602 MODELED PERFORMANCE PATHWAY REQUIREMENTS PERFORMANCE-BASED COMPLIANCE

602.1 Performance-based compliance. Compliance for buildings and their sites to be designed on a performance basis shall be determined by predictive modeling of both energy performance and CO₂e emissions. Predictive energy modeling shall use source energy 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 Section 602.2. Predictive CO₂e emissions modeling shall be in accordance with Section 602.3.

602.1.1 zEPI 602.2 Energy performance modeling. Performance-based designs shall demonstrate a zEPI of not more than 54.50 as determined in accordance with Equation 6-1 for energy use reduction and shall demonstrate a CO₂e emissions reduction in accordance with Section 602.2 and Equation 6-2 for CO₂e.

\[
zEPI = 57 \times \left(\frac{\text{Proposed building performance}}{\text{Baseline building performance}}\right) \left(\frac{\text{EUIp}}{\text{EUI}}\right)
\]

(Equation 6-1)

where:

- \(EUIp\) = the proposed energy use index in source kBtu/sf-y for the proposed design of the building and its site calculated in accordance with Section 602.1.2.
- \(EUI\) = the base annual energy use index in source kBtu/sf-y for a baseline building and its site calculated in accordance with Section 602.1.2.

Proposed Building Performance = The proposed building performance in source kBtu for the proposed design of the building and its site calculated in accordance with Section 602.2.1.

Baseline Building Performance = The baseline building performance in source kBtu for a baseline building and its site calculated in accordance with Section 602.2.1.

57 = A fixed value representing the performance of a baseline building designed to comply with the 2012 International Energy Conservation Code.

602.1.2 Base annual energy use index. 602.2.1 Modeling methodology. The proposed energy use index (EUIp) building performance and the baseline building performance of the building and building site shall be calculated in accordance with Equation 6-1 and Appendix G to ASHRAE 90.1, as modified by Sections 602.1.2.1 through 602.1.2.3 Section 602.2.1.1 and Section 602.2.1.2. The annual energy use modeling shall include all energy used for building and site functions and its anticipated occupancy.

602.1.2.1 Modifications to Appendix G of ASHRAE 90.1—Energy units. The performance rating building performance calculations in Section G4.2 G3 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. 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 Btus and multiplying by the conversion factor in Table 602.1.2.2 based on the geographical location of the building.
602.1.2.2 Electric power. In calculating the annual energy use index, the proposed building performance and the baseline building performance, electric energy used shall be calculated in source energy consistent units by converting multiplying 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.

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.

### Table 602.1.2.2 602.2.1.2

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>ENERGY CONVERSION FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>1.09</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>1.13</td>
</tr>
<tr>
<td>LPG</td>
<td>1.12</td>
</tr>
<tr>
<td>Purchased District Heating - Hot Water</td>
<td>1.35</td>
</tr>
<tr>
<td>Purchased District Heating - Steam</td>
<td>1.45</td>
</tr>
<tr>
<td>District Cooling</td>
<td>0.33 x value in Table 602.1.2.1</td>
</tr>
<tr>
<td>Other</td>
<td>1.1</td>
</tr>
</tbody>
</table>

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

602.1.3 Registered design professional in responsible charge of building energy simulation. For purposes of this section, and where it is required that documents be prepared by a registered design professional, the code official is authorized to require the owner to engage and designate on the building permit application a registered design professional who shall act as the registered design professional in responsible charge of building energy simulation. Modelers engaged by the registered design professional in responsible charge of building energy simulation shall be certified by an approved accrediting entity. Where the circumstances require, the owner shall designate a substitute registered design professional in responsible charge of building energy simulation who shall perform the duties required of the original registered design professional in responsible charge of building energy simulation. The code official shall be notified in writing by the owner whenever the registered design professional in responsible charge of building energy simulation is changed or is unable to continue to perform the duties.

602.2 Annual direct and indirect CO₂e emissions. The CO₂e emissions calculations for the proposed and baseline building and building site shall be determined based on the proposed and baseline building performance calculated in accordance with Sections 602.2.1 and 602.2.2 as modified by Sections 602.3.1 and 602.3.2. The emissions associated with the proposed...
design shall be less than or equal to the CO₂ e emissions associated with the standard reference design in accordance with Equation 6-2.

\[ \text{CO₂ e pdp} \geq (\text{zEPI} \times \text{CO₂ e sr bd bbp})/57 \]  

(Equation 6-2)

where:

\( \text{zEPI} \) = the minimum score in accordance with Section 602.1.1 602.2.

\( \text{CO₂ e pdp} \) = emissions associated with the proposed design building performance.

\( \text{CO₂ e sr bd bbp} \) = emissions associated with the standard reference budget design baseline building performance in accordance with Section 602.1.2.

57 = A fixed value representing CO₂ e emissions of a baseline building designed to comply with the 2012 International Energy Conservation Code.

### 602.2.4 602.3.1 Onsite CO₂ e emissions from electricity

Emissions associated with use of electric power shall be based on electric power excluding any renewable or recovered waste energy covered under Section 602.2.1. Emissions shall be calculated by converting the electric power used by the building at the electric utility meter or measured point of delivery, to MWHs, and multiplying by the CO₂ e conversion factor in Table 602.2.1 based on the EPA eGRID Sub-region in which the building is located.

### 602.2.2 602.3.2 Onsite nonrenewable energy

Emissions associated with the use of nonrenewable energy sources other than electrical power such as natural gas, fuel oil, and propane shall be calculated by multiplying the fossil fuel energy used by the building and its site at the utility meter by the national emission factors in Table 602.2.2 and the conversions required by this section. Emissions associated with fossil fuels not specified in Table 602.2.2 shall be calculated by multiplying the fossil fuel used by the building at the utility meter by 250. Emissions associated with purchased district energy shall be calculated by multiplying the energy used by the building at the utility meter by 150 for hot water and steam, and for district cooling shall be calculated by multiplying the factors from Table 602.2.2 602.2.1 based on the EPA eGRID Sub-region in which the building is located.

<table>
<thead>
<tr>
<th>TABLE 602.2.2 602.3.2 FOSSIL FUEL EMISSION FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMISSION RATE (lb/MMBtu HHV)</td>
</tr>
<tr>
<td>CO₂ e</td>
</tr>
</tbody>
</table>

For SI: MMBtu = 1,000,000 Btu = 10 terms; HHV = High-heating value.

<table>
<thead>
<tr>
<th>TABLE 602.3.2 FOSSIL FUEL EMISSION FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATIONARY FUEL TYPE</td>
</tr>
<tr>
<td>Natural Gas</td>
</tr>
<tr>
<td>Fuel Oil</td>
</tr>
<tr>
<td>Propane</td>
</tr>
<tr>
<td>Other Fossil Fuels</td>
</tr>
<tr>
<td>Purchased District Energy – Hot water and steam</td>
</tr>
</tbody>
</table>

For SI: MMBtu = 1,000,000 Btu = 10 terms; HHV = High-heating value.

### 602.2.3 Annual direct and indirect CO₂ e emissions associated with onsite use of fossil fuels and purchased district energy

Emissions associated with the use of natural gas, fuel oil, and propane shall be calculated by multiplying the natural gas, fuel oil, and propane delivered to the building at the utility meter by the corresponding emission factors in Table 602.2.2. Emissions associated with fossil fuels not listed shall be calculated by multiplying the fossil fuel delivered to the building at the utility meter by 250.
Emissions associated with purchased district heating shall be calculated by multiplying the heating energy delivered to the building at the utility meter by 150 for hot water and steam, and for district cooling, the factors from Table 602.2.1 based on the EPA eGRID Sub-region in which the building is located.

Reason: This proposal clarifies and simplifies Section 602 of the IgCC by cleaning up language, reorganizing the sections, and reducing the zEPI calculation to the basic required units.

602.1 This Section clearly states that modeling shall produce information on both energy performance and CO2e emissions, and changes the energy units from kBtu/sf-y to kBtu.

602.1.1 (new 602.2) This proposal is a modification on that submitted by the American Institute of Architects. Instead of using EUI and EUP, this proposal uses the units and language that are found in ASHRAE Appendix G for clarity and consistency. The EUI concept is not forsaken, but the need to divide the energy use by building area is an unnecessary complication, since the baseline building and proposed building will be exactly the same. Furthermore, it is unnecessary to specify that the energy use is "annual", since whatever measure of time is used must be consistent for both the baseline and proposed calculations.

We agree with AIA that zEPI is a critical piece of the goals included in the IgCC that focuses the energy performance of buildings and sites on achieving a zero net energy design for buildings. zEPI points to a unit on a scale that goes from a theoretical 100 to zero where 100 equal actual performance for existing buildings as identified in the 2003 CBECS database and 57 equals the performance level associated with the 2012 IECC.

The 57 on that scale is a fixed number which was assumed as part of the 2012 IgCC to equate to the performance of the 2012 IECC energy performance. The 50 represents a 10% reduction from what the IECC would allow. To truly get to a zero energy performance goal will require adjusting zEPI each code cycle. This change indicates that zEPI should be adjusted to 50, which would lead to steps as follows:

- 2015 - zEPI = 50
- 2018 - zEPI = 40
- 2021 - zEPI = 30
- 2024 - zEPI = 20
- 2027 - zEPI = 10
- 2030 - zEPI = 0

We believe that communities which wish to achieve zero energy design buildings are looking to this code for that approach to clearly be outlined and included in the code.

602.1.2 (new 602.2.1) This Section is renumbered to be a direct subsection of 602.2, in that it builds on the zEPI requirement with further information on how the building performance modeling shall be done. The language is cleaned up to make it clear that the modeling shall be done in accordance with ASHRAE Appendix G as modified.

602.1.2.1 (new 602.2.1.1) The title of this Section did not make sense, as required modifications were identified in multiple Sections. The change to Section G3 of ASHRAE 90.1 refers directly to the modeling methodology, whereas the previously referenced Section G1.2 addressed Performance Rating. This Section also incorporates a provision formerly in Section 602.1.2.3, as it is related to the calculation of energy units.

602.1.2.2 (new 602.2.1.2) The title of this Section is changed to clarify the actual purpose of the Section, which constitutes the second required modification to Appendix G. The language is amended for clarity.

602.1.2.3 is deleted in its entirety. The first sentence of the Section is moved up to Section 602.1.2.1 (new 602.2.1.1), and the other sentences are deleted in favor of providing the information in Table 602.1.2.2 with the other fuel conversion factors.

Table 602.1.2.2 is expanded to include the emission conversion factors formerly in 602.2.2, and the footnote marking is clarified to be applicable only to NG, Fuel Oil, and LPG.

602.1.3 is deleted in its entirety. The requirement for a registered design professional in responsible charge is a defined term and is recognized in practice. Adding to the term a qualifier for energy modeling adds a level of complexity that isn't recognized in any form by a sanctioning body and adds confusion to the professions.

602.2 (new 602.3) is amended to more closely parallel the language in 602.1 and 602.1.2 (new 602.2). The abbreviations used in the calculation are changed to correlate with the definitions provided.

602.2.1 (new 602.3.1) and 602.2.2 (new 602.3.2) The titles are changed for clarity.

Table 602.2.2 (new Table 602.3.2) is replaced to include the emission conversion factors formerly in 602.2.2.

Cost Impact: Will not increase the cost of construction