Detailed Stringency Analysis of Proposed Amendments to Chapter 11 of the 2015 IRC and the Residential Provisions in the 2015 IECC that were Submitted to the Texas State Energy Conservation Office (SECO) During July 4 – August 4, 2014 Comment Period

Prepared for
Texas State Energy Conservation Office (SECO)

A Report

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EXECUTIVE SUMMARY

The purpose of this analysis was to perform an assessment of several proposed amendments that were received as part of the review process conducted by the Texas State Energy Conservation Office (SECO). The proposed amendments were received from the Texas Association of Builders (TAB) and Fox Energy Specialists.

The proposed amendments are described below:

1. Modifications to Section N1102.4, 2015 IRC and Section R402.4, 2015 IECC. This amendment is a comprehensive amendment, which provides flexibility for meeting the energy code requirements while maintaining the energy performance. It will provide a "true" unrestricted performance path that will allow for cost-optimized construction of an energy equivalent house.
2. Modifications to Section N1101.4, 2015 IRC and to Section R102.1.1, 2015 IECC. This proposed amendment eliminates the need to meet all mandatory requirements identified by the IRC/IECC as long as the program exceeds the energy-efficiency levels that are required.
3. Additions to text in Section N1101.6 and Section N1102.3.3, 2015 IRC, and Section R202 and Section R402.3.3, 2015 IECC – The proposed amendment allows for the use of overhangs to meet the solar heat gain coefficient requirements within the IECC.
4. Modifications to Section N1102.4, 2015 IRC, and Section R402.4, 2015 IECC – This proposed amendment eliminates the need to test dwelling units individually and allow the builders to test the entire multi-family building structure as a whole, as is done in commercial buildings.
5. Modifications to N1102.4.1.2 and Table N1105.5.2(1) 2015 IRC, and Section 402.4.1.2 and Table R405.5.2(1), 2015 IECC – The proposed amendment modifies the requirement from 3 ACH_{50} to 4 ACH_{50} in Climate-Zones 3 through 8.
6. Modifications to Chapter 11, N1102.4, 2015 IRC and to Section R402.4, 2015 IECC – The proposed amendment allows builders to trade improvements in other building energy components for less stringent building envelope pressure test results. This performance option provides flexibility in meeting the air tightness requirements and provides options for recovering unexpected air tightness test failure.
7. Modifications to Table N1102.1.2 and Table 1102.1.4 2015 IRC, Tables R402.1.1 and Table R402.1.3, 2015 IECC – This proposed amendment replaces the 2015 IECC Tables R402.1.2 and R402.1.4 in the residential section of the 2015 with Table 402.1.1 and Table 402.1.3 of the 2009 IECC.
8. This amendment reduces the basement wall insulation values requirements in Climate Zone 5, to a more reasonable R-value/U-factor based on values acceptable to both NAHB and DOE in the 2009 IRC.
9. Modifications to Table N1102.1.2 and Table 1102.1.4 2015 IRC, Tables R402.1.1 and Table R402.1.3, 2015 IECC – This proposed amendment reinstates the appropriate minimum ceiling R-values in Climate Zones 2, 3, 4 and 5 to those published in the 2009 IRC, Chapter 11.
10. Modifications to Table N1102.1.1 , 2015 IRC, Tables R402.1.1, 2015 IECC – This proposed amendment changes the Climate Zone 4 SHGC back to N/R since the addition of a prescriptive restriction for the SHGC of 0.40 is not a requirement that saves energy.
11. Modifications to Table N1102.1.1 and Table N1102.1.3 , 2015 IRC, Table R402.1.1 and Table 402.1.3, 2015 IECC – This proposed amendment reinstates the appropriate minimum wall assembly R-values / U-factors in Climate Zone 3 and 4 published in the 2009 IECC.
12. This amendment reinstates the appropriate minimum wall assembly R-values/U-factors in Climate Zones 6, 7 and 8 as published in the 2009 IRC.
13. Modifications to Table N1105.5.2(1), 2015 IRC, Table R405.5.2(1), 2015 IECC – This proposed amendment reinstates the performance option in the IRC Chapter 11 to reduce the prescriptive

requirements by installing HVAC equipment with higher energy-efficiency performance ratings than required by the code.

14. Modifications to Table N1105.5.2 (1), 2015 IRC, Table R405.5.2 (1), 2015 IECC – This proposed amendment provides the building designer the ability to reduce window area and get credit for the energy saved.
15. Modifications to Table N1102.1.2, 2015 IRC, Table R402.1.2, 2015 IECC – The proposed amendment proposes changes to the wood framed wall insulation specification as identified in Table 402.1.2 of the 2015 IECC to an R-15 for Climate Zones 2, 3 and 4.
16. Modifications to Section N1102.4.1.2, 2015 IRC, Section R402.4.1.2, 2015 IECC – The proposed amendment changes the air infiltration testing requirements as identified in Section R402.4.1.2 of the 2015 IECC to 5 ACH50 for all Texas Climate Zones.
17. Modifications to Section N1106, 2015 IRC, Section R406, 2015 IECC – The proposed amendment amends the Energy Rating Index Compliance Alternatives as adopted in Section R406 of the 2015 IECC to more realistic scores as proposed in a joint study conducted by the Natural Resources Defense Council (NRDC), Leading Builders of America (LBA), Institute for Market Transformation (IMT), and Britt/ Makela Group, Inc (BMG).

A stringency analysis was performed to assess the incorporation of these proposed amendments into the 2015 code[1]. The analysis was conducted in two steps. In the first step the amended 2015 IECC was compared to the Texas Building Energy Performance Standard (TBEPS)[2]. The conclusions are presented below:

1. The stringency of the proposed comprehensive amendment 1 was assessed on an individual basis in amendments 6, 13 and 14;
2. The proposed amendment 2 is as stringent as TBEPS if the above-code energy efficiency program is the US EPA ENERGY STAR;
3. The proposed amendment 3 is as stringent as the TBEPS provided the values in the proposed Table R402.3.3 are equivalent to or more stringent than the values in Table 5.5.4.4.1, SHGC Multipliers for Permanent Projections found in ASHRAE Standard 90.1-2013;
4. The proposed amendment 4 is as stringent as TBEPS for R-2 occupancies provided it meets all the requirements of Section C402.5 of the 2015 IECC;
5. The proposed amendments 5, 6, 7, 9, 10, 11, 15 and 16 are as stringent as the TBEPS;
6. The proposed amendment 14 meets the TBEPS for a house with typical conditioned floor and window dimensions in Texas. For certain other cases, the proposed amendment is less stringent than the TBEPS and the 2015 IECC;
7. The modifications proposed by amendments 8 and 12 pertain to Climate Zones that are outside Texas;
8. The proposed amendment 13 meets the annual energy cost performance requirement of the TBEPS;
9. The stringency of proposed amendment 17 cannot be assessed because the ERI is currently not a requirement in the TBEPS.

In the second step, the proposed amendments were compared to the published 2015 IECC code.

[1] The 2015 code includes specifications in Chapter 11 of the 2015 IRC and specifications in Chapter 4[RE] of the 2015 IECC.

[2] Texas Building Energy Performance Standard (TBEPS) is based on Chapter 11 of the 2009 IRC and Chapter 4 of the 2009 IECC.

This report is organized in the following order:

Section 1: Provides a brief overview of the task.

Section 2: Lists the proposed amendments that are assessed by this report.

Section 3: Describes the TBEPS and 2015 IECC compliant base-case simulation models that were used for this assessment.

Section 4: Presents the stringency analysis that was performed to assess the impact of implementing the proposed amendments to the 2015 code and comparing the proposed amendments with both the TBEPS and the 2015 code compliant base-case.

Section 5: Provides the conclusions from the study.

Table of Contents

List of Tables

List of Figures

1. OVERVIEW

In 2007, the 80th legislature mandated the Energy Systems Laboratory (Laboratory) to take part in Texas rule-making process. As detailed in the Health and Safety Code, Chapter 388, Texas Building Energy Performance Standards, Sec. 388.003 (b-1), the Laboratory is required to submit written recommendations to the State Energy Conservation Office (SECO) on whether the energy efficiency provisions of the latest published editions of the International Residential Code (IRC) or the International Energy Conservation Code (IECC) for residential or commercial energy efficiency and air quality are equivalent to or more stringent than the provisions of editions previously adopted as the Texas Building Energy Performance Standards (TBEPS). As according to the Health and Safety Code, Section 388.003 (b-3), the Laboratory is also mandated to consider all the comments collected by SECO from persons who have an interest in the adoption of energy codes on the new code editions.

This report includes a detailed analysis of the proposed amendments to Chapter 11 of the 2015 IRC and Chapter 4 [RE] of the 2015 IECC that were submitted to SECO during the July 4 – August 4, 2014 comment period. The proposed amendments were compared to the TBEPS compliant base-case building. The proposed amendments were also compared to the 2015 code compliant base-case building. The analysis was conducted using Version 4.01.11 of the BDL input file prepared for the IC3. The performance path as described in 2009 and 2015 IECC was used for the analysis. Seventeen such proposed amendments were received and are described in the next section.

2. DESCRIPTION OF THE PROPOSED AMENDMENTS

The proposed amendments were received from the Texas Association of Builders (TAB) and Fox Energy Specialists. The proposed amendments are described below:

1. Modifications to Chapter 11, N1102.4, 2015 IRC and Section R402.4, 2015 IECC. This amendment is a comprehensive amendment, which provides flexibility for meeting the energy code requirements while maintaining the energy performance. It will provide a "true" unrestricted performance path that will allow for cost-optimized construction of an energy equivalent house.
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16. Modifications to Section N1102.4.1.2, 2015 IRC, Section R402.4.1.2, 2015 IECC – The proposed amendment changes the air infiltration testing requirements as identified in Section R402.4.1.2 of the 2015 IECC to 5 ACH50 for all Texas Climate Zones.
17. Modifications to Section N1106, 2015 IRC, Section R406, 2015 IECC – The proposed amendment amends the Energy Rating Index Compliance Alternatives as adopted in Section R406 of the 2015 IECC to more realistic scores as proposed in a joint study conducted by the Natural Resources Defense Council (NRDC), Leading Builders of America (LBA), Institute for Market Transformation (IMT), and Britt/ Makela Group, Inc (BMG).

Detailed description of the proposed amendments is presented in Appendix A of this report. A stringency test was performed to assess the incorporation of these amendments into the 2015 IECC. The stringency test involves comparing the changes specified by the proposed amendment to the corresponding TBEPS compliant base-case building. The stringency test was also conducted by comparing the 2015 code with proposed amendments to the published 2015 code. A description of both the TBEPS compliant base-case and the published 2015 code base-case are presented in the next section.

3. DESCRIPTION OF THE TBEPS AND 2015 COMPLIANT BASE-CASE BUILDINGS USED FOR THE ANALYSIS

An analysis was performed comparing provisions for the performance section of the 2015 and 2009 IECC. Accordingly, Section R405 of the 2015 code and Section 405 of the 2009 code were considered.

The analysis was conducted using a simple residential house model that was designed to represent typical residential construction in Texas. IC3 BDL Version 4.01.11 was used to perform the analysis. According to the provisions outlined in the three codes for performance based compliance, the analysis includes the

energy consumption from heating, cooling and hot water heating only as accounted for at source[3]. The analysis was carried out for the three counties, which represent the three climate zones in Texas: Harris (Climate Zone 2), Tarrant (Climate Zone 3) and Potter (Climate Zone 4). The climate zones and selected counties are presented in Figure 1. TMY2 weather data for the three counties was used in the analysis. The assumptions adopted for the analysis and the results are presented in the sections below.

A simple model of the house was designed to represent the typical characteristics of residential construction in Texas. The base-case house implemented in this analysis was a single-family, single-story house with three bedrooms and a conditioned floor area of 2,500 ft^2. The ducts were positioned in an unconditioned ventilated attic. The front of the house faced south. The base-case model had a slab-on-grade floor construction. The window-to-wall area ratio (WWAR) was arbitrarily set at 15%. No exterior shading was implemented in the base-case model. The specifications are presented in Table 1 and are discussed in the sections that follow.

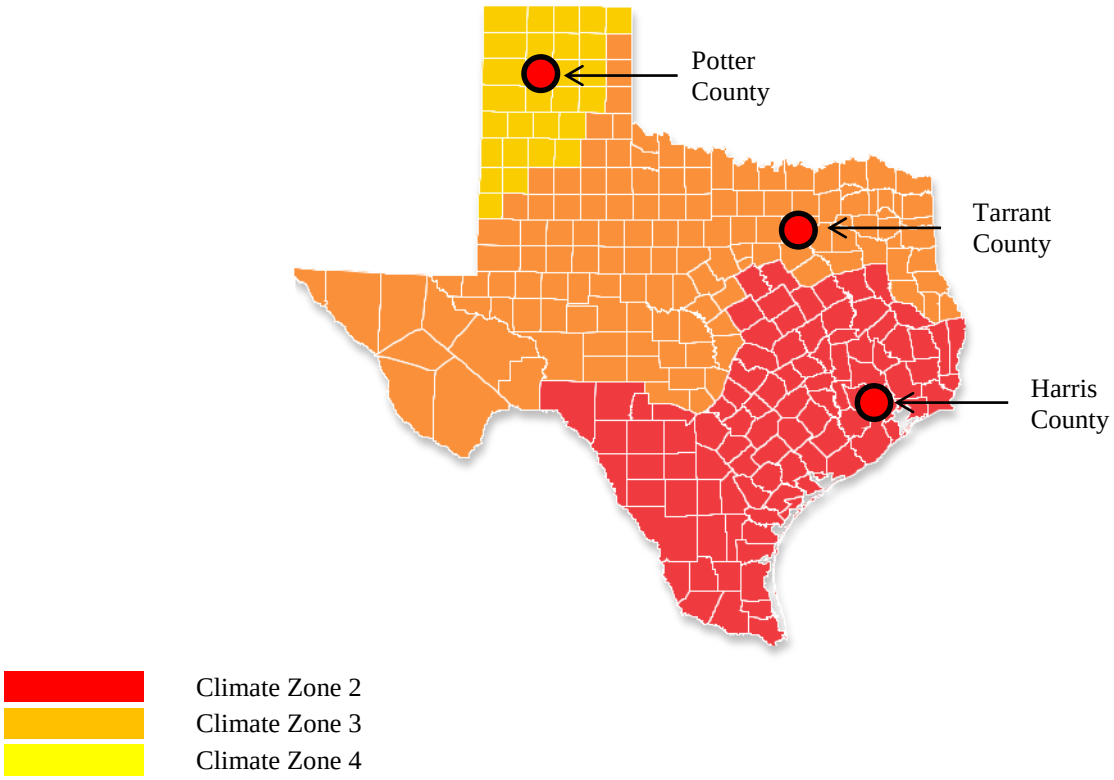


Figure 1: IECC Climate Zone Classifications and the Three Selected Counties

[3] The source energy multiplier of 3.16 was used for electricity and the source energy multiplier of 1.1 was used for natural gas (Section 405.3, IECC 2009).

Table 1: Description of the base-case residential building used in the analysis of the provisions for the simulated performance alternative in the 2009 and 2015 IECC

Characteristics	2009 IECC STANDARD REFERENCE HOUSE				2015 IECC STANDARD REFERENCE HOUSE			
	Assumptions and Specifications			Information Source 2009 IECC	Assumptions and Specifications			Information Source 2015 IECC
	CZ 2A (Harris)	CZ 3A (Tarrant)	CZ 4B (Potter)		CZ 2A (Harris)	CZ 3A (Tarrant)	CZ 4B (Potter)	
CONSTRUCTION								
Foundation Floor: Type	As proposed Slab-on-Grade				As proposed Slab-on-Grade			
Foundation Floor: Perimeter Insulation	R-0	R-0	R-10, 2ft	Table 402.1.1	R-0	R-0	R-10, 2ft	Table R402.1.2
Roof: Type	Composition shingle on wood sheathing			Table 405.5.2(1)	Composition shingle on wood sheathing			Table R405.5.2(1)
Roof: Configuration	Proposed Design			Table 405.5.2(1)	Proposed Design			
Roof: Absorptance	0.75			Table 405.5.2(1)	0.75			Table R405.5.2(1)
Roof: Emittance	0.9			Table 405.5.2(1)	0.9			Table R405.5.2(1)
Ceiling: Type	Wood Frame			Table 405.5.2(1)	Wood Frame			Table R405.5.2(1)
Ceiling: Insulation (Btu/hr-sq.ft.-°F)	0.035	0.035	0.03	Table 405.5.2(1) Table 402.1.3	0.03	0.03	0.026	Table R405.5.2(1) Table R402.1.4
Wall: Construction	Wood Frame			Table 405.5.2(1)	Wood Frame			Table R405.5.2(1)
Wall: Absorptance	0.75			Table 405.5.2(1)	0.75			Table R405.5.2(1)
Wall: Emittance	0.9			Table 405.5.2(1)	0.9			Table R405.5.2(1)
Wall: Insulation (Btu/hr-sq.ft.-°F)	U-0.082	U-0.082	U-0.082	Table 405.5.2(1)	U-0.084	U-0.060	U-0.060	Table R405.5.2(1) Table R402.1.4
Glazing: U-Factor (Btu/hr-sq.ft.-°F)	0.65	0.5	0.35	Table 405.5.2(1) Table 402.1.1	0.4	0.35	0.35	
Solar Heat Gain Coefficient (SHGC)	0.3	0.3	NR (0.4)	Table 405.5.2(1) Table 402.1.1	0.25	0.25	0.4	
Window: Area	15%			Table 405.5.2(1)	15%			Table R405.5.2(1)
Interior Shading	Summer = 0.7 (All hours when heating is required) Winter = 0.85 (All hours when heating is required)			Table 405.5.2(1)	Interior shade fraction: 0.92 - (0.21 x SHGC for standard reference design house)			Table R405.5.2(1)
Exterior Shading	None			Table 405.5.2(1)	None			Table R405.5.2(1)
Skylights	None			Table 405.5.2(1)	None			Table R405.5.2(1)
Doors: Area	40 sqft, North Orientation			Table 405.5.2(1)	40 sqft, North Orientation			Table R405.5.2(1)
Doors: U-value	0.65	0.5	0.35	Table 405.5.2(1)	0.4	0.35	0.35	Table R405.5.2(1)

Table 1: Continued

Characteristics	2009 IECC STANDARD REFERENCE HOUSE				2015 IECC STANDARD REFERENCE HOUSE			
	Assumptions and Specifications			Information Source 2009 IECC	Assumptions and Specifications			Information Source 2015 IECC
	CZ 2A (Harris)	CZ 3A (Tarrant)	CZ 4B (Potter)		CZ 2A (Harris)	CZ 3A (Tarrant)	CZ 4B (Potter)	
SPACE CONDITIONS								
Air Exchange Rate	SLA = 0.00036			Table 405.5.2(1)	5 ACH_{50}	3 ACH_{50}	3 ACH_{50}	Table R405.5.2(1)
Mechanical Ventilation	None			Table 405.5.2(1)	0.01 x CFA + 7.5 x (Nbr+1) CFM 0.03942 x CFA + 29.565 x (Nbr + 1) kWhr/yr			Table R405.5.2(1)
Space Temperature Setpoint	72°F Heating, 75°F Cooling, No set-back			Table 405.5.2(1)	72°F Heating, 75°F Cooling, No set-back			Table R405.5.2(1)
Internal Heat Gains	Igain = 17,900 + 23.8 x CFA + 4104 x Nbr BTU/day			Table 405.5.2(1)	Igain = 17,900 + 23.8 x CFA + 4104 x Nbr BTU/day			Table R405.5.2(1)
MECHANICAL SYSTEMS								
HVAC System Type	As Proposed Cooling: Electric Heating: Natural gas / Heat pump			Table 405.5.2(1)	As Proposed Cooling: Electric Heating: Natural gas / Heat pump			Table R405.5.2(1)
HVAC System Efficiency	As Proposed AC: SEER 13 Gas furnace: 0.78 AFUE Heat pump: 7.7			Table 405.5.2(1)	As Proposed AC: SEER 13 Gas furnace: 0.78 AFUE Heat pump: 7.7			Table R405.5.2(1)
Cooling Capacity (Btu/hr)	500 ft^2 / ton of refrigeration			Table 405.5.2(1)	500 ft^2 / ton of refrigeration			Table R405.5.2(1)
Heating Capacity (Btu/hr)				Table 405.5.2(1)				
DHW System Type	Gas Electric			Table 405.5.2(1)	Gas Electric			Table R405.5.2(1)
DHW Heater Energy Factor	As proposed Gas EF: 0.67 - 0.0019V Electric EF: 0.97 - 0.00132V			Table 405.5.2(1)	As proposed Gas EF: 0.67 - 0.0019V Electric EF: 0.97 - 0.00132V			Table R405.5.2(1)
Thermal Distribution	Tested: Leakage to the outside of 8 CFM/100 sqft of CFA Tested Duct Location: Unconditioned attic			Section 403.2.2 Table 405.5.2(1) Table 405.5.2(2)	Tested: Total leakage of 4 CFM/100 sqft of CFA Tested Duct Location: Unconditioned attic			Table R405.5.2(1)
Duct Insulation	Supply: R-8 Return: R-6			Section 405.2	Supply: R-8 Return: R-8			Section 403.3.1

3.1 Building Envelope

The envelope is described in terms of the following building components: above grade walls, ceilings, roofs, attics, vertical glazing and opaque doors. The above grade walls were wood frame walls. The overall U-factor for wall assembly set for the three codes is described below:

- For the 2009 code, an overall U-factor of 0.082 was modeled for the three climate zones.
- For the 2015 code, an overall U-factor of 0.084 was modeled for Climate Zone 2 and a U-factor of 0.060 was modeled for Climate Zone 3 and 4.

The ceilings were also wood frame construction, with the insulation located above the horizontal ceiling. The overall U-factor for ceilings set for the three codes is described below:

- For the 2009 code, the overall U-factor of the ceiling construction was set at 0.035 for Climate Zone 2 and 3, and 0.030 for Climate Zone 4.
- For the 2015 code, the overall U-factor for the ceiling construction was set at 0.03 for Climate Zone 2 and 3, and 0.026 for Climate Zone 4.

The building had a slab-on-grade floor construction, which is typical across the three climate zones in the state. The insulation for slab-on-grade set for the three codes is described below:

- For the 2009and 2015 codes, the slab-on-grade floor insulation was set at R-0 for Climate Zone 2 and 3, and R-10 for Climate Zone 4.

The glazing for the base-case house was arbitrarily set at 15% of conditioned wall area and was equally distributed on all four orientations (N, E, S & W). No external shading was modeled for the base-case building. The overall SHGC and U-factor for vertical glazing implemented for the three codes is described below:

- For the 2009 code, a SHGC of 0.3 was assumed in Climate Zone 2 and 3. A SHGC of 0.4 was assumed In Climate Zone 4. The fenestration had a U-factor of 0.65 for Climate Zone 2, a U-factor of 0.5 for Climate Zone 3, and a U-factor of 0.35for Climate Zone 4.
- For the 2015 code, a SHGC of 0.3 was assumed in Climate Zone 2 and 3. A SHGC of 0.4 was assumed In Climate Zone 4. The fenestration had a U-factor of 0.65 for Climate Zone 2, a U-factor of 0.5 for Climate Zone 3, and a U-factor of 0.35for Climate Zone 4.

3.2 Building Space Conditions

The space conditions included: space temperature set-points, air exchange rate, mechanical ventilation, and internal gains. The space temperature set points were set at 72°F for space heating and 75°F for space cooling across the three codes. No thermostat set back was simulated. A vented, unconditioned attic was modeled above the ceiling of the conditioned space. The attic was vented, with 1 ft^2 of leakage area per 300 ft^2 of ceiling area assumed across the three codes.

The infiltration leakage rates assumed for the three codes is described below:

- In the 2009 code, the infiltration leakage rate was assumed to be 0.00036.
- In the 2015 codes, the infiltration leakage rate for Climate Zone 2 was set to 5 ACH_{50} and for Climate Zone 3 and 4 was set to be 3 ACH_{50}.

Mechanical ventilation was incorporated along with the infiltration rates in certain cases. A 'supply-only' system was assumed to provide mechanical ventilation. The mechanical ventilation rate was calculated using the equation provided in the codes:

$$Mech.\ Ventilation\ (CFM) = 0.01 \times CFA + 7.5 \times (Nbr + 1)$$

Where, CFA = Conditioned floor area, and
Nbr = Number of bedrooms.
Additional energy consumption from mechanical ventilation was added to the annual energy consumption from ventilation fans. The additional energy consumption from mechanical ventilation was calculated using the equation provided in the codes:

$$Mech.\ Ventilation\ (kWhr/yr) = 0.03942 \times CFA + 29.565 \times (Nbr + 1)$$

Where, CFA = Conditioned floor area, and
Nbr = Number of bedrooms.
The mechanical ventilation rates assumed for the three codes are described below:

- No mechanical ventilation was assumed for the three climate zones in the 2009 code.
- No mechanical ventilation was assumed for Climate Zone 2 in the 2015 codes.
- Mechanical ventilation rates were incorporated along with the infiltration rates in Climate Zone 3 and 4 in the 2015 codes.

The internal heat gains across the three codes were calculated using the equation:

$$Igain = 17{,}900 + 23.8 \times CFA + 4104 \times Nbr.\ (Btu/day\ per\ dwelling\ unit)$$

Where, CFA = Conditioned floor area, and
Nbr = Number of bedrooms.
The value for internal heat gain was set using the equation described above. The schedules for internal heat gain are set as constant for all hours of the day.

3.3 Building Mechanical Systems

The mechanical systems variables included: duct leakage, duct insulation, heating and cooling system efficiencies and domestic water heating systems efficiencies. The base-case house was assumed to have electric cooling and natural gas heating. For the base-case house with ducts positioned in the attic, the duct leakage rates are described below:

- In the 2009 code, the duct leakage was modeled at a leakage rate of 8 CFM to the outside per 100 ft^2 of conditioned floor area.
- In the 2015 code, the duct leakage was set at a total leakage rate of 4 CFM per 100 ft^2 of conditioned floor area.

The duct insulation rates are described below:

- In the 2009 code, the value of supply duct insulation and was set at R-8 and for return duct insulation was set at R-6.
- In the 2015 code, the value of both the supply and return duct insulation and was set at R-8.

The cooling system fuel type was electricity, with minimum efficiency set at SEER 13 implemented in the three codes according to the current NAECA standards. The cooling system for the base-case house for the three codes in was sized using 500 ft^2 / ton of cooling rule-of-thumb.

Two options were modeled for the space heating systems: natural gas furnace (i.e. electric-gas) and electric air-source heat pump (all-electric). The natural gas furnace was modeled with a minimum efficiency of 0.78 AFUE implemented in the three codes according to the current NAECA standards. The natural gas furnace was modeled with a minimum efficiency of 0.78 AFUE implemented in the three codes according to the current NAECA standards. The heating system for the base-case house for the three codes in was sized using 500 ft^2 / ton of cooling rule-of-thumb.

Two options were modeled for domestic hot water heating systems: gas water heater for the electric-gas house and electric water heater for the all-electric house. The tank temperature was set at 120°F according to the requirement in the three codes. A 40 gallon tank was assumed for the analysis (ASHRAE 2003). The efficiency for gas water heater was calculated by the following equation implemented in the three codes:

$$\textit{Energy Factor for Natural Gas Fired Water Heaters} = 0.67 - 0.0019V$$

Where V = Storage capacity of the DHW tank
This results in a minimum efficiency of 0.594 for the base-case building with three bedrooms.
The efficiency for electric water heater was calculated by the following equation implemented in the three codes:

$$\textit{Energy Factor for Electric Water Heaters} = 0.97 - 0.00132V$$

Where V = Storage capacity of the DHW tank
This results in a minimum efficiency of 0.917 for the base-case building with three bedrooms.
Domestic hot water usage was calculated using the following equation:

$$\textit{Usage} = 30 + 10 \times \textit{Nbr (gal/day)}$$

Where Nbr = Number of bedrooms.

4. STRINGENCY ASSESSMENT OF THE PROPOSED AMENDMENTS

The analysis was conducted to assess the impact of the proposed amendments to the 2015 code on the TBEPS. The analysis also assessed the impact of the proposed amendments to the 2015code on the published 2015 code. The analysis was carried out by calculating a percent difference in the source energy consumption. For the comparison with the TBEPS base-case, source energy consumption was calculated as per specifications in the 2009 IECC. This comparison requires compliance with the 2009 IECC to be established using heating, cooling, and service water heating only. A factor of 3.16 was used to calculate the source energy generation for electricity consumption and a factor of 1.1 was used to calculate source energy generation for natural gas consumption reported at site. For the comparison with the 2015 code compliant base-case, source energy consumption was calculated as per specifications in the 2015 IECC, which is similar to the specifications in the 2009 IECC.

The sub-sections below describe the proposed amendments to the 2015 IECC citing the commenter, the analysis conducted to assess the stringency of this amendment with the TBEPS and the published 2015 code, the results, and finally the conclusion of the analysis.

4.1 Proposed Amendment 1

This proposed amendment to the 2015 IECC (2015 IRC) is a comprehensive amendment, which proposes to provide flexibility for meeting the energy code requirements while maintaining the energy performance. This proposed amendment consists of information from proposed amendments 6, 13 and 15. The proposed modifications are presented below:

- Modifications to Section R402.4, 2015 IECC (Chapter 11, N1102.4, 2015 IRC). The proposed amendment removes the maximum test values from mandatory testing requirement for air

leakage. The maximum test values are now reported in a separate section on leakage rates, which is prescriptive.

- Modifications to Table R402.4, 2015 IECC (Chapter 11, Table N1105.5.2 (1), 2015 IRC). The proposed amendment requires the glazing area of the standard reference house to be retained at 15% for all cases of glazing area in the proposed design house.
- Modifications to Table R402.4, 2015 IECC (Chapter 11, Table N1105.5.2 (1), 2015 IRC). The proposed amendment reinstates the trade-off option for heating, cooling and domestic hot water equipment by recommending federal minimum standards for equipment of the standard reference house.

The stringency of the proposed comprehensive amendment with both the TBEPS and 2015 IECC can was assessed on an individual basis when considering proposed amendments 6, 13 and 14.

4.2 Proposed Amendment 2

This proposed amendment proposes modifications to Section R102.1.1, 2015 IECC (Section N1101.4, 2015 IRC). The proposed modification to the code eliminates the need to meet all mandatory requirements identified by the IRC/IECC as long as the program exceeds the energy-efficiency levels that are required.

It was determined that removing the mandatory requirements in the 2015 IECC implies the removal of certain requirements that may impact the calculations utilized to demonstrate reduction in energy levels.

It was concluded that the proposed amendment is as stringent as the TBEPS if the energy efficiency program is the US EPA ENERGY STAR. The proposed amendment is less stringent than the 2015 IECC.

4.3 Proposed Amendment 3

This proposed amendment provides additions to text in Section R202 and Section R402.3.3, 2015 IECC (Section N1101.6 and Section N1102.3.3, 2015 IRC). The proposed modification allows for the use of overhangs to meet the solar heat gain coefficient requirements within the IECC.

The 2009 IECC and the 2015 IECC do not provide for the use of projection factors to show compliance with the code. However, Table 5.5.4.4.1, SHGC Multipliers for Permanent Projections, in ASHRAE Standard 90.1-2013 provides multipliers for fenestration SHGC when using permanent projections.

The proposed amendment is as stringent as the TBEPS and the 2015 IECC provided the values in the proposed Table R402.3.3 use multipliers that are equivalent to or more stringent than the values in Table 5.5.4.4.1, SHGC Multipliers for Permanent Projections found in ASHRAE Standard 90.1-2013.

4.4 Proposed Amendment 4

This proposed amendment proposes modifications to Section R402.4, 2015 IECC (Section N1102.4, 2015 IRC). The proposed modification eliminates the need to test dwelling units individually and allow the builders to test the entire multi-family building structure as a whole, as is done in commercial buildings. The proposed amendment introduces an exception to the provisions of R402.4 on air leakage in the 2015 code. The exception allows for dwelling units of R-2 occupancies (i.e. multi-family apartment units) and multiple single family dwelling units (i.e. townhomes) to comply with Section C402.5 in the 2015 IECC.

Section C402.5 on air leakage in the 2015 IECC provides specifications other than only testing requirements. These include requirements for air intakes, stairways and shafts as well as the provision for vestibules. Hence, complying with this section requires meeting all these requirements in addition to meeting the requirements for test results.

The proposed amendment is as stringent as the TBEPS and the 2015 IECC for R-2 occupancies provided it meets all the requirements of Section C402.5 of the 2015 IECC.

4.5 Proposed Amendment 5

This analysis was performed to evaluate the proposed amendment to modify Section 402.4.1.2 and Table R405.5.2 (1), 2015 IECC (Chapter 11, N1102.4.1.2 and Table N1105.5.2(1), 2015 IRC) by modifying the blower door test requirement from 3 ACH_{50} to 4 ACH_{50} for Climate Zones 3 through 8.

For this analysis, the modified leakage rates of 4 ACH_{50} were considered for three different house sizes. The impact of the modified leakage rates was compared to a corresponding TBEPS compliant base-case house with air leakage rates of 0.00036 SLA as prescribed by Table 405.5.2(1) of the 2009 IECC[4]. The impact of the modified leakage rates was also compared to a corresponding 2015 IECC compliant base-case house with air leakage rates of 3 ACH_{50} as prescribed by Table R405.5.2(1) of the 2015 IECC for Climate Zones 3 and 4. The analysis was performed for the Climate Zone 3 and Climate Zone 4 as described in the TBEPS.

Table 2 presents the difference in annual source energy consumption from implementing increased leakage rates in 2015 IECC compliant test-case when compared to the energy consumption obtained from the TBEPS compliant base-case. Table 3 presents the difference in annual source energy consumption from implementing increased leakage rates in 2015 IECC compliant test-case when compared to the corresponding energy consumption obtained from the 2015 IECC compliant base-case.

The proposed amendment is as stringent as the TBEPS. The proposed amendment is less stringent than the published 2015 IECC.

Table 2: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case Implementing Increased Leakage Rates with the TBEPS Compliant Base-Case

County	2009 IECC Climate Zones	House Size (ft^2)	% Difference in Total Energy Consumption (2009 IECC Source) Positive values indicate increase in stringency	
			Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Tarrant	**3**	1,000	7%	4%
		2,500	16%	11%
		5,000	21%	16%
Potter	**4**	1,000	12%	8%
		2,500	18%	12%
		5,000	24%	16%

[4] A 0.00036 SLA translates to 7ACH_{50}, which is the test value provided in Section 402.4..2.1 of the 2009 IECC.

Table 3: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case Implementing Increased Leakage Rates with the 2015 IECC Compliant Base-Case

County	2009 IECC Climate Zones	House Size (ft^2)	% Difference in Total Energy Consumption (2015 IECC Source) Positive values indicate increase in stringency	
			Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Tarrant	**3**	1,000	-2%	-1%
		2,500	-3%	-2%
		5,000	-5%	-3%
Potter	**4**	1,000	-2%	-1%
		2,500	-5%	-3%
		5,000	-6%	-4%

4.6 Proposed Amendment 6

The proposed amendment provides modifications to Section R402.4, 2015 IECC (Chapter 11, N1102.4, 2015 IRC). The proposed change allows builders to trade improvements in other building energy components for less stringent building envelope pressure test results. This performance option provides flexibility in meeting the air tightness requirements and provides options for recovering unexpected air tightness test failure.

The 2009 IECC and the 2015 IECC require mandatory testing results for air leakage. In order to demonstrate compliance, the 2009 IECC requires a blower door test measurement of 7 ACH_{50}. The 2015 IECC requires a measurement of 5 ACH_{50} for Climate Zone 1 and 2, and a 3 ACH_{50} for Climate Zones 3 through 8. The proposed amendment recommends that test air leakage rates be made prescriptive. However, no changes are proposed to the test air leakage rates described in Table R405.5.2 (1), which provides specifications for the performance path in the 2015 IECC. Hence, by following either prescriptive or performance path in the proposed amendment, test air leakage rates described in 2015 IECC have to be adhered to.

The proposed amendment is as stringent as the TBEPS and the 2015 IECC.

4.7 Proposed Amendment 7

This analysis was performed to evaluate the proposed amendment to modify Table R402.1.1 and Table R402.1.3, 2015 IECC (Table N1102.1.2 and Table 1102.1.4 2015 IRC). The proposed amendment replaces the information in Tables R402.1.2 and R402.1.4 in the residential section of the 2015 IECC (Table N1102.1.2 and Table 1102.1.4, 2015 IRC) with corresponding information in Table 402.1.1 and Table 402.1.3 of the 2009 IECC (Refer to TAB Proposed Amendment 7, Appendix for Table).

For this analysis, a 2015 IECC compliant house with modified envelope components was compared to a corresponding TBEPS compliant base-case house. In addition, the 2015 IECC compliant house with modified envelope components was compared to a corresponding 2015 IECC compliant base-case house. The analysis was performed for Climate Zone 2, 3 and 4 as described in the TBEPS.

Table 4 presents a difference in the annual energy consumption on replacing the content in Table R402.1.1 and Table R402.1.3 of the 2015 IECC with the information provided in Table 402.1.1 and Table

402.1.3 of the 2009 IECC for the three Climate Zones in Texas. The test case was compared to the corresponding TBEPS compliant base-case. Table 5 presents a difference in the annual energy consumption on replacing the content in Table R402.1.1 and Table R402.1.3 of the 2015 IECC with the information provided in Table R402.1.1 and Table R402.1.3 of the 2015 IECC for the three climate zones in Texas. The test case was compared to the corresponding 2015 IECC compliant base-case.

The proposed amendment is as stringent as the TBEPS. The proposed amendment is less stringent than the published 2015 IECC.

Table 4: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with Modified Envelope Components in Three Climate Zones with the TBEPS Compliant Base-Case

County	2009 IECC Climate Zones	% Difference in Total Energy Consumption (2009 IECC Source) Positive values indicate increase in stringency	
		Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Harris	**2**	3%	2%
Tarrant	**3**	9%	6%
Potter	**4**	16%	10%

Table 5: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with Modified Envelope Components in Three Climate Zones with the 2015 IECC Compliant Base-Case

County	2009 IECC Climate Zones	% Difference in Total Energy Consumption (2015 IECC Source) Positive values indicate increase in stringency	
		Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Harris	**2**	-7%	-5%
Tarrant	**3**	-12%	-8%
Potter	**4**	-8%	-5%

4.8 Proposed Amendment 8

This amendment reduces the basement wall insulation values requirements in Climate Zone 5, to a more reasonable R-value/U-factor based on values acceptable to both NAHB and DOE in the 2009 IRC.

This amendment is not applicable to the climate zones of Texas.

4.9 Proposed Amendment 9

This analysis was performed to evaluate the proposed amendment to modify, Tables R402.1.1 and Table R402.1.3, 2015 IECC (Table N1102.1.2 and Table 1102.1.4 2015 IRC). The proposed amendment reinstates the appropriate minimum ceiling R-values in Climate Zones 2, 3, 4 and 5 to those published in the Table 402.1.3 2009 IECC. The minimum ceiling R-values were changed from R-38 to R-30 (From U-

0.030 to 0.035) for Climate Zones 2 and 3; as well as from R-49 to R-38 (From U-0.026 to U-0.030) for Climate Zone 4 (Refer to TAB Proposed Amendment 9, Appendix for Table).

For this analysis, the 2015 IECC compliant test-case was updated with modified values for ceiling insulation and was compared to a corresponding TBEPS compliant base-case house. In addition, the modified 2015 IECC compliant test-case was compared to a corresponding 2015 IECC compliant base-case house. The analysis was performed for Climate Zone 2, Climate Zone 3 and Climate Zone 4 as described in the TBEPS.

Table 6 presents a difference in the annual energy consumption on replacing the content for ceiling insulation in Table R402.1.1 and Table R402.1.3 of the 2015 IECC with the corresponding values for ceiling insulation provided in Table 402.1.1 and Table 402.1.3 of the 2009 IECC for the three Climate Zones in Texas. The test-case was compared to the corresponding TBEPS compliant base-case. Table 7 presents a difference in the annual energy consumption on replacing the content for ceiling insulation in Table R402.1.1 and Table R402.1.3 of the 2015 IECC with the corresponding values for ceiling insulation provided in Table R402.1.1 and Table R402.1.3 of the 2012 IECC for the three Climate Zones in Texas. The test-case was compared to the corresponding 2015 IECC compliant base-case.

The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment is less stringent than the 2015 IECC compliant base-case.

Table 6: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with Modified Ceiling Insulation in Three Climate Zones with the TBEPS Compliant Base-Case

County	2009 IECC Climate Zones	% Difference in Total Energy Consumption (2009 IECC Source) Positive values indicate increase in stringency	
		Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Harris	**2**	8%	6%
Tarrant	**3**	17%	12%
Potter	**4**	20%	13%

Table 7: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with Modified Ceiling Insulation in Three Climate Zones with the 2015 IECC Compliant Base-Case

County	2009 IECC Climate Zones	% Difference in Total Energy Consumption (2015 IECC Source) Positive values indicate increase in stringency	
		Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Harris	**2**	-2%	-1%
Tarrant	**3**	-2%	-1%
Potter	**4**	-3%	-2%

4.10 Proposed Amendment 10

This analysis was performed to evaluate the proposed amendment to modify Table R402.1.2 of the 2015 IECC (Table N1102.1.1, 2015 IRC) by removing the specifications of the solar heat gain coefficient for Climate Zone 4.

For this analysis the specifications for window SHGC were changed from 0.4 as specified in Table R402.1.2, 2015 IECC (Table N1102.1.1, 2015 IRC) to 0.5, which is assumed to be the highest possible SHGC corresponding to the U-value specified in the 2015 IECC for Climate Zone 4 (NFRC 2014). The modified test-case was compared to a corresponding TBEPS compliant base-case house as well as the 2015 IECC compliant base-case house. The analysis was performed for Climate Zone 4 as described in the TBEPS.

Table 8 presents the difference in annual energy consumption from increasing the SHGC from 0.4 to 0.5 in Climate Zone 4 of the 2015 IECC compliant test-case. The test-case was compared to the TBEPS compliant base-case. Table 9 presents the difference in annual energy consumption from increasing the SHGC from 0.4 to 0.5 in Climate Zone 4 of the 2015 IECC compliant test-case. The test-case was compared to the 2015 IECC compliant base-case.

The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment is less stringent than the 2015 IECC compliant base-case.

Table 8: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with Increased SHGC in Climate Zone 4 with the TBEPS Compliant Base-Case

County	**House Size** (ft^2)	**WWAR** (%)	% Difference in Total Energy Consumption (2009 IECC Source) Positive values indicate increase in stringency	
			Gas Space Heating, Gas DHW	Heat Pump Space Heating, Electric DHW
Potter	**1000**	10%	15%	9%
		15%	13%	8%
		20%	11%	7%
		25%	9%	6%
		30%	7%	5%
		35%	7%	5%
		40%	5%	3%
		45%	4%	3%
	2500	10%	24%	15%
		15%	22%	14%
		20%	20%	12%
		25%	18%	11%
		30%	15%	10%
		35%	14%	9%
		40%	12%	8%
		45%	11%	8%
	5000	10%	30%	20%
		15%	28%	18%
		20%	26%	17%
		25%	24%	16%
		30%	22%	15%
		35%	20%	13%
		40%	18%	12%
		45%	17%	11%

Table 9: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with Increased SHGC in Climate Zone 4 with the 2015 IECC Compliant Base-Case

County	House Size (ft^2)	WWAR (%)	% Difference in Total Energy Consumption (2015 IECC Source) Positive values indicate increase in stringency	
			Gas Space Heating, Gas DHW	Heat Pump Space, Heating, Electric DHW
Potter	1000	10%	1%	0%
		15%	-1%	-1%
		20%	-1%	-1%
		25%	-2%	-2%
		30%	-3%	-3%
		35%	-3%	-3%
		40%	-4%	-4%
		45%	-4%	-4%
	2500	10%	0%	0%
		15%	0%	-1%
		20%	-1%	-2%
		25%	-2%	-2%
		30%	-3%	-3%
		35%	-3%	-3%
		40%	-4%	-4%
		45%	-5%	-4%
	5000	10%	0%	0%
		15%	0%	0%
		20%	-1%	-1%
		25%	-1%	-2%
		30%	-2%	-2%
		35%	-3%	-3%
		40%	-4%	-3%
		45%	-4%	-4%

4.11 Proposed Amendment 11

This analysis was performed to evaluate the proposed amendment to modify, Tables R402.1.1 and Table R402.1.3, 2015 IECC (Table N1102.1.2 and Table 1102.1.4, 2015 IRC). The proposed amendment reinstates the appropriate minimum wall R-values in Climate Zones 3 and 4 to those published in the Table 402.1.1 and Table 402.1.3 2009 IECC. The minimum wall R-values were changed from R-13+5[5] to R-13 (From U-0.060 to 0.082) for Climate Zones 3 and 4 (Refer to TAB Proposed Amendment 11, Appendix for Table).

For this analysis, the 2015 IECC compliant test-case was updated with proposed minimum wall R-values and compared to a corresponding TBEPS compliant base-case house. The modifications were also compared to a corresponding 2015 IECC compliant base-case house. The analysis was performed for Climate Zone 3 and Climate Zone 4 as described in the TBEPS.

Table 10 presents a difference in the annual energy consumption on replacing the content for wall insulation in Table R402.1.1 and Table R402.1.3 of the 2015 IECC with the corresponding values for ceiling insulation provided in Table 402.1.1 and Table 402.1.3 of the 2009 IECC for the three climate zones in Texas. Table 11 presents a difference in the annual energy consumption on replacing the content for wall insulation in Table R402.1.1 and Table R402.1.3 of the 2015 IECC with the corresponding values for ceiling insulation provided in Table R402.1.1 and Table R402.1.3 of the 2015 IECC for the three climate zones in Texas. The test-case was compared to the corresponding TBEPS compliant base-case.

[5] The first value is the cavity insulation. The second value is continuous insulation.

The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment is less stringent than the 2015 IECC compliant base-case.

4.1 Proposed Amendment 12

This amendment reinstates the appropriate minimum wall assembly R-values/U-factors in Climate Zones 6, 7 and 8 as published in the 2009 IRC.

This amendment is not applicable to the climate zones of Texas.

4.2 Proposed Amendment 13

This proposed amendment provides modifications to Table R405.5.2(1), 2015 IECC (Table N1105.5.2(1), 2015 IRC). This proposed change reinstates the performance option in the IRC Chapter 11 to reduce the prescriptive requirements by installing HVAC equipment with higher energy-efficiency performance ratings than required by the code.

The 2009 IECC and the 2015 IECC do not allow trade-offs between equipment and building thermal envelope.

The proposed amendment meets the annual energy cost performance requirement of the TBEPS. The stringency of the proposed amendment when compared to TBEPS and 2015 IECC can only be assessed using specific measures on a case by case basis.

Table 10: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with Modified Wall Insulation with the TBEPS Compliant Base-Case

County	2009 IECC Climate Zones	% Difference in Total Energy Consumption (2009 IECC Source) Positive values indicate increase in stringency	
		Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Tarrant	**3**	15%	10%
Potter	**4**	17%	11%

Table 11: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with Modified Wall Insulation with the 2015 IECC Compliant Base-Case

County	2009 IECC Climate Zones	% Difference in Total Energy Consumption (2015 IECC Source) Positive values indicate increase in stringency	
		Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Tarrant	**3**	-4%	-3%
Potter	**4**	-6%	-4%

4.3 Proposed Amendment 14

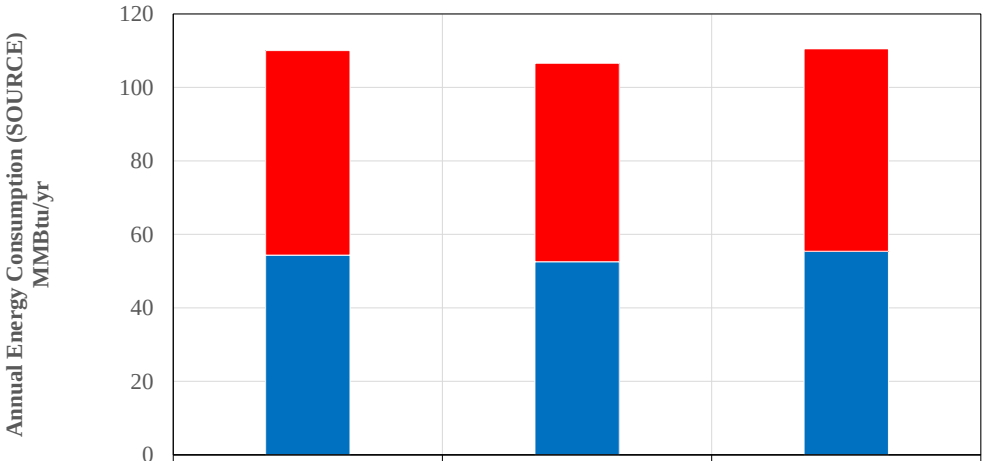
The proposed amendment provides modifications to Table R405.5.2 (1), 2015 IECC (Table N1105.5.2 (1), 2015 IRC). This proposed amendment provides the building designer the ability to reduce window area and get credit for the energy saved.

For this analysis, the window-to-wall-area-ratio of a Proposed Design house was varied for three different house sizes. Respective energy consumption of the corresponding Standard Reference house designed in accordance with TBEPS and the 2015 IECC with the WFAR fixed at 15% was evaluated.

Figure 2 presents the annual source energy consumption of a house with typical dimensions in Texas for TBEPS compliant base-case, 2015 compliant base-case and the 2015 compliant test-case with the WFAR fixed at 15%. The typical house in Texas is single-storied with a conditioned floor area of 2,398 ft^2 and a window-to-floor area ratio of 11.9% (Home Innovation Research Labs 2012). For a typical house in Texas, the annual source energy consumption of the 2015 IECC compliant test case with the proposed amendments was lower than the corresponding source energy consumption of the TBEPS compliant base-case but higher than the source energy consumption of the 2015 IECC compliant case.

Table 12 presents the annual source energy consumption from implementing different window-to-wall-area-ratios (WWAR) in the corresponding Standard Design Reference house compliant with TBEPS and the 2015 IECC with the WFAR fixed at 15%. In certain cases the Standard Reference Design house compliant with the proposed amendment consumes more energy than the corresponding TBEPS and 2015 IECC compliant cases.

For a typical house in Texas, the proposed amendment is as consumptive as TBEPS and is more consumptive than the 2015 IECC. For certain other test cases as seen in Table 12, the proposed amendment is more consumptive than the corresponding TBEPS and 2015 compliant base-case buildings.



	TBEPS	2015 IECC	2015 IECC w/A
TOTAL	110.0	89.7	93.6
Source Gas	55.7	54.0	55.1
Source Electric	54.4	52.5	55.4

Figure 2: Comparing the Annual Energy Consumption of TBEPS, 2015 IECC and 2015 IECC w/ Amendments Compliant Standard Reference Design House for a Typical House in Texas

Table 12: Comparing the Annual Energy Consumption of TBEPS and 2015 IECC w/ Amendments Compliant Standard Reference Design for Different Window-to-floor Area Ratios

County & 2009 IECC Climate Zones	House Size (ft^2)	WFAR (%) (WWAR%)	IECC Source Energy Consumption (Standard Reference Design) (MMBtu/yr)					
			Gas Heating, Gas Domestic Hot Water (DHW)			Heat Pump Heating, Electric Domestic Hot Water (DHW)		
			2009 IECC	2015 IECC	2015 IECC w/ Amend.	2009 IECC	2015 IECC	2015 IECC w/ Amend.
Harris Climate Zone 2	1,000	10.1% (10%)	55.1	52.3	54.7	66.4	64.6	66.8
		15.0% (15%)	57.9	54.7	54.7	68.6	66.8	66.8
		15.0% (20%)	57.9	54.7	54.7	68.6	66.8	66.8
		15.0% (25%)	57.9	54.7	54.7	68.6	66.8	66.8
		15.0% (30%)	57.9	54.7	54.7	68.6	66.8	66.8
		15.0% (35%)	57.9	54.7	54.7	68.6	66.8	66.8
		15.0% (40%)	57.9	54.7	54.7	68.6	66.8	66.8
		15.0% (45%)	57.9	54.7	54.7	68.6	66.8	66.8
	2,500	6.4% (10%)	89.5	81.9	92.4	99.9	94.3	104.1
		9.6% (15%)	94.9	85.5	92.4	104.6	97.8	104.1
		12.8% (20%)	100.3	89.5	92.4	109.3	101.6	104.1
		15.0% (25%)	104.0	92.4	92.4	112.8	104.1	104.1
		15.0% (30%)	104.0	92.4	92.4	112.8	104.1	104.1
		15.0% (35%)	104.0	92.4	92.4	112.8	104.1	104.1
		15.0% (40%)	104.0	92.4	92.4	112.8	104.1	104.1
		15.0% (45%	104.0	92.4	92.4	112.8	104.1	104.1
	5,000	4.5% (10%)	140.3	122.0	149.2	150.4	136.4	162.0
		6.8% (15%)	147.9	127.9	149.2	157.4	141.8	162.0
		9.1% (20%)	156.0	133.5	149.2	164.6	147.5	162.0
		11.3% (25%)	163.6	139.4	149.2	171.6	153.2	162.0
		13.6% (30%)	171.5	145.2	149.2	178.2	158.2	162.0
		15.0% (35%)	176.4	149.2	149.2	182.6	162.0	162.0
		15.0% (40%)	176.4	149.2	149.2	182.6	162.0	162.0
		15.0% (45%)	176.4	149.2	149.2	182.6	162.0	162.0

Note: Cells marked in red indicate that the Standard Reference Design house compliant with 2015 w/ amendment consumes more energy than the corresponding TBEP compliant Standard Reference Design house.

Table 12: Continued

County & 2009 IECC Climate Zones	House Size (ft^2)	WWAR (%)	IECC Source Energy Consumption (Standard Reference Design) (MMBtu/yr)					
			Gas Heating, Gas Domestic Hot Water (DHW)			Heat Pump Heating, Electric Domestic Hot Water (DHW)		
			2009 IECC	2015 IECC	2015 IECC w/ Amend.	2009 IECC	2015 IECC	2015 IECC w/ Amend.
Tarrant Climate Zone 3	**1,000**	10.1% (10%)	60.5	53.3	55.5	70.8	65.5	67.7
		15.0% (15%)	63.4	55.5	55.5	73.3	67.7	67.7
		15.0% (20%)	63.4	55.5	55.5	73.3	67.7	67.7
		15.0% (25%)	63.4	55.5	55.5	73.3	67.7	67.7
		15.0% (30%)	63.4	55.5	55.5	73.3	67.7	67.7
		15.0% (35%)	63.4	55.5	55.5	73.3	67.7	67.7
		15.0% (40%)	63.4	55.5	55.5	73.3	67.7	67.7
		15.0% (45%)	63.4	55.5	55.5	73.3	67.7	67.7
	2,500	6.4% (10%)	100.1	81.2	92.1	108.4	94.0	104.4
		9.6% (15%)	105.3	85.3	92.1	112.8	98.1	104.4
		12.8% (20%)	110.4	89.4	92.1	117.2	101.9	104.4
		15.0% (25%)	113.7	92.1	92.1	120.4	104.4	104.4
		15.0% (30%)	113.7	92.1	92.1	120.4	104.4	104.4
		15.0% (35%)	113.7	92.1	92.1	120.4	104.4	104.4
		15.0% (40%)	113.7	92.1	92.1	120.4	104.4	104.4
		15.0% (45%	113.7	92.1	92.1	120.4	104.4	104.4
	5,000	4.5% (10%)	158.4	118.3	146.6	164.3	134.2	160.4
		6.8% (15%)	165.3	124.2	146.6	170.6	139.9	160.4
		9.1% (20%)	172.5	130.4	146.6	177.0	145.3	160.4
		11.3% (25%)	179.8	136.3	146.6	183.6	151.0	160.4
		13.6% (30%)	187.2	142.4	146.6	189.9	156.7	160.4
		15.0% (35%)	191.9	146.6	146.6	194.3	160.4	160.4
		15.0% (40%)	191.9	146.6	146.6	194.3	160.4	160.4
		15.0% (45%)	191.9	146.6	146.6	194.3	160.4	160.4
Potter Climate Zone 4	**1,000**	10.1% (10%)	72.5	62.1	65.0	90.4	82.3	85.4
		15.0% (15%)	74.9	65.0	65.0	93.2	85.4	85.4
		15.0% (20%)	74.9	65.0	65.0	93.2	85.4	85.4
		15.0% (25%)	74.9	65.0	65.0	93.2	85.4	85.4
		15.0% (30%)	74.9	65.0	65.0	93.2	85.4	85.4
		15.0% (35%)	74.9	65.0	65.0	93.2	85.4	85.4
		15.0% (40%)	74.9	65.0	65.0	93.2	85.4	85.4
		15.0% (45%)	74.9	65.0	65.0	93.2	85.4	85.4
	2,500	6.4% (10%)	124.2	95.3	108.2	146.9	124.3	137.3
		9.6% (15%)	127.3	99.3	108.2	150.4	128.4	137.3
		12.8% (20%)	131.3	104.4	108.2	154.8	133.5	137.3
		15.0% (25%)	134.1	108.2	108.2	158.3	137.3	137.3
		15.0% (30%)	134.1	108.2	108.2	158.3	137.3	137.3
		15.0% (35%)	134.1	108.2	108.2	158.3	137.3	137.3
		15.0% (40%)	134.1	108.2	108.2	158.3	137.3	137.3
		15.0% (45%	134.1	108.2	108.2	158.3	137.3	137.3
	5,000	4.5% (10%)	199.0	140.4	173.7	231.0	185.7	218.6
		6.8% (15%)	203.6	146.2	173.7	236.7	192.0	218.6
		9.1% (20%)	209.1	153.0	173.7	242.4	199.3	218.6
		11.3% (25%)	214.7	160.5	173.7	249.0	206.0	218.6
		13.6% (30%)	220.9	168.5	173.7	255.3	213.9	218.6
		15.0% (35%)	225.6	173.7	173.7	260.1	218.6	218.6
		15.0% (40%)	225.6	173.7	173.7	260.1	218.6	218.6
		15.0% (45%)	225.6	173.7	173.7	260.1	218.6	218.6

4.4 Proposed Amendment 15

The proposed amendment proposes modifications to Table R402.1.2, 2015 IECC (Table N1102.1.2, 2015 IRC). The modification proposes changes to the wood framed wall insulation specification as identified in Table 402.1.2 of the 2015 IECC (R-13 for Climate Zone 2, R-13+5 for Climate Zone 3 and 4) to an R-15 for Climate Zones 2, 3 and 4.

For this analysis, the 2015 IECC compliant test-case was updated with the proposed wall R-values. The updated test-case was compared to a corresponding TBEPS compliant base-case house. The modified test-case was also compared to the corresponding 2015 IECC compliant base-case house. The analysis was performed for Climate Zone 3 and Climate Zone 4 as described in the TBEPS.

Table 13 presents a difference in the annual energy consumption on replacing the content for wall insulation in Table R402.1.1 and Table R402.1.3 of the 2015 IECC with R-15 for the three climate zones in Texas. The test-case was compared to the corresponding TBEPS compliant base-case. Table 14 presents a difference in the annual energy consumption on replacing the content for wall insulation in Table R402.1.1 and Table R402.1.3 of the 2015 IECC with R-15 for the three climate zones in Texas. The test-case was compared to the corresponding 2015 IECC compliant base-case.

The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment less stringent than the 2015 IECC compliant base-case.

Table 13: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with R-15 Wall Insulation in Three Climate Zones with the TBEPS Compliant Base-Case

County	2009 IECC Climate Zones	% Difference in Total Energy Consumption (2009 IECC Source) Positive values indicate increase in stringency	
		Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Harris	**2**	11%	7%
Tarrant	**3**	17%	11%
Potter	**4**	19%	13%

Table 14: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case with R-15 Wall Insulation in Three Climate Zones with the 2015 IECC Compliant Base-Case

County	2009 IECC Climate Zones	% Difference in Total Energy Consumption (2015 IECC Source) Positive values indicate increase in stringency	
		Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Harris	**2**	1%	1%
Tarrant	**3**	-3%	-2%
Potter	**4**	-4%	-2%

4.5 Proposed Amendment 16

The proposed amendments propose modifications to Section 402.4.1.2 and Table R405.5.2 (1), 2015 IECC (Chapter 11, N1102.4.1.2 and Table N1105.5.2 (1), 2015 IRC). The proposed changes modify the blower door test requirement from 5 ACH_{50} in Climate Zone 2 and 3 ACH_{50} in Climate Zone 3 and 4 as proposed in 2015 IECC to 5 ACH_{50} for all Climate Zones.

For this analysis, the modified leakage rates of 5 ACH_{50} were considered for three different house sizes. The impact of the modified leakage rates was compared to a corresponding TBEPS compliant base-case house with air leakage rates of 0.00036 SLA[6] as prescribed by Table 405.5.2(1) of the 2009 IECC. The proposed modifications are also compared to the corresponding 2015 IECC compliant base-case with specifications for air-leakage provided in Table R405.5.2 (1) of the 2015 IECC. The analysis was performed for the Climate Zone 2, 3 and 4 as described in the TBEPS.

Table 15 presents the difference in annual source energy consumption from implementing increased leakage rates in 2015 IECC compliant test-case when compared to the energy consumption obtained from the TBEPS compliant base-case. Table 16 presents the difference in annual source energy consumption from implementing increased leakage rates in 2015 IECC compliant test-case when compared to the energy consumption obtained from the 2015 IECC compliant base-case.

The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment is less stringent than the 2015 IECC compliant base-case.

Table 15: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case Implementing Increased Leakage Rates of 5ACH_{50} with the TBEPS Compliant Base-Case

County	2009 IECC Climate Zones	House Size (ft^2)	% Difference in Total Energy Consumption (2009 IECC Source) Positive values indicate increase in stringency	
			Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Harris	**2**	1,000	6%	3%
		2,500	10%	7%
		5,000	14%	10%
Tarrant	**3**	1,000	10%	6%
		2,500	15%	10%
		5,000	17%	13%
Potter	**4**	1,000	9%	6%
		2,500	15%	10%
		5,000	19%	13%

[6] A 0.00036 SLA translates to 7ACH_{50}, which is the test value provided in Section 402.4.2.1 of the 2009 IECC.

Table 16: Comparing Annual Energy Consumption for 2015 IECC Compliant Test-Case Implementing Increased Leakage Rates of 5ACH$_{50}$ with the 2015 IECC Compliant Base-Case

County	2009 IECC Climate Zones	House Size (ft^2)	% Difference in Total Energy Consumption (2015 IECC Source) Positive values indicate increase in stringency	
			Gas Heating, Gas Domestic Hot Water	Heat Pump Heating, Electric Domestic Hot Water
Harris	**2**	1,000	0%	0%
		2,500	0%	0%
		5,000	0%	0%
Tarrant	**3**	1,000	-4%	-2%
		2,500	-5%	-4%
		5,000	-10%	-7%
Potter	**4**	1,000	-5%	-3%
		2,500	-9%	-6%
		5,000	-12%	-7%

4.6 Proposed Amendment 17

The proposed amendment provides modifications to Section R406, 2015 IECC (Section N1106, 2015 IRC). The proposed changes provide modifications to the Energy Rating Index Compliance Alternative as adopted in Section R406 of the 2015 IECC to more realistic scores as proposed in a joint study conducted by the Natural Resources Defense Council (NRDC), Leading Builders of America (LBA), Institute for Market Transformation (IMT), and Britt/ Makela Group, Inc (BMG).

The maximum Energy Rating Index (ERI) values reported in Table R406.4 2015 IECC were adopted from a study performed at the Florida Solar Energy Center (Fairey 2013). The alternate values provided by the amendment are reported in a joint study conducted by several groups. Currently, insufficient evidence is available from the alternate study to conduct a comparison of the maximum ERI values. Hence, it is concluded that insufficient information is provided for assessing the stringency of this amendment.

5. CONCLUSIONS

This report presents an assessment of 17 proposed amendments that were received as part of the review process initiated by the State Energy Conservation Office (SECO). Fourteen proposed amendments were received from the Texas Association of Builders (TAB) and three proposed amendments were received from Fox Energy Specialists.

The analysis presents the following conclusions:

1. Proposed Amendment 1: This proposed amendment to the 2015 IECC is a comprehensive amendment, which proposes to provide flexibility for meeting the energy code requirements while maintaining the energy performance. The stringency of this proposed comprehensive amendment with both the TBEPS and 2015 IECC was assessed individually in proposed amendments 6, 13 and 14.

2. Proposed Amendment 2: This proposed amendment proposes modifications to Section N1101.4, 2015 IRC (Section R102.1.1, 2015 IECC). The proposed modification to the code eliminates the need to meet all mandatory requirements identified by the IRC/IECC as long as the program exceeds the energy-efficiency levels that are required. It was concluded that the proposed amendment meets TBEPS if the energy efficiency program is the US EPA ENERGY STAR. It was also concluded that the proposed amendment is less stringent than the 2015 IECC.

3. Proposed Amendment 3: This proposed amendment provides additions to text in Section N1101.6 and Section N1102.3.3, 2015 IRC (Section R202 and Section R402.3.3, 2015 IECC). The proposed modification allows for the use of overhangs to meet the solar heat gain coefficient requirements within the IECC. The proposed amendment is as stringent as the TBEPS and the 2015 IECC provided the values in the proposed Table R402.3.3 are equivalent to or more stringent than the values in Table 5.5.4.4.1, SHGC Multipliers for Permanent Projections found in ASHRAE Standard 90.1-2013.

4. Proposed Amendment 4: This proposed amendment provides modifications to Section N1102.4, 2015 IRC (Section R402.4, 2015 IECC). The proposed modification eliminates the need to test dwelling units individually and allow the builders to test the entire multi-family building structure as a whole, as is done in commercial buildings. The proposed amendment is as stringent as the TBEPS and 2015 IECC for R-2 occupancies provided it meets all the requirements of Section C402.5 of the 2015 IECC.

5. Proposed Amendment 5: The proposed amendment provides modifications to N1102.4.1.2 and Table N1105.5.2 (1) 2015 IRC, (Section 402.4.1.2 and Table R405.5.2 (1), 2015 IECC). The proposed modification increases the maximum limit for blower door test requirements from 3 ACH_{50} to 4 ACH_{50} in Climate Zones 3 through 8. The proposed amendment is as stringent asthe TBEPS. The proposed amendment is less stringent than the published 2015 IECC.

6. Proposed Amendment 6: The proposed amendment provides modifications to Section R402.4, 2015 IECC (Chapter 11, N1102.4, 2015 IRC). The proposed change allows builders to trade improvements in other building energy components for less stringent building envelope pressure test results. This performance option provides flexibility in meeting the air tightness requirements and provides options for recovering unexpected air tightness test failure. The proposed amendment is as stringent as the TBEPS and the 2015 IECC.

7. Proposed Amendment 7: The proposed amendment provides modifications to Tables R402.1.1 and Table R402.1.3, 2015 IECC (Table N1102.1.2 and Table 1102.1.4, 2015 IRC). The proposed change replaces the 2015 IECC Tables R402.1.2 and R402.1.4 in the residential section of the 2015 with Table 402.1.1 and Table 402.1.3 of the 2009 IECC. The proposed amendment is as stringent as the TBEPS. The proposed amendment is less stringent than the published 2015 IECC.

8. Proposed Amendment 8: This amendment reduces the basement wall insulation values requirements in Climate Zone 5, to a more reasonable R-value/U-factor based on values acceptable to both NAHB and DOE in the 2009 IRC. This amendment is not applicable to the climate zones of Texas.

9. Proposed Amendment 9: The proposed amendment provides modifications to Tables R402.1.1 and Table R402.1.3, 2015 IECC (Table N1102.1.2 and Table 1102.1.4 2015 IRC). This proposed recommendation reinstates the appropriate minimum ceiling R-values in Climate Zones 2, 3, 4 and 5 to those published in the 2009 IRC, Chapter 11. The proposed amendment is as stringent as

the TBEPS compliant base-case. The proposed amendment is less stringent than the published 2015 IECC.

10. Proposed Amendment 10: The proposed amendment provides modifications to Table R402.1.1, 2015 IECC (Table N1102.1.1, 2015 IRC). This proposed amendment changes the Climate Zone 4 SHGC back to N/R since the addition of a prescriptive restriction for the SHGC of 0.40 is not a requirement that saves energy. The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment is less stringent than the 2015 IECC compliant base-case.

11. Proposed Amendment 11: The proposed amendment provides modifications to Table R402.1.1 and Table 402.1.3, 2015 IECC (Table N1102.1.1 and Table N1102.1.3 , 2015 IRC). This proposed amendment reinstates the appropriate minimum wall assembly R-values / U-factors in Climate Zone 3 and 4 published in the 2009 IECC. The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment is less stringent than the 2015 IECC compliant base-case.

12. Proposed Amendment 12: This amendment reinstates the appropriate minimum wall assembly R-values/U-factors in Climate Zones 6, 7 and 8 as published in the 2009 IRC. This amendment is not applicable to the climate zones of Texas.

13. Proposed Amendment 13: This proposed amendment provides modifications to Table R405.5.2 (1), 2015 IECC (Table N1105.5.2 (1), 2015 IRC). This proposed change reinstates the performance option in the IRC Chapter 11 to reduce the prescriptive requirements by installing HVAC equipment with higher energy-efficiency performance ratings than required by the code. The proposed amendment meets the annual energy cost performance requirement of the TBEPS. The stringency of the proposed amendment when compared to TBEPS and 2015 IECC can only be assessed using specific measures on a case by case basis.

14. Proposed Amendment 14: The proposed amendment provides modifications to Table R405.5.2 (1), 2015 IECC (Table N1105.5.2 (1), 2015 IRC). This proposed amendment provides the building designer the ability to reduce window area and get credit for the energy saved. For a typical house in Texas, the proposed amendment is as stringent as TBEPS and less stringent than the 2015 IECC. For certain other test cases as seen in Table C-6, the proposed amendment is less stringent than the corresponding TBEPS and 2015 IECC compliant base-case.

15. Proposed Amendment 15: The proposed amendment proposes modifications to Table R402.1.2, 2015 IECC (Table N1102.1.2, 2015 IRC). The modification proposes changes to the wood framed wall insulation specification as identified in Table 402.1.2 of the 2015 IECC to an R-15 for Climate Zones 2, 3 and 4. The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment is less stringent than the 2015 IECC.

16. Proposed Amendment 16: The proposed amendments propose modifications to Section 402.4.1.2 and Table R405.5.2 (1), 2015 IECC (Chapter 11, N1102.4.1.2 and Table N1105.5.2 (1), 2015 IRC). The proposed changes modify the blower door test requirement from 5 ACH_{50} in Climate Zone 2 and 3 ACH_{50} in Climate Zone 3 and 4 as proposed in 2015 IECC to 5 ACH_{50} for all Climate Zones. The proposed amendment is as stringent as the TBEPS compliant base-case. The proposed amendment is less stringent than the 2015 IECC compliant base-case.

17. Proposed Amendment 17: The proposed amendment provides modifications to Section R406, 2015 IECC (Section N1106, 2015 IRC). The proposed changes provide modifications to the Energy Rating Index Compliance Alternative as adopted in Section R406 of the 2015 IECC to

more realistic scores as proposed in a joint study conducted by the Natural Resources Defense Council (NRDC), Leading Builders of America (LBA), Institute for Market Transformation (IMT), and Britt/ Makela Group, Inc (BMG). The ERI is currently not a requirement in the TBEPS and hence has not been assessed.

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APPENDIX A

Proposed Amendments from Texas Association of Builders (TAB) and Fox Energy Specialists

TAB Proposed Amendment 1

E1. Comprehensive Amendment

This amendment is a comprehensive amendment, which provides flexibility for meeting the energy code requirements while maintaining the energy performance. It will provide a "true" unrestricted performance path that will allow for cost-optimized construction of an energy equivalent house.
(Includes Amendments E6, E7, 14, 15)

Revise as follows:

R402.4 Air leakage ~~(Mandatory)~~. The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections N1102.4.1 through N1102.4.4.

R402.4.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections N1102.4.1.1 and N1102.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation (Mandatory). The components of the *building thermal envelope* as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the *code official*, an *approved* third party shall inspect all components and verify compliance.

R402.4.1.2 Testing (Mandatory). The building or dwelling unit shall be tested ~~and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8~~ for air leakage. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*. During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures;
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.4.1.3 Leakage rate (Prescriptive). The building or dwelling unit shall have an air leakage rate not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section N1102.4.1.2.

7/18/2014

TABLE R405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Glazing[a]	Total area[b] =	
	~~(c)The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area.~~	As proposed
	~~(d)~~15% of the conditioned floor area~~; where the proposed glazing area is 15% or more of the conditioned floor area.~~	
	Orientation: equally distributed to four cardinal compass orientations (N, E, S, & W)	As proposed
	U-factor: from Table R402.1.3	As proposed
	SHGC: From Table R402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed 0.92-(0.21 × SHGC as proposed)
	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design) External shading: none	As proposed
Heating systems [f, g]	~~As proposed for other than electric heating without a heat pump. Where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC-Commercial Provisions.~~	As proposed
	Fuel type: same as proposed design	As proposed
	Efficiencies:	
	Electric: air-source heat pump with prevailing federal minimum standards	As proposed
	Nonelectric furnaces: natural gas furnace with prevailing federal minimum standards	As proposed
	Nonelectric boilers: natural gas boiler with prevailing federal minimum standards	As proposed
	Capacity: sized in accordance with Section N1103.6	
Cooling systems [f,h]	~~As proposed~~ Fuel type: Electric	
	Efficiency: in accordance with prevailing federal minimum standards	As proposed
	Capacity: sized in accordance with Section N1103.6	As proposed
Service Water Heating [f,g,h,i]	~~As proposed~~	As proposed
	Fuel type: same as proposed design	As proposed
	Efficiency: in accordance with prevailing federal minimum standards	Same as standard reference Same as standard reference ~~gal/day = 30 + (10 × *Nbr*)~~
	Use: gal/day = 30 + 10 × *Nbr*	
	Tank temperature: 120°F	
	~~Use: same as proposed design~~	

Reason:
This amendment is a comprehensive amendment which provides flexibility for meeting the energy code requirements while maintaining the energy performance. It will provide a "true" unrestricted performance path that will allow for cost-optimized construction of an energy equivalent house. The proposed changes

provide alternatives that encourage innovation and the use of materials and equipment which will result in a home which is at least equivalent of that prescribed in the energy code.

The modifications will reinstate many of the changes made since the 2006 IRC CHAPTER 11 which restricted the flexibility of the builder/designer to construct an energy efficient code compliant home while still meeting the energy performance levels of the current code.

Items included in this amendment:

- Energy neutral building tightness trade-offs
- Credit for more energy efficient buildings which incorporate reduced window area
- Energy neutral heating, cooling and water heating equipment efficiency trade-offs

Currently all homes have a mandatory requirement to be equal to or tighter than 3ACH50 or 5ACH50, depending on climate zone. Proposed changes will allow for homes to be less tight provided other efficiency changes are made to the house which offset energy lost due to the change in air infiltration.

Currently, when conducting a performance analysis, a building glazing area greater than 15% of the conditioned floor area (CFA) is penalized for using more energy. However, a building with less than 15% window to CFA does not get credit for saving energy. This amendment allows the builder/designer to optimize window area that is both energy efficient and pleasing to the consumer.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 2

E2. Remove Mandatory Requirements for Above Code Program

This proposal eliminates the need to meet all "Mandatory" requirements identified by the IRC/IECC as long as the program exceeds the energy-efficiency levels required.

Revise as follows:

R102.1.1 Above code programs.
The *code official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this code. Buildings *approved* in writing by such an energy efficiency program shall be considered in compliance with this code. ~~The requirements identified as "mandatory" in Chapter 4 shall be met.~~

Reason:
The key element of an above code program is that it must meet or exceed the energy efficiency requirements of the IECC. Requiring such a program to also meet the detailed prescriptive requirements labeled as "mandatory" in the IECC defeats the purpose of performance based above code program. This code change proposal will allow flexibility in the methodology used for any above code program to meet or exceed the minimum energy efficiency requirements of the IECC.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 3

E3. Overhang Credit for SHGC (Climate Zone 1-4)

This amendment allows for the use of overhangs to meet the solar heat gain coefficient requirements within the IECC.

Add new text as follows:

PROJECTION FACTOR. The ratio of the horizontal depth of an overhang, eave, or permanently attached shading device, divided by the distance measured vertically from the bottom of the fenestration glazing to the underside of the overhang, eave, or permanently attached shading device.

R402.3.3 Glazed fenestration SHGC exception. In Climate Zones 1 through 4, permanently shaded vertical fenestration shall be permitted to satisfy the SHGC requirements. The projection factor of an overhang, eave, or permanently attached shading device shall be greater than or equal to the value listed in table 402.3.3 for the appropriate orientation. The minimum projection shall extend beyond each side of the glazing a minimum of 12 inches (0.3 m). Each orientation shall be rounded to the nearest cardinal orientation (+/-45 degrees or 0.79 rad) for purposes of calculations and demonstrating compliance.

TABLE R402.3.3
MINIMUM PROJECTION FACTOR REQUIRED BY ORIENTATION FOR SHGC EXCEPTION

ORIENTATION	PROJECTION FACTOR
North	>=0.46[a]
South	>=0.20
East	>=0.50
West	>=0.50

a. For the north orientation, a vertical projection located on the west-edge of the fenestration with equivalent PF >= 0.15 shall also satisfy the minimum projection factor requirement.

Reason:
The concept of using shading to reduce heat gain is integral to the architectural of some of the oldest world cultures. Shading in modern construction offers many possibilities. This proposed code change allows for the use of overhangs to meet the solar heat gain coefficient requirements within the IECC. Permanent exterior shading features, such as overhangs are allowed to be used in IECC Chapter 5 as a prescriptive trade-off to meeting SHGC requirements within the code. The calculation for determining the projection factor for overhangs has been in the 2000, 2003, 2006, and 2009 IECC for commercial buildings and has been proven to be very simple to calculate, fitting well into a prescriptive approach. The use of the shading devices was previously allowed under the 2003 IECC and is currently allowed as a trade-off under the commercial provisions of the IECC. Allowing flexibility in meeting the solar heat gain coefficient through the use of proven shading alternatives will increase the usability of the code for the building and design community while ensuring that the new fenestration is energy efficient. When credit for shading is permitted in the building code, it encourages an integrated approach to building designs, energy use, construction materials, renewable resources particularly as part of urban infrastructure, site and town planning and building design to be considered holistically. It also creates the opportunity for aesthetically pleasing and ingenious designs that might not otherwise be permitted.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 4

E4. Multi-Family Air Leakage Testing

This amendment eliminates the need to test dwelling units individually and allow builders to test the entire structure as a whole, as is done in commercial buildings

Revise as follows:

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Section R402.4.1 through R402.4.4.

Exception: Dwelling units of R-2 Occupancies and multiple single family dwellings shall be permitted to comply with IECC Section C402.4

Reason:
Air tightness testing for single family detached homes is very straightforward; however, it is much more difficult to accurately test attached dwelling units including multi-family buildings. Currently the IECC treats low-rise multi-family buildings, which are 3 stories or less, like single family homes and multi-family buildings of 4 stories or more like commercial buildings. Regardless of height, all multi-family buildings have the same air tightness testing complications, such as: Does the entire building need to be tested at one time? What about multi-family buildings with open corridors? Does every dwelling need to be tested? Can the leakages be averaged between units? Is the leakage tested only to the "outside" or should it include leakage to adjacent units?

By approving this change, low-rise multi-family buildings and attached single family dwellings will avoid these complications, but yet will still held to the same level of performance as high rise (R-2) residential building as well as all commercial buildings.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 5

E5. Air Leakage Rate Correction (Climate Zones 3-8)

This amendment modifies the requirements from 3 Air Changes per Hour (ACH) to 4 ACH in Climate Zones 3-8

Revise as follows:

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and ~~3~~ 4 air changes per hour in Climate Zones 3 through 8. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

Table R405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Air leakage rate of 5 air changes per hour in Climate Zones 1 and 2, and ~~3~~ 4 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area Nbr = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate[c]. The mechanical ventilation rated shall be in addition to the air leakage rate and shall be as proposed.

Reason:
Building tightness is an important part of an energy efficient and comfortable house; however, 3 air changes per hour at 50 Pascals is an extremely low target tightness especially for smaller homes. The ASHRAE Handbook of Fundamentals shows that less than 10% of new homes achieve 3 ACH or less. Four ACH is still an aggressive tightness level, which will provide a tight, comfortable, energy efficient home for the consumer.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 6

E6. Air Leakage Trade-Offs

This Amendment allows builders to trade improvements in other building energy components for less stringent building envelope pressure test results. This performance option provides flexibility in meeting the air tightness requirements and provides options for recovering from an unexpected air tightness test failure. ***(Part of Amendment E1)***

Revise as follows:

R402.4 Air leakage ~~(Mandatory)~~. The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

R402.4.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation (Mandatory). The components of the *building thermal envelope* as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the *code official*, an *approved* third party shall inspect all components and verify compliance.

R402.4.1.2 Testing (Mandatory). The building or dwelling unit shall be tested ~~and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8~~ for air leakage. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*. During testing:

7. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures;
8. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
9. Interior doors, if installed at the time of the test, shall be open;
10. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
11. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
12. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.4.1.3 Leakage rate (Prescriptive). The building or dwelling unit shall have an air leakage rate not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

Reason:
These modifications remove the mandatory maximum air tightness requirement and provide designers and builders the flexibility to trade-off building tightness with other performance path measures when using the performance path. Currently the building tightness requirement is mandatory and the 3 and 5 ACH tightness levels even under ideal circumstances are very difficult to achieve. This will provide energy neutral trade-offs for expensive and sometimes unattainable requirements with other building improvements. This proposal does not change the stringency of the code it only increases the flexibility while not lowering efficiency.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 7

Nonfenestration Ufactors shall be obtained from measurement, calculation or an apprCNed source.

a. When more than half the insulation is on the interior, the mass wall Ufactors shall be a maximum of 0.17 in Zone 1, 0.14 in Zone 2, 0.12 in Zone 3, 0.10 in Zone 4 except Marine, and the same as the frame wall Ufactor in Marine Zone 4 and Zones 5 through 8.
b. Basement wall Ufactor of 0.360 in warm-humid locations as defined by Figure 301.1 and Table 301.2.
c. Foundation Ufactor requirements shown in Table 402.1.3 include wall construction and interior air films but exclude soil conductivity and exterior air films. Ufactors for determining code compliance in accordance with Section 402.1.4 (total*VA* alternative) ofSection 405 (Simulated Performance Alternative) shall be modified to include soil conductivity and exterior air films .

Reason:
The table values in the 2012 IECC and the 2015 IECC did not show justification for the cost increases from the 2009 IECC. Studies indicate nationally almost a $6,000 increase to the cost of constructing a single family detached dwelling with a 13 year simple payback. With statistics showing that for every $1,000 increase to the cost of construction nearly 250,000 potential home buyers will not qualify for a mortgage. That puts the impact of the increased cost of a home to disqualifying approximately 2.5 million families from purchasing a home. That equates to approximately $48,000,000 in potential taxes revenues never being generated for municipalities.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 9

E9. Ceiling R-Value/U-Factors Reduction (Climate Zones 2-5)

This amendment reinstates the appropriate minimum ceiling R-Values in climate zones 2, 3, 4 and 5, those published in the 2009 IRC CHAPTER 11.

Revise as follows:

TABLE N1102.1.1 (R402.1.1)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b,e]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R -VALUE	BASEMENT[c] WALL R -VALUE	SLAB[d] R-VALUE AND DEPTH	CRAWL[c] SPACE WALL R - VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	~~38~~ 30	13	4/6	13	0	0	0
3	0.35	0.55	0.25	~~38~~ 30	20 or 13+5[h,i]	8/13	19	5/13f	0	5/13
4 except Marine	0.35	0.55	0.40	~~49~~ 38	20 or 13+5[h,i]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	~~49~~ 38	20 or 13+5[h,i]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h,i]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h,i]	19/21	38[g]	15/19	10, 4 ft	15/19

TABLE N1102.1.3 (R402.1.3) EQUIVALENT U-FACTORS[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor[b]	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	~~0.030~~ 0.035	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	~~0.030~~ 0.035	0.060	0.098	0.047	0.091c	0.136
4 except Marine	0.35	0.55	~~0.026~~ 0.030	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	~~0.026~~ 0.030	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

All Footnotes remain unchanged

Reason:

There were four changes in the Ceiling R-value requirements in the 2012 IECC Edition, none of which should have been considered cost-effective. An energy and cost analysis was performed to show that the simple paybacks are in the 80-130 year range.

Climate Zone	epresentative City	Change	Energy Savings	Incremental Cost	Simple Payback
2	Orlando, FL	R-38->R-30	$10/yr	$1,305	130 years

7/18/2014

3	Atlanta, GA	R-38->R-30	$16/yr	$1,305	82 years
4	Richmond, VA	R-49->R-38	$15/yr	$1,379	92 years
5	Indianapolis, IN	R-49->R-38	$15/yr	$1,379	92 years

The energy modeling was done using the Energy Plus simulation engine and BEopt version 1.4, Cost figures came from ASHRAE RP-1481. Vaulted or cathedralized ceiling are very problematic when trying to achieve R- 49, which is about 16 inches thick. This would require a rafter at least 17" tall (which does not exist) or an insulated panel, which represents a very small portion of the market.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 10

E10. Correct SHGC for Climate Zone 4

This amendment changes the Climate Zone 4 SHGC back to N/R, since the addition of a prescriptive restriction for the SHGC of 0.40 is not a requirement that saves energy.

Revise as follows:

TABLE N1102.1.1 (R402.1.1)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b,e]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R -VALUE	BASEMENT[c] WALL R -VALUE	SLAB[d] R-VALUE AND DEPTH	CRAWL[c] SPACE WALL R - VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h,i]	8/13	19	5/13f	0	5/13
4 except Marine	0.35	0.55	~~0.40~~ NR	49	20 or 13+5[h,i]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h,i]	13/17	30g	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h,i]	15/20	30g	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h,i]	19/21	38[g]	15/19	10, 4 ft	15/19

Reason:

The addition of a prescriptive restriction for the SHGC of 0.40 was added in the 2012 IECC. This is not a requirement that saves energy. In Climate Zone 4, heating degree days outnumber cooling degree days by about 2 to 3 times. Therefore for most of the year, the "sun is your friend" and solar heat gain is beneficial and reduces heating loads. There are some exceptions to this, but the majority of homes will not benefit from this restriction. The values being modified by this proposal are the same as what was proposed by the Department of Energy in their proposal EC13 from the last cycle. The values currently adopted were an increase from proposals not submitted by the Department of Energy.

Return to Table of Contents

7/18/2014

TAB Proposed Amendment 11

E11. Wall R-Value/U-Factors Corrections (Climate Zone 3 & 4)

This amendment reinstates the appropriate minimum wall assembly R-Values/U-Factors in Climate Zone 3 & 4 published in the 2009 IECC.

Revise as follows:

TABLE N1102.1.1 (R402.1.1)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b,e]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE AND DEPTH	CRAWL[c] SPACE WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	~~20 or 13+5[h,i]~~ 13[i]	8/13	19	5/13f	0	5/13
4 except Marine	0.35	0.55	0.40	49	~~20 or 13+5[h,i]~~ 13	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h,i]	13/17	30g	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h,i]	15/20	30g	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h,i]	19/21	38[g]	15/19	10, 4 ft	15/19

TABLE N1102.1.3 (R402.1.3) EQUIVALENT U-FACTORS[a]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor[b]	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	~~0.060~~ 0.84	0.098	0.047	0.091c	0.136
4 except Marine	0.35	0.55	0.026	~~0.060~~ 0.84	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

All Footnotes remain unchanged

Reason:
Frame wall requirements in climate zone 3 changed from R-13 to R-20, which was, is not cost effective for the consumer.

Climate Zone	Representative City	Wall R-Value Change	Energy Savings	Incremental Cost	Simple Payback
3	Atlanta, GA	R-13->R-20	$50/yr	$1,199	24 years

7/18/2014

TAB Proposed Amendment 13

E13. Mechanical Equipment Trade-Off

This amendment reinstates the performance option in the IRC CHAPTER 11 to reduce prescriptive requirements by installing HVAC equipment with higher energy-efficiency performance ratings than required by the code. ***(Part of Amendment E1)***

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Revise as follows:

TABLE R405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems [f, g]	~~As proposed for other than electric heating without a heat pump. Where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section R403 of the IECC Commercial Provisions.~~ Fuel type: same as proposed design Efficiencies: Electric: air-source heat pump with prevailing federal minimum standards Nonelectric furnaces: natural gas furnace with prevailing federal minimum standards Nonelectric boilers: natural gas boiler with prevailing federal minimum standards Capacity: sized in accordance with Section R403.6	~~As proposed~~ As proposed As proposed As proposed As proposed
Cooling systems [f,h]	~~As proposed~~ Fuel type: Electric Efficiency: in accordance with prevailing federal minimum standards Capacity: sized in accordance with Section R403,6	As proposed As proposed
Service Water Heating [f,g,h,i]	~~As proposed~~ Fuel type: same as proposed design Efficiency: in accordance with prevailing federal minimum standards Use: gal/day = 30 + 10 × *Nbr* Tank temperature: 120°F ~~Use: same as proposed design~~	~~As proposed~~ As proposed Same as standard reference Same as standard reference ~~gal/day = 30 + (10 × *Nbr*)~~

Reason:
This amendment serves to retain energy neutral equipment trade-off provisions from the 2006 International Energy Conservation Code (IECC) for the heating systems,

6/19/2014

TAB Proposed Amendment 14

E14. Window Area Trade-Off

This amendment will provide the building designer the ability to reduce window area and get credit for the energy saved. ***(Part of Amendment E1)***

Revise as follows:

TABLE R405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Glazing[a]	Total area[b] =	As proposed
	~~(a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area.~~	
	~~(b)~~ 15% of the conditioned floor area~~; where the proposed glazing area is 15% or more of the conditioned floor area.~~	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S, & W)	As proposed
	U-factor: from Table R402.1.3	As proposed
	SHGC: From Table R402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	0.92-(0.21 × SHGC as proposed)
	Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design)	As proposed
	External shading: none	

Reason:

Walls generally perform better thermally than windows. Currently in the code there is no incentive in the performance path for the building designer to optimize the window area in order to save energy and provide daylighting, egress and views that makes for a safe and comfortable house. These modifications will provide the building designer the ability to reduce window area and get credit for the energy saved. As this section is currently written, the house is penalized for having more than 15% window area yet receives no credit toward code compliance when the window area is reduced below 15%. This change rectifies this disparity and makes the performance path a more representative of actual energy use.

Return to Table of Contents

6/19/2014

Fox Energy Specialists Proposed Amendment 15

Wall Assembly Requirements

One area of major concern that the 2015 IECC will impose are those regarding wood framed wall assembly requirements to accommodate for the insulation specifications as outlined in Table R402.1.2 of the 2015 IECC. In climate zones 3 and 4, insulation values will either need to be a minimum of R20 or R13+R5 of continuous rigid insulation. Climate zone 2 is unaffected by this change, as this specification is identical to the 2009 IECC requirement for wood framed wall insulation (R13).

The added costs associated with the R13+5 specification builders will use in CZs 3 and 4 is approximately $3600 on your average 2,300 square foot home. An R20 insulation value inside a wood framed wall assembly would force builders to construct 2x6 exterior walls, rather than conventional 2x4 wall construction. The added cost to that change in framing design, lumber supply, and construction could potentially be even higher than the alternative (R13+5) specification.

Recommendation – Amend the wood framed wall insulation specification as identified in Table R402.1.2 of the 2015 IECC to an R15 for **all** Texas climate zones. This provides a consistent specification for all professionals in the residential construction industry (Texas builders and enforcement), while achieving a higher level of thermal performance (approx. 15%) on all wood framed wall assemblies constructed moving forward.

Fox Energy Specialists Proposed Amendment 16

Air Infiltration

As is the case with wall assembly requirements, there are also differing air infiltration specifications outlined in the 2015 IECC depending on where you build a home in Texas. Section R402.4.1.2 of the 2015 IECC specifies that the building thermal envelope shall not exceed an air leakage rate of 5 ACH50 in climate zone 2, and 3 ACH50 in climate zones 3 and 4. It is fair to say that the building industry in general has largely embraced the air infiltration testing requirements introduced in the 2009 IECC, as it is a good way to verify and demonstrate the overall building envelope performance. However, moving from 7 ACH50 for all Texas climate zones (2009 IECC) to the proposed 5 ACH50 and 3 ACH50 requirements is a monumental hurdle that will blind-side many builders in the State. To provide a frame of reference, ENERGY STAR® Certified Homes are currently required to achieve 6 ACH50 in climate zone 2 and 5 ACH50 in climate zones 3 and 4[2]. To amend the state energy code to 2015 IECC requirements, ENERGY STAR builders across Texas would have to adhere to a more stringent air leakage requirement without receiving any credit (or market differentiation) for building to a higher energy efficiency standard, such as ENERGY STAR.

Recommendation – Amend the air infiltration testing requirements as identified in section R402.4.1.2 of the 2015 IECC to 5 ACH50 for **all** Texas climate zones. This proposed amendment is consistent with what many local municipalities are currently adopting as an alternative to the 2012 IECC. This amendment would also provide a consistent specification across the State (as the 2009 IECC did) while still lowering the minimum air infiltration rate by almost 30%.

Fox Energy Specialists Proposed Amendment 17

Energy Rating Index

The introduction of the Energy Rating Index (ERI) Compliance Alternative is a welcomed new addition to the 2015 IECC, *in theory*. The ERI score is defined as a numerical score where 100 is equivalent to the 2006 IECC and 0 is equivalent to a net-zero home. The most commonly known ERI process used nationally is RESNET's ANSI Approved[3] Home Energy Rating System (HERS) Index® method for inspecting and calculating a home's energy performance. The HERS Index provides credit to homes in areas previous versions of the IECC did not recognize (i.e. mechanical efficiencies, radiant barrier roof decking, etc.). However, it is our opinion that the ERI scores adopted in the 2015 IECC are extremely way too low for mainstream construction in Texas. In today's marketplace, the vast majority of builders that utilize the HERS Index are doing so because they are choosing to build to an above energy code standard (i.e. ENERGY STAR, National Green Building Standard, Green Built Texas, etc.). Since 2012, these above energy code homes built in Texas received an average HERS Index of 65. Suggesting an ERI score of 51, 52, or 54 as the alternative standard to meeting the 2015 IECC will basically nullify this otherwise very builder and consumer friendly compliance alternative.

Recommendation – Amend the Energy Rating Index Compliance Alternative as adopted in section R406 of the 2015 IECC to more realistic scores as proposed in a joint study conducted by the Natural Resources Defense Council (NRDC), Leading Builders of America (LBA), Institute for Market Transformation (IMT), and Britt/Makela Group, Inc. (BMG)[4]. These proposed ERI scores for all Texas climates zones are listed below.

Texas Climate Zones	2015 IECC Adopted Scores	IMT, LBA, NRDC, BMG Proposed Scores
Zone 2	52	**59**
Zone 3	51	**59**
Zone 4	54	**63**

[2] ENERGY STAR Certified Homes, Version 3 National Program Requirements - http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/National_Program_Requirements.pdf?eda8-6196

[3] ANSI RESNET Standard 301-2014 - http://www.resnet.us/standards/ANSI-RESNET_301-2014.pdf

[4] http://www.imt.org/uploads/resources/files/Fact_Sheet_on_ERI_Proposal.pdf