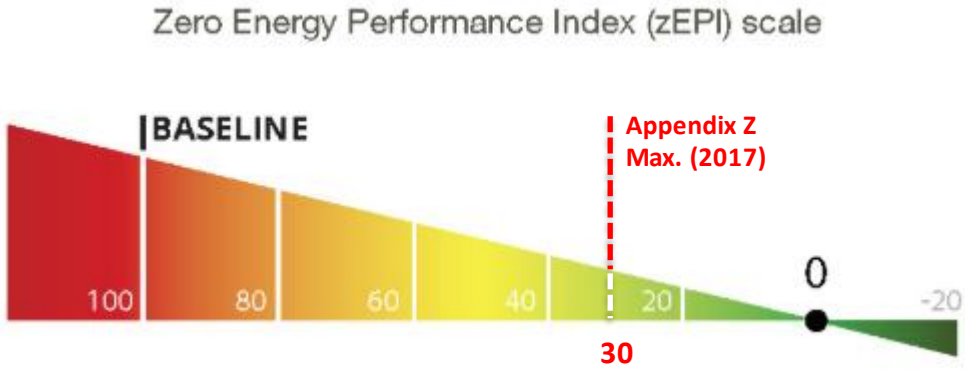
# Appendix Z Calculation Guidance

The District's 2017 Energy Conservation Code – Commercial provisions (2017 ECC) introduced a compliance pathway for net-zero energy buildings called Appendix Z. This collection of requirements defines net-zero energy buildings for the District and is now being used to determine compliance with the Green Building Act of 2006, as amended by the 2022 Greener Government Buildings Amendment Act, which requires that publicly-owned and -financed buildings meet the net-zero energy standard. Appendix Z is an efficiency-first approach to net-zero energy building design. Compliance with Appendix Z necessitates a high-performance envelope for passive load reduction and highly efficient mechanical systems for active load reduction. This resource helps project teams calculate three key metrics needed to determine compliance with Appendix Z's minimum performance requirements:

- Z2.1.1 Zero Energy Performance Index (zEPI)
- Z2.2.1 Annual Heating Demand (TEDI)
- Z2.2.2 Annual Cooling Demand (CEDI)

## Z2.1.1 ZERO ENERGY PERFORMANCE INDEX (zEPI)

Appendix Z utilizes zEPI to measure the proposed energy efficiency of a building relative to net-zero energy. zEPI does this by establishing an absolute scale where 0 represents a net-zero energy building and 100 represents an average commercial building in the year 2000. This scale allows for straightforward comparisons, such as a score of 50 representing a building anticipated to use half as much energy as the baseline building. A zEPI threshold is suitable for most building typologies because it is a relative standard, calculated by comparing the proposed building design to the same building designed to code minimum standards.




*Based on: https://newbuildings.org/code_policy/zepi/*

For the 2017 ECC, Appendix Z requires buildings to demonstrate a zEPI of 30 or lower in accordance with the following equation:

$$zEPI = 50.4 \times \left(\frac{EUIp}{EUIb}\right) \qquad \text{(Z2.1.1)}$$

Where:

**EUIp** = proposed annual source energy use intensity, measured in kBtu/ft²/yr
**EUIb** = baseline annual source energy use intensity, measured in kBtu/ft²/yr

Both EUIp and EUIb:

- Measure a building's energy consumption per square foot per year;
- Include energy used by the building and site;
- Exclude on-site renewable energy generation and off-site procurement;
- Use source energy measurements that account for transmission losses; and
- Are calculated per ASHRAE 90.1-2016 Appendix G, as modified by Appendix Z Sections Z2.1.2.1 and Z2.1.2.2 (these are typically outputs of compliant modeling software).

For additional information, see NBI's zEPI resource.

### Z2.2.1 ANNUAL HEATING DEMAND (TEDI) & Z2.2.2 ANNUAL COOLING DEMAND (CEDI)

Appendix Z also sets thresholds for the maximum allowable heating and cooling of a building. Importantly, Appendix Z's heating and cooling demand thresholds in Z2.2.1 and Z2.2.2, respectively, are measured as demand intensity (in kBtu/ft²/yr) and signify the amount of energy provided (heating energy) or removed (cooling energy) to maintain indoor comfort. As a result, 'annual heating demand' is commonly referred to as thermal energy demand intensity (TEDI), and 'annual cooling demand' is commonly referred to as cooling energy demand intensity (CEDI).

In evaluating Appendix Z compliance, a building's thermal energy performance should be calculated according to the following equations:

$$Annual\ heating\ demand\ (TEDI) = \frac{\sum Annual\ Space\ and\ Ventilation\ Heating\ Outputs\ (kBtu/yr)}{Interior\ Conditioned\ Floor\ Area\ (ft^2)} \quad \text{(Z2.2.1)}$$

$$Annual\ cooling\ demand\ (CEDI) = \frac{\sum Annual\ Space\ and\ Ventilation\ Cooling\ Outputs\ (kBtu/yr)}{Interior\ Conditioned\ Floor\ Area\ (ft^2)} \quad \text{(Z2.2.2)}$$

Where:

**Σ Annual Space and Ventilation Heating/Cooling Outputs =** the annual heating/cooling output of all systems in the building that maintain space temperature setpoints and heat/cool ventilation air including the heating/cooling coils of the central air systems (e.g., make-up air units and air handling units) and terminal equipment (e.g., fan coils, heat pumps, and unit heaters). Typically, these values (in kBtu) can be gathered from energy modeling programs.

**Important Notes:**

- Neither heating nor cooling demand are dependent on mechanical equipment efficiencies or fuel sources. The energy demand metric (i.e., TEDI and CEDI) focuses only on equipment outputs, rather than on the equipment inputs, which would be energy use (i.e., EUI or zEPI).
- Despite having the same units of measurement (kBtu/ft²/yr), energy demand (TEDI/CEDI) is not the same as energy use (EUI).
- Annual heating demand and annual cooling demand are not calculated using peak load figures that are typically measured in kBtu/hr.
- Annual heating and cooling demands are most directly impacted by building envelope measures like insulation, fenestration, air tightness, window-to-wall ratios, solar orientation, and other traditional passive measures.

For additional information, see TEDI 101 for MA Stretch Code by AIRLIT Studio and the Massachusetts Stretch Energy Codes - 2023 Technical Guidance.