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Preliminary Report on Integration of Florida's Code Energy Efficiencies using the 2009 IECC as the Foundation Code

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Abstract

The Florida Building Commission is in the initial phase of it triennial revision of the Florida Building Code. The Florida Building Code has included specific energy provisions since its inception in 2001. Those provisions are the Florida Energy Code (FEC), which was initiated in 1979. In 2008, the Florida legislature enacted HB 7135, requiring the 2010 FEC to provide 20% energy savings compared with the 2007 FEC. HB 7135 also requires that the energy provisions of the Florida Building Code use the 2009 IECC as the foundation and that the IECC shall be modified to maintain the efficiencies of the FEC. This constitutes a legal distinction within Florida's code process, requiring that modifications to the 2009 IECC foundation code be based on the Legislature's mandates for the FEC. This preliminary report provides a review of the current Florida and IECC energy code provisions and makes recommendations on how FEC energy efficiency provisions can be integrated into a Florida code framework that uses the 2009 IECC as the foundation code. A follow-on report, expanding on technical issues, is anticipated as part of the consensus process of developing and promulgating the 2010 FEC.

1 Background

In 2008, the Florida Legislature included two important energy provisions related to the Florida Building Code in HB 7135. The first provision requires the Florida Building Commission to select the most recent version of the International Energy Conservation Code (IECC) as a foundation code. This provision, s.553.73(6)(a), F.S., reads as follows:

> *"…The commission shall select the most current version of the International Energy Conservation Code (IECC) as a foundation code; however, the IECC shall be modified by the commission to maintain the efficiencies of the Florida Energy Efficiency Code for Building Construction adopted and amended pursuant to s. 553.901."*

The second provision, s.553.9061(1), F.S., requires the Florida Building Commission to increase the stringency of the energy provisions within the Florida Building Code in a stepwise fashion at each 3-year cycle of Building Code updates. This provision reads in part:

> *"The Florida Building Commission shall:*
>
> *(a) Include the necessary provisions by the 2010 edition of the Florida Energy Efficiency Code for Building Construction to increase the energy performance of new buildings by*

at least 20 percent as compared to the energy efficiency provisions of the 2007 Florida Building Code adopted October 31, 2007."

The remainder of this provision, sub clauses (b) through (d), repeats the test of sub clause (a) with the edition dates and energy performance increases incremented for each succeeding 3-year code cycle up through the 2019 edition of the code as follows:

2013 edition: at least 30 percent as compared to the 2007 Florida Building Code
2016 edition: at least 40 percent as compared to the 2007 Florida Building Code
2019 edition: at least 50 percent as compared to the 2007 Florida Building Code

In addition, HB 7135 provides a list of specific building options that must be considered in code support and compliance, as follows:

"2) The Florida Building Commission shall identify within code support and compliance documentation the specific building options and elements available to meet the energy performance goals established in subsection (1). Energy efficiency performance options and elements include, but are not limited to:

(a) Solar water heating.
(b) Energy-efficient appliances.
(c) Energy-efficient windows, doors, and skylights.
(d) Low solar-absorption roofs, also known as "cool roofs."
(e) Enhanced ceiling and wall insulation.
(f) Reduced-leak duct systems.
(g) Programmable thermostats.
(h) Energy-efficient lighting systems."

Finally, prior to its Fourth of July holiday recess, the U.S. House of Representative passed HR 2454, the *American Energy Security Act*. As passed by the House, this act provides for stringent increases in national model energy codes over time – in much the same fashion as does Florida HB 7135. In fact, HR 2454 uses the same basis for determination of efficiency improvements as does Florida's HB 7135. As written, the federal bill requires national model code improvements to be made with respect to the 2006 IECC for residential buildings and with respect to ASHRAE Standard 90.1-2004 for commercial buildings. These standards are identical to those used as the basis for the 2007 FEC, which Florida's HB 7135 uses as the standard of comparison. Should the U.S. Senate adopt the same provisions, federal law will make Florida's HB 7135 appear prescient in that it will be entirely consistent with federal law after the fact. The primary difference will lie in the time table. As it stands, HR 2454 calls for a 30% efficiency improvement in national model codes at the effective date of the bill and a 50% improvement by 2017 for residential buildings and 2018 for commercial buildings. It further requires 5% improvement per year until a total of 70% improvement has been reached in 2030. DOE has one year from the target dates to adopt the national code that meets these targets. States then have one year after DOE adopts the national codes to achieve compliance.

2 2009 International Energy Conservation Code (IECC)

The 2009 IECC contains provisions for both residential and commercial buildings. Like most building codes, the IECC defines residential buildings as those that are 3-stories or less above grade, used for residential occupancy. All other buildings fall under the commercial building code provisions.

2.1 Commercial Buildings

Within the commercial building provisions of the 2009 IECC (Chapter 5), there are two primary means of compliance. The first is by meeting the requirements of the 2007 edition of ANSI/ASHRAE/IESNA Standard 90.1, *Energy Standard for Buildings Except for Low-Rise Residential Buildings*. The second means of compliance is through the specific requirements of Chapter 5 of the IECC. These two sets of provisions are largely the same and the remaining discussion will center on ANSI/ASHRAE/IESNA Standard 90.1-2007, hereinafter referred to as "90.1."

Within the 90.1 commercial building compliance procedures, there are three methods or options that can be used to demonstrate compliance, as follows:

Prescriptive Building Option requires that each and every building envelope component meet a prescribed efficiency standard. Using this compliance option, no trade-off of efficiency of one envelope component or lighting or HVAC system with that of another envelope component or lighting or HVAC system is allowed. This option may not be used if window area exceeds 40% of exterior wall area of if skylight area exceeds 5% of roof area.

Building Envelope Trade-off Option requires that the *envelope performance factor* of the proposed building is less than or equal to the *envelope performance factor* of the budget building. The *envelope performance factor* for both the proposed and the budget building are computed using a complex set of heating degree day (HDD) and cooling degree hour (CDH) based equations prescribed by Appendix C of 90.1. This compliance option allows for trade-offs between envelope components only and may not be used if window area exceeds 40% of exterior wall area of if skylight area exceeds 5% of roof area.

Energy Cost Budget Method requires computer simulation of whole-building performance showing that the projected energy costs to operate the *proposed building design* is equal to or less than the projected energy costs to operate the *budget building design* as specified by the standard. Within specified limits, all envelope component, interior lighting and HVAC system efficiencies can be traded against one another using this compliance method.

2.2 Residential Buildings

Residential energy code requirements are given by Chapter 4 of the 2009 IECC. As for commercial buildings, there are three compliance options or methods of demonstrating compliance, as follows:

Prescriptive option requires that each and every building envelope component meet a prescribed efficiency standard. Using this compliance option, no trade-off of efficiency of one envelope component with that of another envelope component is allowed. Unlike for commercial buildings, there is no maximum allowable window area requirement for this option.

Total UA alternative requires that the total building envelope UA (sum of U-factor time the assembly area) is less than or equal to the UA resulting from the U-factors given by the prescriptive option table (Table 402.1.3). This compliance option allows for trade-offs between envelope components only. Again, unlike for commercial buildings, there is no maximum allowable window area requirement for this option.

Simulated Performance Alternative requires computer simulation of whole-building performance showing that the projected energy cost to operate the *proposed building design* is equal to or less than the projected energy cost to operate the *budget building design* as specified by the standard. Alternatively, source energy use may be used to make this comparison in lieu of the energy cost. Unlike the commercial building Energy Cost Budget method, this residential compliance method does not allow for trade-offs of HVAC equipment efficiencies, allowing trade-offs between envelope components only.

3 2007 Florida Building Code (including the 2009 Supplement)

The energy provisions of the 2007 Florida Building Code, hereinafter called the “2007 FEC,” and the energy provisions of 2009 supplement to the 2007 FEC, hereinafter called the “2009 FEC,” are very similar. The principle difference is the fact that 2009 FEC compliance requires that projected energy loads or cost in compliant buildings be equal to or less than 85% of the projected energy loads or cost for buildings that are minimally compliant with the 2007 FEC.

This provision of the 2009 FEC was implemented with an effective date of March 1, 2009, as a direct result of a Florida Governor’s Executive Order, [1] which directed the Secretary of the Department of Community Affairs (DCA) to convene the Florida Building Commission for the purpose of revising the 2007 FEC in order to “increase the energy performance of new construction in Florida by at least 15% from the 2007 Energy Code.”

The energy efficiency provisions of the 2007 FEC are identical to or more stringent than those of the 2006 IECC. Thus, the Governor’s Executive Order had the effect of reducing energy use in new Florida buildings by 15% as compared with the 2006 IECC. It is worth noting that this was accomplished by the Florida Building Commission, albeit not effected in the field, prior to the

[1] Office of the Governor, Executive Order #07-126, “Establishing Immediate Actions to Reduce Greenhouse Gas Emissions within Florida.”

publication of the 2009 IECC, advancing Florida significantly beyond of the remainder of the nation with respect to energy efficiency in new buildings.

It is also important to note at this point that, while the 2007 FEC was promulgated in October 2007, it was never implemented in the field. This occurred for two reasons: first, the 2007 FEC was equal in stringency to the revised edition of the 2004 FEC (i.e. it was equivalent in stringency to the prevailing national model code at that time – the 2006 IECC)[2] and second, the Governor's Executive Order intervened in the code process, requiring that the 2009 FEC be at least 15% more stringent than the 2007 FEC. These two "facts on the ground" led the Florida Building Commission to retain the revised 2004 FEC until the 2009 FEC could be finalized and implemented.

3.1 Commercial Buildings

The commercial buildings energy provisions of the 2007 FEC are identical to the 2004 edition of ANSI/ASHRAE/IESNA Standard 90.1. Thus, by definition, the 2009 FEC is 15% more efficient than 90.1-2004. Analysis conducted by the Florida Solar Energy Center (FSEC)[3] comparing 90.1-2004 (i.e. 2007 FEC without the 15% improvement) and ASHRAE 90.1-2007 show that 90.1-2007 is between 4% and 9% more stringent than 90.1-2004. In effect, the 2009 FEC (i.e. with the 15% improvement), is better than the ASHRAE 90.1-2007 baseline by a margin of 6% to 11% subject to building type and size. This means that the 2010 FEC, when implemented in accordance with HB 7135, will be approximately 10-15% more energy efficient than the 2009 IECC.

Compliance with the 2009 FEC requires a comparative whole-building simulation analysis (Method A) showing that the *proposed building* projected energy costs are equal to or less than 85% of the projected energy costs for the *baseline building*. The Florida baseline building for the 2009 FEC is identical to the baseline building for the 2007 FEC (i.e. the *budget building design* of 90.1-2004).

For core and shell construction, Method B of the 2009 FEC requires that the envelope components be approximately 10% more efficient than the 90.1-2004 prescriptive requirements to obtain a building permit. However, final compliance for build-out is achieved through a comparative whole-building performance simulation analysis showing that the completed building's projected energy costs are equal to or less than 85% of the projected energy cost for the baseline building.

3.2 Residential Buildings

Similar to commercial buildings, the projected energy loads in a Florida *as-built home* must be equal to or less than 85% of the projected energy loads in the Florida *baseline home*. Again, this Florida baseline home is the same as the 2007 FEC baseline home (i.e. the 2006 IECC *standard*

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[2] Fairey, P., May 2007. "Effectiveness of Florida's Residential Energy Code: 1979-2007." FSEC-CR-1717-07, Florida Solar Energy Center, Cocoa, FL (http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-1717-07.pdf).
[3] Basarkar, M., L. Gu and M. Swami, March 17, 2009. "Simulation Results for Comparison of ASHRAE Standard 90.1-2004 vs. ASHRAE Standard 90.1-2007." FSEC e-mail communication to DCA.

reference design home). Thus, by definition, new Florida homes must be 15% more efficient than homes that meet the performance standards of the 2006 IECC (Section 404).

FSEC has also conducted analysis to determine the relative energy efficiency of the 2009 FEC relative to the 2009 IECC.[4] This analysis, which does not calculate the effect of certain prescriptive criteria of the FEC, shows that the 2009 FEC is approximately 1-3% less stringent in terms of energy efficiency than the 2009 IECC. This effectively means that the 2010 FEC, when implemented in accordance with HB 7135 requirements for 20% greater efficiency than the 2007 FEC, will be approximately 2-4% more energy efficient than the 2009 IECC.

Compliance with the residential section of the 2009 FEC may be demonstrated in one of two ways, as follows:

> Whole-building performance option (Method A) requires a comparative whole-building simulation analysis showing that the energy loads for the *as-built home* are no more than 85% of the energy loads of the Florida *baseline home*. Within specified limits, all envelope component and HVAC system efficiencies can be traded against one another using this compliance option.
>
> Prescriptive option (Method B) requires that each and every building envelope component meet a prescribed efficiency standard. Using this compliance option, no trade-off of efficiency of one envelope component with that of another envelope component is allowed. To qualify for this option, the home must use a programmable thermostat, the window area of the home must be equal to or less than 16% of the conditioned floor area and the ducts must be either in the conditioned space or tested to be leak free (i.e. leakage to outdoors of less than 3 cfm25 per 100 square feet of conditioned floor area).

4 Differences Among the Codes

There are both substantive energy efficiency and structural differences between the 2009 FEC and the 2009 IECC. The largest of the substantive energy efficiency differences can be summarized as stemming from the HB 7135 requirement that Florida's 2010 Energy Code be 15% more efficient than the 2007 FEC and the fact that the minimum efficiency requirements of 2009 IECC have changed compared to the 2006 IECC requirements, upon which the 2009 FEC is largely based.

Structurally, the greatest differences relate to the fact that the organization and numbering system used in the 2009 FEC differs from that of the 2009 IECC. However, in addition to this fact, the 2009 FEC includes substantially more code specificity than the 2009 IECC on a number of items that Florida has considered important over the years for the control of leakage in forced air distribution systems and the control of humidity in Florida buildings. These differences are covered in more detail based on building type in the following sections.

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[4] Fairey, P., June 2009. "Effectiveness of Florida's Residential Energy Code: 1979 – 2009." FSEC-CR-1806-09, Florida Solar Energy Center, Cocoa, FL. (http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-1806.pdf)

4.1 Commercial Buildings

Specific differences between the provisions of 90.1-2004 (2007 FEC) and 90.1-2007 are as follows:

- Demand Control Ventilation (DCV) required for high-occupancy spaces (addendum v)
- Minimum efficiency for HVAC equipment increased (Addendum b, f, g)
- Minimum efficiency for boilers increased (Addendum t)
- Baseline fan power allowance reduced (addenda ac, ar)
- More Stringent opaque elements – Roofs, walls, Floor, (Addendum as)
- More stringent Fenestration elements (Addendum at)
    - Dependence of U and SHGC on %WWR eliminated.
    - Dependence of U and SHCG now on Fenestration framing type & application
    - U and SHGC are now tighter in 90.1-2007 than 90.1-2004
- Prescriptive compliance limits WWR to 40% (instead of 50%) (Addendum at)
- Baseline WWR for Energy budget method limits WWR to 40% (was 50%) or proposed building value whichever is less (Addendum at)
- Estimated average stringency of 90.1-2007 compared to 90.1-2004 is approx 10%

A simulation analysis comparing the performance differences between 90.1-2004 and 90.1-2007 has also been conducted.[5] Typical models for three building types: a strip mall, a small office and a medium office, were simulated using the EnergyPlus and EnergyGauge software. The building models are constructed in accordance with two different baseline standards: 90.1-2004 and 90.1-2007.

The prototype models for the strip mall and the medium office building were obtained from the DOE commercial building benchmark database developed jointly by NREL, PNNL and LBNL.[6] The strip mall is a 22,500 ft^2 building with 8 small and 2 large zones served by packaged single-zone equipment. The strip mall has a 26% window-to-wall area ratio (WWR) with all of the glazing facing south. The medium office is a 53,626 ft^2, three-story building with 50% (WWR) of evenly distributed glass for the 90.1-2004 model and 40% (WWR) of evenly distributed glass for the 90.1-2007 model. The small office is a 10,000 ft^2 single-story building with 50% (WWR) glass for the 90.1-2004 model and 40% (WWR) for the 90.1-2007 model. Tables 1-3 present results from the analysis.

Table 1 Comparison results for Medium Office Building

	ASHRAE 90.1 2004			**ASHRAE 90.1 2007**				
	Electricity (GJ)	**Natural Gas (GJ)**	**Total (GJ)**	**Electricity (GJ)**	**Natural Gas (GJ)**	**Total (GJ)**	**% Difference**	**Absolute Difference**
Jacksonville	2824.01	402.86	3226.87	2704.6	271.3	2975.9	7.8	251.0
Orlando	2959.99	259.82	3219.81	2818.16	169.91	2988.07	7.2	231.7
Miami	3109.77	94.38	3204.15	2861.09	78.37	2939.46	8.3	264.7

[5] *ibid*., Basarkar, et al., March 2009

[6] Torcellini, et al., 2008. "DOE Commercial Building Benchmark Models." Proceeding, *2008 ACEEE Summer Study on Energy Efficiency in Building*, Pacific Grove, California, August 17-22, 2008.

Table 2 Comparison results for Strip Mall

	ASHRAE 90.1 2004			ASHRAE 90.1 2007				
	Electricity (GJ)	Natural Gas (GJ)	Total (GJ)	Electricity (GJ)	Natural Gas (GJ)	Total (GJ)	% Difference	Absolute Difference
Jacksonville	1299.04	159.49	1458.53	1254.96	137.06	1392.02	4.6	66.5
Orlando	1363.53	65.02	1428.55	1311.42	54.09	1365.51	4.4	63.0
Miami	1619.07	9.33	1628.4	1536.29	9.63	1545.92	5.1	82.5

Table 3 Comparison results for Small Office

	ASHRAE 90.1 2004	ASHRAE 90.1 2007		
	Total (MBtu)	Total (MBtu)	% Difference	Absolute Difference
Jacksonville	668	606	9.3%	62
Orlando	649	602	7.2%	47
Miami	721	678	6.0%	43

Results of this analysis show that the performance requirements of 90.1-2007 are 4% to 9% more efficient than 90.1-2004. As a result, the current 2009 FEC (with its requirement that buildings exceed 2007 FEC requirements 15%), exceeds the minimum performance requirements of 90.1-2007 by 6% to 11%, depending on building type and size.

4.2 Residential Buildings

The substantive energy efficiency differences between the FEC 2009 and the IECC 2009 are found in both the prescriptive options and the performance options of the two codes.

4.2.1 *Prescriptive Option*

The prescriptive envelope thermal requirements of the 2009 IECC have changed with respect to the 2006 IECC as follows:

- The window U-factor requirements for climate zone 2 (north, central and much of south Florida) has been reduced from U=0.75 to U=0.65. The U-factor for climate zone 1 (southen-most Florida) remains unchanged
- The window Solar Heat Gain Coefficient (SHGC) requirements for both climate zones 1 and 2 (all of Florida) has changed from SHGC=0.40 to SHGC=0.30
- The mass wall R-value for climate zone 1 has changed from R-3 to a duel requirement of R-3 if more than half of the insulation is on the exterior of the wall and R-4 if more than half of the insulation is on the interior of the mass wall
- The mass wall R-value for climate zone 2 has changed from R-4 to a duel requirement of R-4 if more than half of the insulation is on the exterior of the wall and R-6 if more than half of the insulation is on the interior of the mass wall.

It is important to point out that, in the prescriptive requirements for windows, there is no requirement that total window area be limited. In other words, if windows meet the above thermal requirements, the exterior envelope area not comprised of structural members may be windows.

In addition to these few thermal envelope changes, the 2009 IECC strengthens prescriptive requirements for envelope air barriers and insulation installation and for air distribution system leakage relative to the 2006 IECC. Section 402.4.2 of the 2009 IECC adds a specific requirement that the envelope air leakage of a home be either tested to be equal to or less than 7 air changes per hour at a pressure difference of 50 Pa or that it comply through field verification with a comprehensive check list of envelope air barrier and insulation installation criteria (given in Table 402.4.2). Section 402.4.2.2 of the 2009 IECC (the field verification option) also contains an interesting enabling provision reading as follows: "Where required by the *code official*, an *approved* party independent from the installer of the insulation shall inspect the air barrier and insulation."

However, due to Florida's mild climate (with respect to air exchange in buildings), these provisions have very little impact in Florida, where for most locations, Florida's baseline home performance requirements already meet or exceed the 7 ach50 requirement of the 2009 IECC.

In addition to envelope leakage, section 403.2.2 of the 2009 IECC adds mandatory provisions for sealing air distribution systems and requires that air distribution systems be either tested for compliance or that the air handler and all ducts be located within the conditioned space. The requirements for compliance through testing are provided for both post-construction testing and for rough-in testing.

- For post-construction testing, air distribution system leakage to outdoors must be equal to or less than 8 cfm per 100 ft^2 of conditioned area <u>or</u> total air distribution system leakage must be less than or equal to 12 cfm per 100 ft^2 of conditioned floor area when tested at a pressure difference of 25 Pa across the entire system, including the manufacturer's air handler.

- For rough-in testing, total air leakage must be less than or equal to 6 cfm per 100 ft2 of conditioned floor area when tested at a pressure difference of 25 Pa across the roughed in system, including the manufacturer's air handler.

4.2.2 *Performance Option*

The performance option of the 2009 IECC has changed substantially compared with the 2006 IECC. The following are the major 2009 IECC changes that impact the performance compliance option:

> The maximum window area for the *standard reference design* [see Table 405.5.2(1)] has been reduced from 18% of the conditioned floor area to 15% of the conditioned floor area. However, if the house has window area less than 15% of the conditioned area then the actual glass area is used in the *standard reference design.* This reduces the projected energy use for the *standard reference design*, increasing code stringency but does not

reward the most cost effective window energy efficiency option– the reduction of window area that is characteristic of affordable housing.

- The Distribution System Efficiency (DSE) for the *standard reference design* has been increased from 0.80 to 0.88. This reduces the projected energy use for the *standard reference design*, increasing code stringency.

- The thermostat settings for both the *standard reference design* and the *proposed design* have been changed from 68 for heating and 78 for cooling to 72 for heating and 75 for cooling. This sometimes increases code stringency and sometimes decreases code stringency, depending on climate, house design and the relationship between heating and cooling loads. Energy credit for programmable thermostats is not allowed.

- Heating, cooling and hot water system efficiencies in the *standard reference design* must be the same as those in the *proposed design*. This provision disallows any trade-offs between envelope efficiencies and heating, cooling and hot water system efficiencies.

The above differences have been examined using Florida's code compliance software (EnergyGauge® USA). A typical 2000 ft^2, 3-bedroom, slab-on-grade home is used for the analysis. Using this home design, IECC *Standard Reference Design* homes are created in accordance with the requirements of the 2006 IECC and the 2009 IECC. Homes are created for Miami, Tampa, Orlando, Tallahassee and Jacksonville to examine impacts across the state. Since the 2009 IECC Standard Reference Design specifies thermostat settings that are different than the 2009 IECC, two sets of analysis are conducted: one for the 2006 IECC thermostat setting and one for the 2009 IECC thermostat settings. Table 4 provides the analysis results.

Table 4. Comparison of the 2006 and 2009 IECC Standard Reference Design homes, showing energy savings under two thermostat setting scenarios.

Location	**78/68 Thermostat setting**				**75/72 Thermostat setting**			
Miami:	**2006**	**2009**	**kWh saved**	**%saved**	**2006**	**2009**	**kWh saved**	**%saved**
Cool	5,912	4,785	1,127	19.1%	8,095	6,730	1,365	16.9%
Heat	52	42	10	19.2%	211	182	29	13.7%
HW	2,268	2,269	-1	0.0%	2,278	2,278	0	0.0%
Total	**8,232**	**7,096**	**1,136**	**13.8%**	**10,584**	**9,190**	**1,394**	**13.2%**
EPI*	**100**	**82**			**	**		
Tampa:	**2006**	**2009**	**kWh saved**	**%saved**	**2006**	**2009**	**kWh saved**	**%saved**
Cool	4,492	3,530	962	21.4%	6,289	5,128	1,161	18.5%
Heat	301	301	0	0.0%	709	675	34	4.8%
HW	2,487	2,488	-1	0.0%	2,492	2,492	0	0.0%
Total	**7,280**	**6,319**	**961**	**13.2%**	**9,490**	**8,295**	**1,195**	**12.6%**
EPI*	**100**	**82**			**	**		
Orlando:	**2006**	**2009**	**kWh saved**	**%saved**	**2006**	**2009**	**kWh saved**	**%saved**
Cool	3,825	3,038	787	20.6%	5,571	4,517	1,054	18.9%
Heat	263	260	3	1.1%	687	645	42	6.1%
HW	2,529	2,529	0	0.0%	2,532	2,532	0	0.0%

Location	78/68 Thermostat setting				75/72 Thermostat setting			
Total	**6,617**	**5,827**	**790**	**11.9%**	**8,790**	**7,694**	**1,096**	**12.5%**
EPI*	**100**	**83**			**	**		
Jacksonville:	**2006**	**2009**	**kWh saved**	**%saved**	**2006**	**2009**	**kWh saved**	**%saved**
Cool	3,068	2,408	660	21.5%	4,569	3,657	912	20.0%
Heat	970	967	3	0.3%	1,860	1,770	90	4.8%
HW	2,725	2,726	-1	0.0%	2,724	2,724	0	0.0%
Total	**6,763**	**6,101**	**662**	**9.8%**	**9,153**	**8,151**	**1,002**	**10.9%**
EPI*	**100**	**83**			**	**		
Tallahassee:	**2006**	**2009**	**kWh saved**	**%saved**	**2006**	**2009**	**kWh saved**	**%saved**
Cool	2,900	2,230	670	23.1%	4,276	3,408	868	20.3%
Heat	1,221	1,231	-10	-0.8%	2,242	2,133	109	4.9%
HW	2,777	2,778	-1	0.0%	2,775	2,776	-1	0.0%
Total	**6,898**	**6,239**	**659**	**9.6%**	**9,293**	**8,317**	**976**	**10.5%**
EPI*	**100**	**84**			**	**		

* 2007 Florida Energy Code Energy Performance Index (EPI) for IECC Standard Reference Design homes.

** Cannot be calculated for these thermostat settings.

Two interesting facts emerge from Table 4. First, the percentage energy savings projected for the 2009 IECC code as compared with the 2006 IECC ranges from a high of 13.8% in south Florida to a low of 9.6% in north Florida. Second, there are only small differences in projected savings as a function of thermostat setting, with the maximum difference occurring in Jacksonville at 1.1% more savings for the 2009 IECC thermostat settings. It is also interesting to note that projected savings are greater for the 2006 IECC thermostat settings in south and central Florida. Assuming the greater of the percentage savings for each climate, the range of projected savings is from 10.5% in north Florida to 13.8% is south Florida.

Table 4 also points out that the 2009 FEC is already very close to meeting or exceeding the performance requirements of the 2009 IECC, especially in northern Florida. The table shows the 2009 FEC Energy Performance Index (EPI) for both the 2006 IECC Standard Reference Design and the 2009 Standard Reference Design. As expected, the 2006 IECC Standard Reference Design attains an EPI of exactly 100 in all climates. The EPI for the 2009 IECC Standard Reference Design homes varies from 84 in north Florida to 82 in south Florida.

Thus, the 2009 FEC is within 1-2% of 2009 IECC performance requirements in north Florida and 2-3% of 2009 IECC performance requirements in central and south Florida. Achieving the new building energy savings required by HB 7135 – a 2010 FEC that is 20% more efficient than the 2007 FEC – will result in a 2010 FEC that exceeds the performance requirements of the 2009 IECC by 2-4%.

5 Florida's 2010 Code Challenges

Paramount in the development of the 2010 FEC update is HB 7135. This legislation requires that two basic directives be met by the Florida Building Commission (FBC) in the development of the 2010 FEC, as follows:

1. That the 2010 FEC provide for buildings that are 20% more efficient than the minimum requirements of the 2007 FEC and,

2. That the 2010 FEC use the 2009 IECC as its "foundation code."

To a certain extent these two directives can appear mutually exclusive. For example, Florida's 2009 FEC is already more efficient than the 2009 IECC requirements for commercial buildings. Thus, adoption of the 2009 IECC, as promulgated, would not only fail to meet the efficiency requirements of HB 7135 but also would result in a loss of commercial building efficiency in Florida.

There are also numerous other challenges related to the specific energy efficiency provisions of the 2009 IECC that will require resolution. Thus, the large challenge for development of the 2010 FEC will be to reconcile the two directives of HB 7135 in a manner that protects the best interests of the various interest groups, stakeholders and the citizens of Florida and achieves the legislated directive to maintain the efficiencies of the FEC. In 2006, a detailed study of the residential specifications of the 2006 IECC and the 2007 FEC was conducted for DCA.[7] This study documents the specific differences between the two codes on a detailed basis. Excepting those changes to the 2009 IECC that are documented in the sections above, the comparisons provided in this study remains valid.

For commercial buildings, it is quite clear that the requirements of the 2009 IECC (i.e. Standard 90.1-2007) are insufficient to meet the 20% efficiency improvement directive of HB 7135. If 90.1-2007 were to be implemented as the requirement for Florida's baseline commercial buildings, Florida would lose 6-11% in achieved energy efficiency with respect to the 2009 FEC and the state would be 11-16% short of meeting the 20% improvement directive of HB 7135. However, excepting the requirement that 90.1-2007 be the basis of commercial building compliance for the 2009 IECC, there are few, if any, specific component or HVAC system requirements that impact development of the 2010 FEC in a way that would prohibit Florida from meeting the 20% efficiency directives of HB 7135.

For residential buildings, however, the matter is not quite as definitive and a number of specific component and HVAC system challenges remain to be resolved by the FBC in consultation with various interest groups and stakeholders. Among these challenges are the following.

5.1 Basis of Efficiency Improvement

The 2009 IECC dramatically changes the thermostat set points used for heating and cooling in the performance compliance option as compared with the 2007 FEC (and the 2006 IECC). As illustrated in Table 4 above, this leads to great difficulty in comparing the relative efficiencies of the two codes. HB 7135 stipulates that the required percentage improvements to the FEC be with respect to the 2007 FEC. If the 2009 IECC thermostat set points are adopted within

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[7] Basarker, M. and R. Vieira, June 2006. "Comparison Matrix of Florida Residential Building Energy Code and the International Energy Conservation Code (IECC) 2006." FSEC-CR-1636-06, Florida Solar Energy Center, Cocoa, FL.

Florida's performance-based compliance option, comparison between the 2010 and future FEC cycles would be made much more complex and difficult. Furthermore, there is little, if any, evidence from field measurements that the 2007 FEC thermostat settings provide energy use projections that do not align with reality.

5.2 Window Treatment

The 2009 IECC allows unlimited glazing area through its prescriptive compliance option. In addition, it allows no energy credit when window area is reduced below the window area baseline in it performance compliance option. At best, these two specifications are internally inconsistent. At worst, they provide for severe gaming of the compliance system. The practice of not providing legitimate energy efficiency credits for window area percentages that are less than the baseline percentage is not equitable from an energy perspective and it unduly and unnecessarily penalizes low income home owners, who typically install smaller percentage window areas than high income home owners.

5.3 Heating, Cooling and Hot Water System Trade-offs

Unlike all previous editions of the IECC the 2009 IECC does not provide a compliance option that allows trade-off between thermal envelope components and equipment efficiency. While such trade-offs are allowed by the commercial building performance compliance option of the 2009 IECC, they are specifically disallowed in the residential performance compliance option. Florida, through its whole-building performance option, has a long history of allowing the marketplace to decide which technologies constitute the most cost effective means of meeting its energy code. This 2009 IECC provision, disallowing equipment to compete head-to-head with other efficiency alternatives, significantly reduces the alternatives that are available to Florida home builders and home owners.

The argument has been made that the thermal envelope of a home has a much longer life than the equipment that serves it. However, history has shown that the service life of the equipment is longer than the lifetime of improvements in the efficiencies of the equipment. As a result, replacements are almost always more efficient than the original equipment.

This 2009 IECC provision also prevents important emerging equipment and systems energy technologies from equitable participation in the energy efficiency marketplace. Without the ability to compete in the energy code arena, there is no incentive to innovate – to conduct the research and development necessary to bring high performance products to the marketplace to compete with the minimum standard. It provides no incentive for use of tankless gas water heaters, geothermal heat pumps and perhaps more important, heat pump and solar hot water systems, – technologies that are particularly cost effective in Florida – through the energy code system. This is in direct conflict with s.553.9061(2), F.S, and other Florida law mandates, which require that the FEC recognize such systems and new technologies for compliance with its energy performance goals.

5.4 Air Distribution System Closure, Air Barriers and Moisture control

The 2009 FEC (and many previous editions of Florida's Energy Code) contains specific provisions on forced air distribution system closure and air barrier integrity. These provisions are significantly more detailed in the 2009 FEC than the provisions for these building elements in the 2009 IECC. While the 2009 IECC makes significant improvements over the 2006 IECC in this regard, its provisions are still not nearly equivalent to those of the 2009 FEC. For example, the prescriptive provisions of the 2009 IECC for air distribution system leakage require that tested duct leakage to outdoors be limited to 8 cfm per 100 ft^2 of conditioned floor area. The equivalent provisions in the 2009 FEC are found in Method B compliance, where the requirement is significantly more stringent at 3 cfm per 100 ft^2 of conditioned floor area.

Additionally, the 2009 FEC contains specific provisions for the treatment of air handler enclosures, return air pathways, return plenums and return air transfer areas. None of these Florida-specific provisions are contained in the 2009 IECC. It is quite important to understand that these provisions are critically important in Florida where they provide significant enhancement to humidity control in Florida buildings. Each of these important, Florida-specific provisions is delineated in detail in the 2006 report to DCA on code differences.[8]

In Florida, with its very humid outdoor summer conditions, it is critically important that such provisions be codified. The research since the mid 1980's has clearly shown that air distribution system leakage, consistency between the thermal and air barriers in envelopes, and correct pressure balance in buildings is critically important to being able to maintain humidity control in Florida buildings. For example, forced-air supply systems located in attics that leak to the outdoors (a common occurrence in residential attics in the mid and late 1980s) will cause the home to be depressurized, bringing an equal amount of humid, outdoor air into the home through its envelope systems. This results in significantly increased humid outdoor air introduced into the conditioned space, often resulting in an inability to control indoor humidity and comfort. Additionally, pressure-induced envelope infiltration often results in building material degradation and electrical safety issues where the entering humid outdoor air comes in contact with surfaces that have been cooled below the outdoor dewpoint temperature by the air conditioning system.

5.5 Compliance Software

Since the mid 1980s, Florida has required that a single, Florida-developed, whole-building, performance-based code compliance software be used to show compliance with the Florida Energy Code. Until the 2007 FEC was promulgated, this software was based on load correlation coefficients and was hampered by the necessity to develop correlation coefficients for each new technology and building methodology that arose. Beginning with the 2007 FEC, Florida revised its code compliance software to use the hourly simulation capability of DOE-2.1E to avoid these load correlation development challenges and to provide more accurate assessment of whole-building energy use.

[8] *ibid*, Basarker, et al., 2006

There are distinct advantages to Florida's code compliance software policy.

- It provides for a completely level playing field, whereby every code compliance calculation is achieved through the same computational mechanism

- It eliminates "gaming" of the code compliance system, which would otherwise occur if various software tools that provide different results were allowed to demonstrate code compliance

- It avoids the need for the state to develop and maintain a set of software verification tests and procedures and administer such a program to ensure that all software used for code compliance produces the same results in all cases in order to avoid compliance "gaming."[9]

The disadvantage of Florida's code compliance software policy is that there is a small cost to maintain and update the compliance software. This cost is fully borne by the software users and is very small (averaging on the order of $1 per new home) compared with the overall costs of code compliance. If the state chose to develop and maintain the software verification tests and procedures to allow multiple software tools to qualify as code compliance software in Florida as California does, there would be additional costs – costs that would be well over and above the current cost.

Since Florida's 2007 FEC aligns rather precisely with the building performance requirements of the 2006 IECC, some interest groups have advocated strongly for the use of the U.S. Department of Energy's "free" *REScheck* software for demonstrating code compliance in Florida. The published User's Guide explains the *REScheck* compliance calculations as follows. [10]

> *"REScheck performs a simple* ***U-factor*** *x Area (****UA****) calculation for each building assembly to determine the overall UA of your building. The UA that would result from a building conforming to the code requirements is compared against the UA for your building. If the total heat loss (represented as a UA) through the* ***building envelope*** *does not exceed the total heat loss from the same building conforming to the code, then the software declares that you pass. A high-efficiency equipment trade-off can also be performed."*

The overall UA compliance mechanism has been shown to misrepresent efficiency in Florida homes, where building characteristics like window SHGC and exterior surface reflectance can be equally or more important to overall building efficiency and energy use than simplified U-factor analysis can predict.

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[9] The state of California chose this alternative for its code system. The California Energy Commission maintains a 400-page set of procedures titled the "Alternative Compliance Manual" specifying detailed software verification testing and reporting requirements for software authorized the State for use in demonstrating code compliance in accordance with Title 24 (California's energy code).

[10] RES*check* Software User's Guide, http://www.energycodes.gov/rescheck/pdfs/rescheck_users_guide_1008.pdf

Current versions of *REScheck* also contain a trade-off option related to HVAC performance, whereby heating and cooling equipment efficiencies above the minimum requirement may be traded against the overall UA requirements for the envelope. However, when *REScheck* becomes available for the 2009 IECC, it will, of necessity, be restricted by the provisions of the 2009 IECC to disallow any equipment efficiency trade-offs, leaving only its UA envelope trade-off capability, which does not adequately account for important Florida energy efficiencies like white roofs and low-SHGC windows.

Florida's leadership in the code compliance software arena is also recognized by the U.S. Department of Energy. As a result, Florida's Governors Energy Office (GEO) has received a significant State Energy Program block grant from the U.S. Department of Energy to upgrade its code compliance software to incorporate DOE's newly released Energy Plus simulation engine into Florida's EnergyGauge code compliance software.

5.6 Baseline Home and Compliance Scoring

The 2009 IECC contains specific requirements for code compliance software. Florida's current code compliance software, EnergyGauge USA FlaRes2008, meets or exceeds these requirements with one exception – it does not use the 2009 *Standard Reference Design* (Baseline Home) and *Proposed Design* (As-built Home) configuration specifications of Table 405.5.2(1) of the 2009 IECC. Rather it uses the *Standard Reference Design* and *Proposed Design* configuration specifications of Table 404.5.2(1) of the 2006 IECC in conjunction with a requirement that the energy loads or costs for the *Proposed Design* be 85% of those of the *Standard Reference Design*. If the FBC chooses to maintain the policy of holding the comparison baseline constant, reducing the required percentage energy use for compliance, then, in order to comply with Florida HB 7135, this value would become 80% in the 2010 FEC.

As detailed in section 4.2.2 of this report, there are four distinct differences between the specifications of the 2006 and 2009 IECC. Most daunting of these differences is the fact that the 2009 IECC alters the thermostat settings used in the performance option rather dramatically. The heating set point is raised by 4 ^{o}F, from 68 to 72 ^{o}F, and the cooling set point is lowered 3 ^{o}F, from 78 ^{o}F to 75 ^{o}F. As shown in Table 4, this difference results in projected energy uses that are significantly different from those projected using the 2006 IECC thermostat settings, making apples-to-apples comparisons across code editions very difficult, if not virtually impossible. Table 5 illustrates this fact, showing the projected total energy use for heating, cooling and hot water for the 2006 and 2009 IECC Standard Reference Design (baseline) homes under both sets of thermostat schedules in five Florida cities.

Table 5. Differences in projected energy use for 2006 and 2009 IECC Standard Reference Design Homes (baseline) under two sets of thermostat set point temperatures

Code:	2006 Baseline			2009 Baseline		
Thermostat:	68/78	72/75	% diff	68/78	72/75	% diff
Miami	8,232	10,584	28.6%	7,096	9,190	29.5%
Tampa	7,280	9,490	30.4%	6,319	8,295	31.3%
Orlando	6,617	8,790	32.8%	5,827	7,694	32.0%
Jacksonville	6,763	9,153	35.3%	6,101	8,151	33.6%

Code:	2006 Baseline			2009 Baseline		
Thermostat:	68/78	72/75	% diff	68/78	72/75	% diff
Tallahassee	6,898	9,293	34.7%	6,239	8,317	33.3%

There is also a difference between "compliance scoring" for the 2009 IECC and the 2009 FEC. The 2009 IECC allows either energy costs or source energy use to be used in determining compliance through the Simulated Performance Option. The 2009 FEC uses a scoring procedure known as the normalized modified loads method,[11] which is based on the building loads, modified by the ratio of the as-built to baseline equipment efficiencies and then normalized to account for efficiency differences between the standard equipment and the best available equipment in the marketplace by fuel type. This scoring method was developed specifically to avoid a distorted outcome that occurs across fuel types when the baseline building is required to have the same fuel type as the as-built building – the condition prescribed by most current energy codes and rating systems.

Full details and discussion of this phenomena are found in the cited reference but suffice it to say that the distorted outcomes stem from the fact that the denominator of what is called the "scoring fraction" changes when the fuel type changes. The "scoring fraction" comprises the ratio of the as-built "points" divided by the baseline "points." It is this fraction multiplied by 100 that determines the Energy Performance Index (EPI) in the 2009 FEC. The simplest way to illustrate the scoring distortion is to take any fraction and increment both its numerator and denominator by the same amount. For example take 3/4 (equivalent to EPI = 75) and add 1 to both the numerator and the denominator. The result is 4/5 (equivalent to EPI = 80) – a significant difference. When the rules of comparative building energy analysis (which is what whole-building performance compliance is) require that the baseline home have the same fuel type as the as-built home, the denominator of this "scoring fraction" will change when the fuel type changes.

The normalized modified loads method is one means of overcoming this mathematical challenge because if forces the denominator of the "scoring fraction" to remain constant. This result is possible because the denominator is based on the building's load, which is independent of fuel type, rather than on the building's energy use, which is dependent on fuel type. The only other known means of overcoming this mathematical scoring distortion is to fix the baseline fuel type, independent of the as-built fuel type, such that the denominator of the "scoring fraction" remains constant across all fuel types.

5.7 Achieving Florida's Goals

Through HB 7135, Florida's legislature has established commendable, albeit arduous, building energy efficiency goals over time. We have considerable certainty that reaching the 20% goal in 2010 will be cost effective.[12] However, as we move forward in time, the goals will become more

[11] Fairey, P., et al., 2000. "The HERS Rating Method and the Derivation of the Normalized Modified Loads Method." FSEC-RR-54-00, Florida Solar Energy Center, Cocoa, FL. (http://www.fsec.ucf.edu/en/publications/html/FSEC-RR-54-00/)

[12] Fairey, P., February 2009, "Energy Efficiency Cost-Effectiveness Tests for Residential Energy Code Update Processes." FSEC-CR-1794-09, Florida Solar Energy Center, Cocoa, FL.

difficult with each code cycle. There are two policy principles that are currently working in Florida's favor with respect to effectively meeting these goals:

1. The Florida legislature has clearly established both the goals and the basis against which the goals are to be measured (i.e. the 2007 FEC), and

2. The Florida Building Commission has initiated the first 15% improvement in the process by choosing to maintain the same baseline performance reference, simply requiring that compliance be achieved by improving on that baseline performance by 15% (i.e. achieving an EPI of 85 or less).

This second policy decision is critically important to achieving Florida's goals because it introduces a level of **measurable certainty** in the marketplace that has not previously existed in the energy code arena. The normal means of strengthening building energy code requirements is to alter the performance baseline. When this is done, it is usually very difficult, if not impossible, to predict the future with respect to qualifying building design. However, the FBC's decision to maintain a consistent performance baseline and simply require the energy use of compliant buildings to be less than the energy use of that baseline by specified percentages over time allows the marketplace to precisely predict the building designs that will qualify, not only today but far into the future. In other words, the marketplace can prepare itself for the future with certainty and there is very little that competitive markets like better than certainty. For example, a designer or builder that is planning for the 2010 code cycle can use the existing Florida energy code compliance software to precisely decide in detail what will achieve compliance and what will not – they need not wait for 2010 FEC compliance software to be produced to accomplish such analysis. This provides a powerful certainty in the market that spurs both investment and innovation.

However, as Florida moves forward, it is also quite important to understand what can and cannot be accomplished from a technical perspective. In some respects, we are close to either the cost effective or the technical limits that can be achieved in building energy efficiency. The cost effectiveness limits may change over time but the physics associated with the technical limitations will not. For example, as we increase the thermal resistance (R-Value) of the building envelope, we eventually reach a point where adding another "R" buys us very little in terms of increased efficiency. We can examine the cost-effectiveness implications of this using Florida's building code software and its newly proposed rule on cost effectiveness.

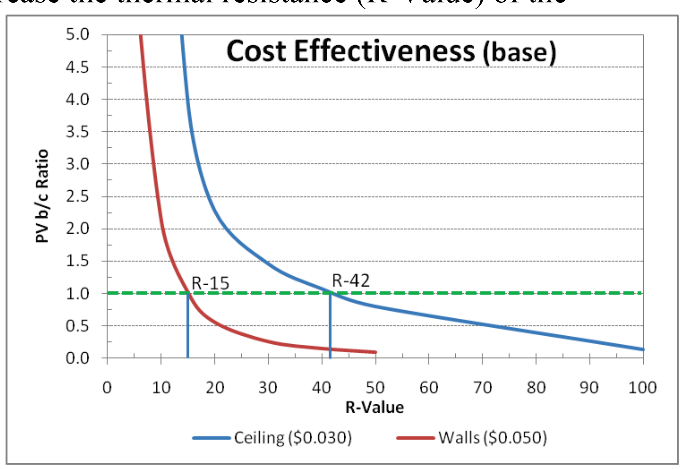

Figure 1. The cost effectiveness for incremental changes in ceiling and wall insulation R-value.

Figure 1 illustrates the principle in terms of the cost-effectiveness of increased wall and ceiling insulation for a 2000 ft^2, single-story, slab-on-grade, frame home located in Daytona Beach, Florida, configured as the 2009 FEC baseline home in all aspects excepting the ceiling and wall insulation levels. The costs shown in the parenthesis on the legends for the ceiling and wall plots are in units of $ per R-Value per square foot of ceiling or wall area. The vertical axis of the graph is the present value (PV) benefit-to-cost (b/c) ratio of each incremental change in R-value, calculated in accordance with Florida's proposed code cost-effectiveness rule (FAC 9B.13.0071). What is very clear from the analysis is that increased ceiling and wall insulation is extremely cost effective if you have no insulation. But it is also quite clear from this figure that once a certain insulation value is passed, the benefit-to-cost ratio approaches zero.

As a parallel to this cost effectiveness analysis, one can also evaluate the impact of increased envelope insulation R-Values on Florida Energy Code compliance. This is accomplished by plotting the same R-value data shown in Figure 1 against the code EPI achieved at each insulation level.

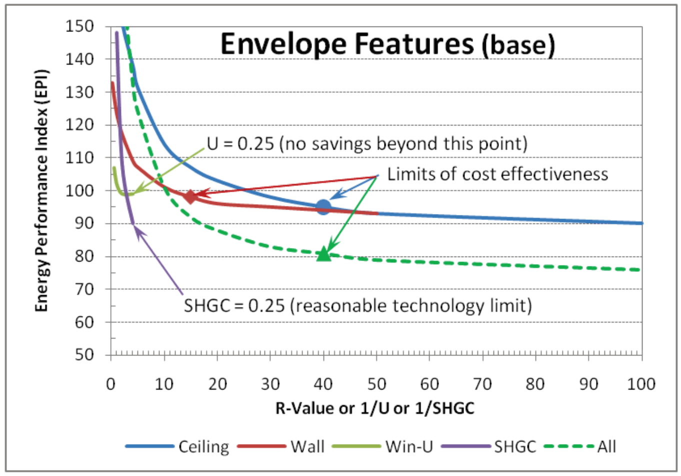

Figure 2. Energy Performance Index values for building envelope features as a function of thermal performance.

Figure 2 provides these data. In addition to wall and ceiling insulation data, Figure 2 contains data on window performance. In the case of windows, the reciprocal of the window U-Factors and Solar Heat Gain Coefficients (1/U and 1/SHGC) are used for the horizontal axis of the plot so as to allow all of these envelope components to coexist on the same plot. For the green dashed line plot line that is labeled 'all', the analysis is structured in such a way that each of the components have the value given on the horizontal axis at each point along the curve. However, as the green dashed line moves toward the right-hand side, the individual components cease to change in value after they have reached their peak or maximum cost effectiveness value (shown on the plot for each individual component). In other words, the U-factor for windows remains 0.25 for all points on the line beyond the R-4 value that corresponds to U=0.25. The same is true for the SHGC=0.25 and for wall insulation above R-15 (its cost effectiveness limit). It should also be pointed out that the window performance values presented in Figure 2 do not consider cost effectiveness. These values are limited only by the point at which no further savings can be achieved for U-factor and the reasonable technological limit for SHGC.

The most significant aspect of Figure 2 is that it vividly illustrates the impossibility of achieving 30%-50% energy savings through improvements in thermal building envelope features alone. Even if we "max out" the technical and cost effective limits of these envelope features, we do not reach the 20% savings requirement for the 2010 FEC. Thus, it is clear that the future even greater performance improvement levels of 30-50% will require consideration of other contributors to overall building energy use than just the building envelope.

Figures 3 and 4 illustrate there are at least two other building envelope and systems factors besides equipment efficiencies that have energy load savings potentials in Florida homes.

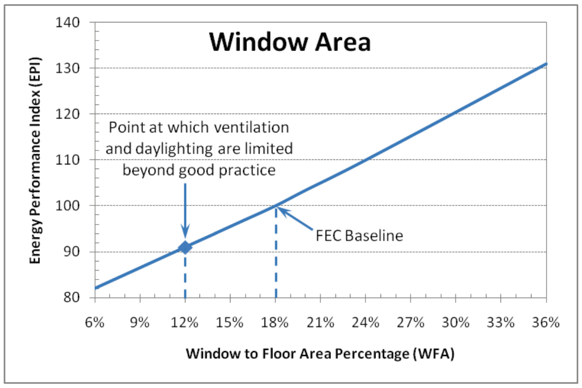

Figure 3. Impact of window area on EPI

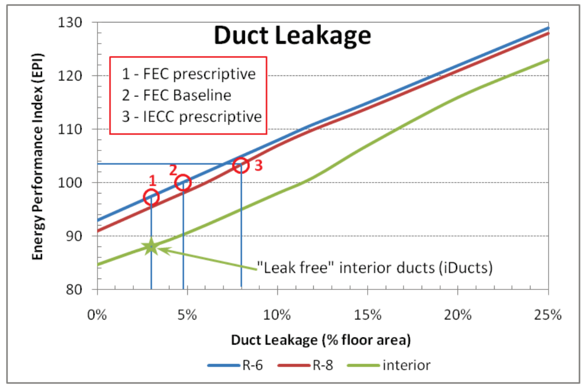

Figure 4. Impact of duct leakage on EPI

It is clear from these figures that each of these building features can have significant impacts on the efficiency of Florida homes. Adapting these features for more efficient design together with integration of higher efficiency space conditioning and water heating equipment will be key to achieving the 30-50% greater efficiency levels required by Florida law.

Figure 4 also illustrates that Florida's baseline for air distribution system efficiency is already more stringent than the prescriptive requirements of the 2009 IECC and that the FEC prescriptive requirement is more stringent than the FEC baseline. These and other technical issues will be the subject of follow-on technical studies as the FBC moves toward development of its 2010 FEC and looks to the future where much more efficiency gains will be required.

6 Preliminary Recommendations

It is highly recommended that the FBC maintain its current policy of using the 2007 FEC performance baseline coupled with decreasing Energy Performance Indices (EPIs) as the basis of compliance with Florida's current and future code cycles. This recommendation is made for two primary reasons, as follows:

1. HB 7135 requires that improvements be made relative to the 2007 FEC and altering the performance baseline would make demonstrating that HB 7135 requirements had been met very difficult, if not impossible (as explained, the change in thermostat set point temperatures implemented by the 2009 IECC confounds comparison).

2. There is significantly enhanced marketplace certainty associated with the current FBC policy that has potential to drive down the energy use in homes and buildings through competition and innovation if the baseline performance standard remains constant rather than changing for each code cycle.

It is also highly recommended that Florida's code continue to allow full trade-offs between envelope efficiency features and heating, cooling and hot water equipment efficiency. Without this ability it very likely will be impossible for Florida to meet the performance goals of

HB 7135 in year 2013 and beyond. The flexibility provided by tradeoff of equipment and building component efficiencies is essential to builder adaptation to increasing requirements and for innovation and integration of new technologies into the construction mainstream. Not allowing these equipment efficiency trade-offs significantly impedes marketplace competition innovation as product manufacturers compete with one another for the most cost competitive means of complying with Florida's code.

From the above review of the relevant codes, it is also clear that the Florida Building Commission will not be able to comply with the provisions of HB 7135 by adopting the 2009 IECC as the foundation code unless significant modifications are made to its provisions. First, the 2009 FEC commercial building provisions are already 6-11% more energy efficient than the 2009 IECC commercial building provisions. Second, HB 7135 establishes a schedule that requires the 2010 FEC to be at least 5% more efficient than the 2009 FEC (i.e. 20% more efficient than the 2007 FEC) and each edition of the FEC after that to be 10% more efficient until 50% increase in efficiency is implemented in the 2019 FEC, which cannot be achieved unless the provisions of the 2009 IECC are modified.

In addition, the specific provisions of the 2009 IECC on residential buildings often conflict with Florida-specific requirements. For example, it is untenable to allow unlimited window area in Florida's residential code compliance prescriptive option (as is done in the 2009 IECC) when window heat gains are a major component of Florida's residential cooling loads. The 2009 IECC is also considerably weaker than the 2009 FEC with respect to air distribution system leakage, air barrier specification, return air transfer area and other specifically codified FEC provisions that Florida deems critical to moisture control and humidity management in homes. Finally, the practice of not allowing equipment efficiencies to play a part in performance-based code compliance is odious and eliminates the flexibility of performance codes by constraining compliance considerations to just trade-offs in building envelope component efficiencies. It severely limits the options available to builders and home owners for code compliance, unduly restricts the cost-effectiveness of code compliance, limits innovation and research and development in the marketplace and disallows cost-effective, enhanced-efficiency options such as tankless water heating, heat pump water heating, heat recovery units and solar water heating, which, by law, the code must provide as compliance options.

To accomplish the duel directives of HB 7135, the following preliminary recommendations should be considered by the FBC and it Energy Technical Advisory Committee (TAC). Using the 2009 IECC document as the basis, modify all sections necessary to bring its provisions in line with the Florida-specific provisions of the 2009 FEC. At a minimum, the following modifications to the IECC 2009 are recommended:

1. Modification of the Chapter 6 Referenced Standards to specify ANSI/ASHRAE/IESNA Standard 90.1-2004 as the baseline standard for commercial building compliance in accordance with sections 501.1 and 501.2 of the 2009 IECC.
2. Modification of section 501.2 to require that compliance requires that the projected energy cost of the *as-built building* be equal to or less than 80% of the energy cost of the *baseline* building.

3. Modification of Table 402.1.1 to place a maximum limit on the window to floor area ratio of fenestration in Florida homes for the prescriptive option.
4. Modification to strike section 402.1.4, Total UA Alternative.
5. Modification of section 402.4.2.1 to require that testing be accomplished by a certified tester in accordance with Florida requirements
6. Modification to strike Table 402.4.2
7. Modification of section 403.2.2 to substitute "Prescriptive" in place of "Mandatory" for this section and strike the Exception at the end of the section
8. Modification of section 403.2.2 sub clause 2 to require that total air leakage be no greater than 3 cfm per 100 ft^2 of conditioned floor area.
9. Modification to strike section 402.5, Maximum fenestration U-factor and SHGC.
10. Modification of section 405.3 to require that compliance requires the normalized loads projected for the *proposed design* be equal to or less than 80% of the projected loads for the *standard reference design* using the normalized modified loads as the basis of comparison.
11. Modification to strike section 405.4.3, Additional documentation
12. Modification of Table 405.5.2(1) to replace it in its entirety with Table 13-613.A.1-1of the 2009 FEC.
13. Modification of section 405.6.1 to require the use of Florida's code compliance software.
14. Modification to strike section 405.6.2.
15. Modification of Chapters 4 and 5 to add the Florida-specific requirements for air distribution system closure, air barrier integrity, return air transfer area, duct insulation, pressure balance and conditioned space (e.g. unvented attics) requirements of the 2009 FEC.
16. Modification of the provisions of Chapter 2 to include all Florida-specific definitions for terms that are added in other sections.
17. Other modifications as necessary for internal consistency.

The above recommendations are preliminary and likely require significant modification as the FBC moves through the consensus process. However, they should enable the FBC to meet both of the principle requirements of HB 7135. The "foundation code" requirement is met because the 2009 IECC is used as the basis for all modifications and the 20% efficiency requirement is met because the 2009 IECC is modified to maintain the efficiencies of the FEC and compliance is based on projected energy costs or normalized loads that are 80% or less than those of the 2007 baseline.