

GEW26-14

202, 302.1, 302.1.1, 602.1, 602.1.1, 602.1.2, 602.1.2.1, 602.1.2.2, 602.1.2.3, 602.2, 603.3.7, 1007.3, 1007.3.3.1, A106, A106.1

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute (srosenstock@eei.org); Charles Foster, Steffes Corporation, representing self.

Delete and substitute definition as follows:

~~**ZERO ENERGY PERFORMANCE INDEX (zEPI).** A scalar representing the ratio of energy performance of the proposed design compared to the average energy performance of buildings relative to a benchmark year.~~

YEARLY ENERGY COST INDEX (yECI). A scalar representing the ratio of the annual energy cost of the proposed design compared to the annual energy cost of the same building constructed in accordance with the minimum requirements and maximum allowances of the *International Energy Conservation Code*.

Revise as follows:

302.1 Requirements determined by the jurisdiction. The jurisdiction shall indicate the following information in Table 302.1 for inclusion in its code adopting ordinance:

1. The jurisdiction shall indicate whether requirements for residential buildings, as indicated in Exception 1 to Section 101.3, are applicable by selecting “Yes” or “No” in Table 302.1. Where “Yes” is selected, the provisions of ICC 700 shall apply and the remainder of this code shall not apply.
2. Where the jurisdiction requires enhanced energy performance for buildings designed on a performance basis, the jurisdiction shall indicate a ~~zEPI of 46~~ yECI of 0.75 or less in Table 302.1 for each occupancy required to have enhanced energy performance.
3. Where “Yes” or “No” boxes are provided, the jurisdiction shall check the box to indicate “Yes” where that section is to be enforced as a mandatory requirement in the jurisdiction, or “No” where that section is not to be enforced as a mandatory requirement in the jurisdiction.

**TABLE 302.1
REQUIREMENTS DETERMINED BY THE JURISDICTION**

Section	Section Title or Description and Directives	Jurisdictional Requirements	
CHAPTER 6. ENERGY CONSERVATION, EFFICIENCY AND CO₂e EMISSION REDUCTION			
302.1, 302.1.1, 602.1	zEPI <u>yECI</u> of Jurisdictional Choice – The jurisdiction shall indicate a zEPI of 46 <u>yECI of 0.75</u> or less in each occupancy for which it intends to require enhanced energy performance.	Occupancy: _____ <u>yEPI</u> <u>yECI</u> : _____	
604.1	Automated demand response infrastructure	<input type="checkbox"/> Yes	<input type="checkbox"/> No
CHAPTER 10. EXISTING BUILDINGS			
1007.2	Evaluation of existing buildings	<input type="checkbox"/> Yes	<input type="checkbox"/> No
1007.3	Post Certificate of Occupancy zEPI <u>yECI</u> , energy demand, and CO ₂ e emissions reporting	<input type="checkbox"/> Yes	<input type="checkbox"/> No

(portions of table not shown remain unchanged)

302.1.1 zEPI of 46 or less yECI of 0.75 or less. Where a ~~zEPI of 46~~ yECI of 0.75 or less is indicated by the jurisdiction in Table 302.1, buildings shall comply on a performance-basis in accordance with Section 601.3.1.

Exception: Buildings less than 25,000 square feet (2323 m²) in *total building floor area* pursuing compliance on a prescriptive basis shall be deemed to have a ~~zEPI of 54~~ yECI of 0.8 and shall not be required to comply with the ~~zEPI~~ yECI of Jurisdictional Choice indicated by the jurisdiction in Table 302.1.

Revise as follows:

602.1 Performance-based compliance. Compliance for buildings and their sites to be designed on a performance basis shall be determined by predictive modeling. Predictive modeling shall use ~~source energy cost kBtu/sf-y unit measure~~ based on compliance with Section 602.1.1 and CO₂e emissions in Section 602.3. Where a building has mixed uses, all uses shall be included in the performance-based compliance.

602.1.1 zEPI. yECI. Performance-based designs shall demonstrate ~~a~~ an annual energy cost index zEPI yECI of not more than ~~54~~ 0.8 as determined in accordance with Equation 6-1 for energy ~~use cost~~ reduction and shall demonstrate a CO₂e emissions reduction in accordance with Section 602.2 and Equation 6-2 for CO₂e.

$$zEPI = 57 \times (EUI_p/EUI) \quad yECI = (EUCI_p/EUCI) \quad \text{Equation 6-1)}$$

where:

~~EUI_p~~ EUCI_p = the proposed annual energy use index in source kBtu/sf-y cost for the proposed design of the building and its site calculated in accordance with Section 602.1.2.
~~EUI~~ EUCI = the base annual energy use index in source kBtu/sf-y cost for a baseline building and its site calculated in accordance with Section 602.1.2.

602.1.2 Base Annual energy cost index. The proposed and base annual energy use cost index (~~EUI_p~~ EUCI_p and ~~EUI~~ EUCI) of the building and building site shall be calculated by a registered design professional in accordance with Equation 6-1 and an annual energy cost simulation software approved by the authority having jurisdiction and ~~Appendix G to ASHRAE 90.1, as modified by Sections 602.1.2.1 through 602.1.2.3.~~ The annual energy use shall include all energy used for building functions and its anticipated occupancy.

~~**602.1.2.1 Modifications to Appendix G of ASHRAE 90.1.** The performance rating in Section G1.2 of ASHRAE 90.1 shall be based on energy use converted to consistent units in accordance with Sections 602.1.2.2 and 602.1.2.3, instead of energy cost.~~

**TABLE 602.1.2.1
ELECTRICITY GENERATION ENERGY CONVERSION FACTORS BY EPA eGRID SUB-REGION^a**

eGRID 2007 SUB-REGION ACRONYM	eGRID 2007 SUB-REGION NAME	ENERGY CONVERSION FACTOR
AKGD	ASCC Alaska Grid	2.97
AKMS	ASCC Miscellaneous	4.76
ERCT	ERCOT All	2.93
FRCC	FRCC All	2.97
HIMS	HICC Miscellaneous	3.82

eGRID-2007 SUB-REGION ACRONYM	eGRID-2007 SUB- REGION NAME	ENERGY CONVERSIO N FACTOR
HIOA	HICC-Oahu	3.14
MORE	MRO-East	3.40
MROW	MRO-West	3.41
NYLI	NPGC-Long-Island	3.20
NEWE	NPCC-New-England	3.01
NYCW	NPGC-NYC/Westchester	3.32
NYUP	NPCC-Upstate-NY	2.51
RFCE	RFC-East	3.15
RFCM	RFC-Michigan	3.05
RFCW	RFC-West	3.14
SRMW	SERC-Midwest	3.24
SRMV	SERC-Mississippi-Valley	3.00
SRSO	SERC-South	3.08
SRTV	SERC-Tennessee-Valley	3.11
SRVC	SERC-Virginia/Carolina	3.13
SPNO	SPP-North	3.53
SPSO	SPP-South	3.05
GAMX	WECC-California	2.61
NWPP	WECC-Northwest	2.26
RMPA	WECC-Rockies	3.18
AZNM	WECC-Southwest	2.95

a. Sources: EPA eGrid2007 version 1.1, 2005 data; EPA eGrid regional gross-grid loss factors; EIA Table 8.4a (Sum tables 8.4b and 8.4c) and Table 8.2c (Breakout of Table 8.2b), 2005 data.

602.1.2.2 Electric power. In calculating the annual energy use index, electric energy used shall be consistent units by converting the electric power use at the utility meter or measured point of delivery to Btus and multiplying by the conversion factor in Table 602.1.2.1 based on the geographical location of the building.

**TABLE 602.1.2.2
U.S. AVERAGE BUILDING FUELS ENERGY CONVERSION FACTORS BY FUEL TYPE^a**

FUEL TYPE	ENERGY CONVERSION FACTOR
Natural Gas	1.09
Fuel Oil	1.13
LPG	1.12

a. Source: Gas Technology Institute Source Energy and Emissions Analysis Tool.

602.1.2.3 Nonrenewable energy. In calculating the annual energy use index for fuel other than electrical power, energy use shall be converted to consistent units by multiplying the nonrenewable energy fossil fuel use at the utility meter or measured point of delivery to Btu's and multiplying by the conversion factor in Table 602.1.2.2. The conversion factor for energy sources not included in Table 602.1.2.2 shall be 1.1. Conversion factors for purchased district heating shall be 1.35 for hot water and 1.45 for steam. The conversion factor for district cooling shall be 0.33 times the value in Table 602.1.2.1 based on the EPA eGRID Sub-region in which the building is located.

602.2 Annual direct and indirect CO₂e emissions. The CO₂e emissions calculations for the building and building site shall be determined in accordance with Sections 602.2.1 and 602.2.2. The emissions associated with the proposed design shall be less than or equal to the CO₂e emissions associated with the standard reference design in accordance with Equation 6-2.

$$CO_2e_{pd} \geq (zEPI_{yECI} \times CO_2e_{srbd})/57 \quad \text{(Equation 6-2)}$$

where:

$zEPI_{yECI}$ = the minimum score calculated energy cost ratio in accordance with Section 602.1.1.

CO_2e_{pd} = emissions associated with the proposed design.

CO_2e_{srbd} = emissions associated with the standard reference budget design in accordance with Section 602.1.2.

603.3.7 Renewable and waste energy. Equipment and systems providing energy from renewable or waste energy sources which is included in the determination of the building $zEPI_{yECI}$, shall be capable of being metered to allow a determination of the output of equipment and systems in accordance with Sections 603.3.7.1 through 603.3.7.5.

Revise as follows:

1007.3 Post certificate of occupancy $zEPI_{yECI}$, energy demand, and CO₂e emissions reporting.

Where the jurisdiction indicates in Table 302.1 that ongoing post certificate of occupancy $yECI_{zEPI}$, energy demand and CO₂e emissions reporting is required, and where the jurisdiction has indicated in Table 302.1 that enhanced energy performance in accordance with Section 302.1 or CO₂e emissions in accordance with Section 602.2 are required, $yECI_{zEPI}$, energy demand, and CO₂e emissions reporting shall be provided in accordance with this section.

1007.3.3.1 Annual net energy use. The $zEPI_{yECI}$ associated with the operation of the building and the buildings on the site, as determined in accordance with Section 602.1, shall be reported by the building owner or the owner's registered agent to the [INSERT NAME OF APPROPRIATE STATE OR LOCAL GOVERNMENT AGENCY RESPONSIBLE FOR COLLECTING REPORTED INFORMATION].

Where there are multiple buildings on a building site, each building shall have its $zEPI_{yECI}$ reported separately. Where there are energy uses associated with the building site other than the buildings on the site, the $zEPI_{yECI}$ for the building site shall be reported separately.

Energy use for the previous year shall cover the complete calendar year and be reported on, or before, March 1st of the following year.

Revise as follows:

**TABLE A106
ENERGY CONSERVATION AND EFFICIENCY**

SECTION	DESCRIPTION	MINIMUM NUMBER OF ELECTIVES REQUIRED AND ELECTIVES SELECTED
A102.2	The jurisdiction shall indicate a number between and including 0 and up to and including 10 to establish the minimum total number of project electives that must be satisfied.	—
A106.1	zEPI <u>yECI</u> reduction project electives	<input type="checkbox"/> Yes <input type="checkbox"/> No
A106.1	Project zEPI <u>yECI</u> is at least 5 points <u>3 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 1 elective
A106.1	Project zEPI <u>yECI</u> is at least 40 points <u>6 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 2 electives
A106.1	Project zEPI <u>yECI</u> is at least 45 points <u>9 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 3 electives
A106.1	Project zEPI <u>yECI</u> is at least 20 points <u>12 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 4 electives
A106.1	Project zEPI <u>yECI</u> is at least 25 points <u>15 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 5 electives
A106.1	Project zEPI <u>yECI</u> is at least 30 points <u>18 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 6 electives
A106.1	Project zEPI <u>yECI</u> is at least 35 points <u>21 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 7 electives
A106.1	Project zEPI <u>yECI</u> is at least 40 points <u>24 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 8 electives
A106.1	Project zEPI <u>yECI</u> is at least 45 points <u>27 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 9 electives
A106.1	Project zEPI <u>yECI</u> is at least 51 points <u>30 percent</u> lower than required by Table 302.1	<input type="checkbox"/> 10 electives
A106.2	Mechanical systems project elective	<input type="checkbox"/> Yes <input type="checkbox"/> No
A106.3	Service water heating	<input type="checkbox"/> Yes <input type="checkbox"/> No
A106.4	Lighting systems	<input type="checkbox"/> Yes <input type="checkbox"/> No
A106.5	Passive design	<input type="checkbox"/> Yes <input type="checkbox"/> No
A106.6	Renewable energy systems—5 percent	<input type="checkbox"/> Yes <input type="checkbox"/> No
A106.6	Renewable energy systems—10 percent	<input type="checkbox"/> Yes <input type="checkbox"/> No
A106.6	Renewable energy systems—20 percent	<input type="checkbox"/> Yes <input type="checkbox"/> No

A106.1 ~~zEPI~~ yECI reduction project electives. Project electives for buildings pursuing performance-based compliance in accordance with Section 601.3.1 shall be in accordance with the portions of Table A106 that reference Section A106.1~~7~~, and Equation 6-1 and the calculation procedures specified in Section 602.1.2.1.

Reason: This purpose of the proposal is to replace the existing zEPI concept with a new IgCC compliance metric; namely, yearly energy cost.

Conceptually, yECI is very straight forward as it merely compares the modeled energy cost of a proposed building to the modeled energy cost for the same building that is built to meet the minimum energy requirements of the IECC. yECI is flexible as it allows the use of any cost estimation software models so long as it has been approved by the authority having jurisdiction.

Energy cost is a metric that is easily understood by consumers, is used in several consensus building energy efficiency standards, and its adoption by the ICC would enhance the code's stature among the consuming public.

Moreover, there are many technical problems with how the existing zEPI metric is calculated. It is linked to ASHRAE Appendix G, and then modified with other factors. Under the latest revision to ASHRAE Standard 90.1 (2013), Appendix G and Chapter 11 (the Energy Cost Budget chapter) have been significantly changed. The key change is that the "baseline" building used for comparison is now "locked" using values and tables from ASHRAE 90.1-2004 (about equivalent to IECC 2006 Commercial Chapters). So while zEPI was originally intended to be compared to a building based on ASHRAE 90.1-2010, the ratio of 51/57 will now be used with a 2004 building, not a 2013 building.

Further, the existing zEPI approach uses so called "source energy" as its basis of comparison. To the extent source energy would ever be helpful (an assumption that is highly debated), the "source energy" estimates used for zEPI are out of date

and not technically defensible. The use of these incorrect and outdated estimates will lead to decisions that would increase energy usage and environmental impacts (e.g., switching end uses from electricity to fuel oil).

A 2012 DOE final report on focus group findings (for a program using source energy estimates) is helpful in understanding some of source energy's shortfalls. (See the Report at http://apps1.eere.energy.gov/buildings/publications/pdfs/commercial_initiative/asset_rating_seattle_focus_groups.pdf)

One of the Report's key findings was "[i]ncluding site versus source energy use was confusing or did not provide value. Site information was preferred by most stakeholders."

In addition, the report also stated "[s]everal building stakeholders did not find the source energy use information helpful because they are more concerned with site energy."

To meet the needs of building owners, the yearly energy cost index (yECI) would be most useful to users of the IgCC as shown in the DOE 2012 report:

Recommendation 5: Revise the cost metric data to enhance relevance to property owners and investors and increase overall understanding.

Property owners and investors were more interested in actual costs—for example, regional costs for energy use, estimated costs for energy consumption, and estimated costs/savings for upgrades for each system. Include estimated cost information, where possible, to address the needs of owners and investors.

Consistent with the DOE Report, by changing to a Yearly Energy Cost Index approach, the baseline building would be either the latest version of the IECC or ASHRAE 90.1 that is being enforced in a jurisdiction. In addition, it is a ratio that will have the most meaning to building owners that are trying to justify the extra expenses of building a green building.

Finally, rather than a 10.5% reduction as would occur using the zEPI approach (51/57 ratio), the requirements under the Yearly Energy Cost Index are 20% (0.8 ratio), which is significantly more stringent than the 10.5% reduction under zEPI.

In terms of specific proposed changes, this proposal would:

1. add a new definition for yECI
2. modify Section 3 by replacing zEPI with yECI,
3. modify Section 6 by replacing zEPI with yECI,
4. modify Section 10 by replacing zEPI with yECI, and
5. modify Appendix A by replacing zEPI with yECI.

Bibliography and web site links:

DOE, 2012. *DOE Commercial Building Energy Asset Rating Program Focus Groups with Primary Stakeholders in Seattle*. U.S. Department of Energy, Washington, D.C.

http://apps1.eere.energy.gov/buildings/publications/pdfs/commercial_initiative/asset_rating_seattle_focus_groups.pdf

<http://www.netl.doe.gov/energy-analyses/pubs/NG-GHG-LCI.pdf>

<http://www.pnas.org/content/early/2011/10/13/1107409108.full.pdf>

http://www.ipcc-nggip.iges.or.jp/public/gp/bgp/2_6_Fugitive_Emissions_from_Oil_and_Natural_Gas.pdf

https://circabc.europa.eu/d/d/workspace/SpacesStore/db806977-6418-44db-a-64-20267139b34d/Brandt_Oil_Sands_GHGs_Final.pdf <http://www.nytimes.com/2011/09/27/business/energy-environment/in-north-dakota-wasted-natural-gas-flickers-against-the-sky.html?pagewanted=all>
<http://www.investmentu.com/2011/September/natural-gas-flaring.html>

Methane Leaks from North American Natural Gas Systems

Science 14 February 2014: DOI: 10.1126/science.1247045

<http://www.sciencemag.org/content/343/6172/733.summary?rss=1>

Cost Impact: Will not increase the cost of construction.

GEW26-14: 602.1-ROSENSTOCK497