	0.0003
	San Patricio	CRI	3	218	2,548	14,354	12,651	63.46	56.11	1,703	445.50	2.68	0.5972	0.0016	0.0021
	Smith	TXU	5	465	2,548	13,139	11,253	65.34	52.97	1,886	1,052.39	3.34	1.7575	0.0048	0.0096
	Travis	Austin Energy	5	5,922	2,426	16,662	13,160	76.83	58.28	3,502	24,886.61	1.44	17.9184	0.0491	0.0791
	Upshur	SWEPCO	6	17	2,548	13,139	11,258	65.34	52.74	1,881	38.37	2.68	0.0514	0.0001	0.0003
	Victoria	CRI	3	156	2,548	13,923	12,251	67.25	60.21	1,672	313.00	2.68	0.4196	0.0011	0.0015
	Williamson	TXU	5	4,111	2,426	16,662	13,160	76.83	58.28	3,502	17,276.07	2.68	23.1586	0.0634	0.1022
	Wilson	ERCOT	4	16	2,426	16,681	13,332	71.48	55.66	3,349	64.30	2.69	0.0865	0.0002	0.0003
Nonattain-ment County	Brazoria	Reliant Energy HL & P	3	2,008	2,548	13,740	11,859	66.52	55.568	1,881	4,532.46	1.88	4.2605	0.0117	0.0207
	Chambers	EGS	4	318	2,548	12,913	11,297	59.02	49.96	1,616	616.67	2.68	0.8266	0.0023	0.0039
	Collin	TXU	5	9,639	2,426	15,725	12,419	78.10	58.40	3,306	38,239.84	3.34	63.8605	0.1750	0.3172
	Dallas	TXU	5	8,595	2,426	15,465	12,448	82.47	61.45	3,017	31,117.34	3.34	51.9660	0.1424	0.3017
	Denton	TXU	6	5,338	2,426	15,725	12,419	78.10	58.40	3,306	21,176.91	3.34	35.3654	0.0969	0.1757
	El Paso	EL PASO Electric Company	6	3,098	2,426	16,085	12,684	76.74	56.52	3,401	12,643.56	2.68	16.9487	0.0464	0.0839
	Fort Bend	Reliant Energy HL & P	4	1,049	2,548	13,093	11,467	61.75	51.80	1,626	2,046.81	1.88	1.9240	0.0053	0.0098
	Galveston	Reliant Energy HL & P	3	2,338	2,548	13,740	11,859	66.52	55.568	1,881	5,277.33	1.88	4.9607	0.0136	0.0241
	Hardin	EGS	4	19	2,548	12,913	11,297	59.02	49.96	1,616	36.84	2.68	0.0494	0.0001	0.0002
	Harris	Reliant Energy HL & P	4	19,183	2,548	13,093	11,467	61.75	51.80	1,626	37,429.87	1.88	35.1841	0.0964	0.1795
	Jefferson	EGS	4	610	2,548	12,913	11,297	59.02	49.96	1,616	1,182.91	2.68	1.5857	0.0043	0.0074
	Liberty	EGS	4	213	2,548	12,913	11,297	59.02	49.96	1,616	413.05	2.68	0.5537	0.0015	0.0026
	Montgomery	EGS	4	4,032	2,548	13,093	11,467	61.75	51.80	1,626	7,867.24	2.68	10.5460	0.0289	0.0538
	Orange	EGS	4	172	2,548	12,913	11,297	59.02	49.96	1,616	333.54	2.68	0.4471	0.0012	0.0021
	Tarrant	TXU	5	10,358	2,426	15,465	12,448	82.47	61.45	3,017	37,500.10	3.34	62.6252	0.1716	0.3636
	Waller	Reliant Energy HL & P	4	22	2,548	13,093	11,467	61.75	51.80	2,047	54.04	1.88	0.0508	0.0001	0.0002
	TOTAL									2,517	297,160.32		417.4298	1.1436	2.0947

Table 5: NOx reduction potential from implementation of 2000 IECC/IRC in type A.1 residential buildings in non-attainment/affected counties.

	County	TMY2[15]	Division (East or West)[16]	1999 Average					IECC 2001				
				Area %	Glazing U-value	SHGC	Roof Insulation	Wall Insulation	Area %	Glazing U-value	SHGC	Roof Insulation	Wall Insulation
Affected County	Bastrop	Austin	West	23.69	1.11	0.71	26.75	14.18	23.69	0.52	0.40	30.00	13.00
	Bexar	San Antonio	West	23.69	1.11	0.71	26.75	14.18	23.69	0.52	0.40	30.00	13.00
	Caldwell	Austin	West	23.69	1.11	0.71	26.75	14.18	23.69	0.52	0.40	30.00	13.00
	Comal	San Antonio	West	23.69	1.11	0.71	26.75	14.18	23.69	0.52	0.40	30.00	13.00
	Ellis	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.50	0.40	38.00	13.00
	Gregg	Lufkin	East	15.28	1.11	0.71	27.08	13.99	15.28	0.60	0.40	30.00	13.00
	Guadalupe	San Antonio	West	23.69	1.11	0.71	26.75	14.18	23.69	0.52	0.40	30.00	13.00
	Harrison	Lufkin	East	15.28	1.11	0.71	27.08	13.99	15.28	0.60	0.40	30.00	13.00
	Hays	Austin	West	23.69	1.11	0.71	26.75	14.18	23.69	0.50	0.40	38.00	13.00
	Johnson	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.50	0.40	38.00	13.00
	Kaufman	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.46	0.40	38.00	16.00
	Nueces	Corpus Chrsti	East	15.28	1.11	0.71	26.75	14.18	15.28	0.75	0.40	19.00	11.00
	Parker	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.46	0.40	38.00	16.00
	Rockwall	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.46	0.40	38.00	16.00
	Rusk	Lufkin	East	15.28	1.11	0.71	27.08	13.99	15.28	0.65	0.40	30.00	13.00
	San Patricio	Corpus Chrsti	East	15.28	1.11	0.71	26.75	14.18	15.28	0.75	0.40	19.00	11.00
	Smith	Lufkin	East	15.28	1.11	0.71	27.08	13.99	15.28	0.65	0.40	30.00	13.00
	Travis	Austin	West	23.69	1.11	0.71	26.75	14.18	23.69	0.50	0.40	38.00	13.00
	Upshur	Lufkin	East	15.28	1.11	0.71	27.08	13.99	15.28	0.60	0.40	30.00	13.00
	Victoria	Victoria	East	15.28	1.11	0.71	26.75	14.18	15.28	0.75	0.40	19.00	11.00
	Williamson	Austin	West	23.69	1.11	0.71	26.75	14.18	23.69	0.50	0.40	38.00	13.00
	Wilson	San Antonio	West	23.69	1.11	0.71	26.75	14.18	23.69	0.52	0.40	30.00	13.00
Nonattainment County	Brazoria	Houston	East	15.28	1.11	0.71	26.75	14.18	15.28	0.75	0.40	19.00	11.00
	Chambers	Port Arthur	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00
	Collin	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.46	0.40	38.00	16.00
	Dallas	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.50	0.40	38.00	13.00
	Denton	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.46	0.40	38.00	16.00
	El Paso	El Paso	West	23.69	1.11	0.71	26.75	14.18	23.69	0.46	0.40	38.00	16.00
	Fort Bend	Houston	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00
	Galveston	Houston	East	15.28	1.11	0.71	26.75	14.18	15.28	0.75	0.40	19.00	11.00
	Hardin	Port Arthur	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00
	Harris	Houston	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00
	Jefferson	Port Arthur	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00
	Liberty	Port Arthur	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00
	Montgomery	Houston	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00
	Orange	Port Arthur	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00
	Tarrant	Fort Worth	West	23.69	1.11	0.71	26.75	14.18	23.69	0.50	0.40	38.00	13.00
	Waller	Houston	East	15.28	1.11	0.71	27.08	13.99	15.28	0.75	0.40	26.00	13.00

Table 6: Simulation input definitions for type A.1 residential buildings in non-attainment/affected counties.

3.18 TNRCC Report

Folder Name: TNRCC Report

This folder contains ESL's annual report to the Texas Natural Resource Conservation Commission (TNRCC).

TEXAS' SENATE BILL 5 LEGISLATION FORREDUCING POLLUTION IN NONATTAINMENT AND AFFECTED AREAS.