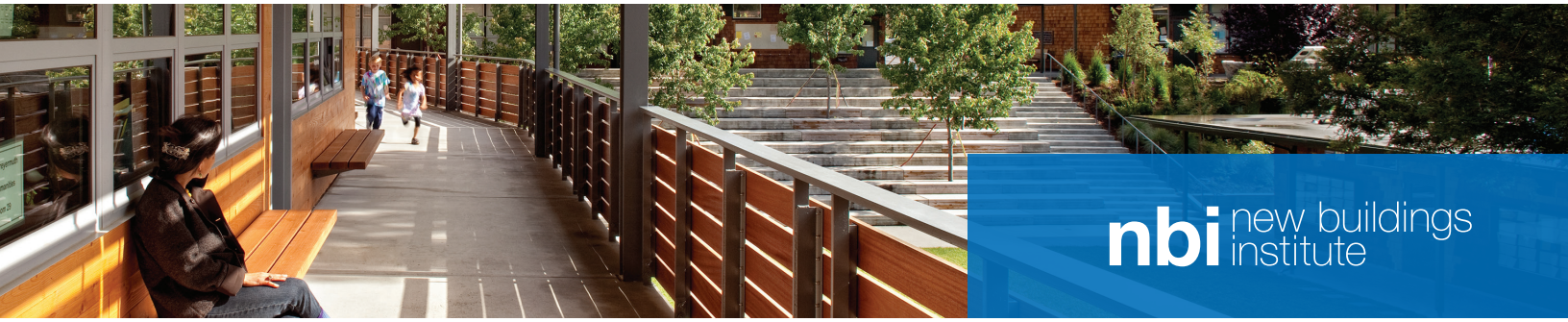


Zero Energy Performance Index (zEPI)

The 2015 International Green Construction Code (IgCC) includes many progressive measures that will improve the energy performance of buildings. One important provision describes the Zero Energy Performance Index (zEPI), which provides a scale for measuring commercial building energy performance. zEPI represents a fundamental shift in measurement of building efficiency as it sets energy targets for actual energy consumption rather than using a predictive energy model of building energy performance to calculate a "percent-better-than-code" metric.

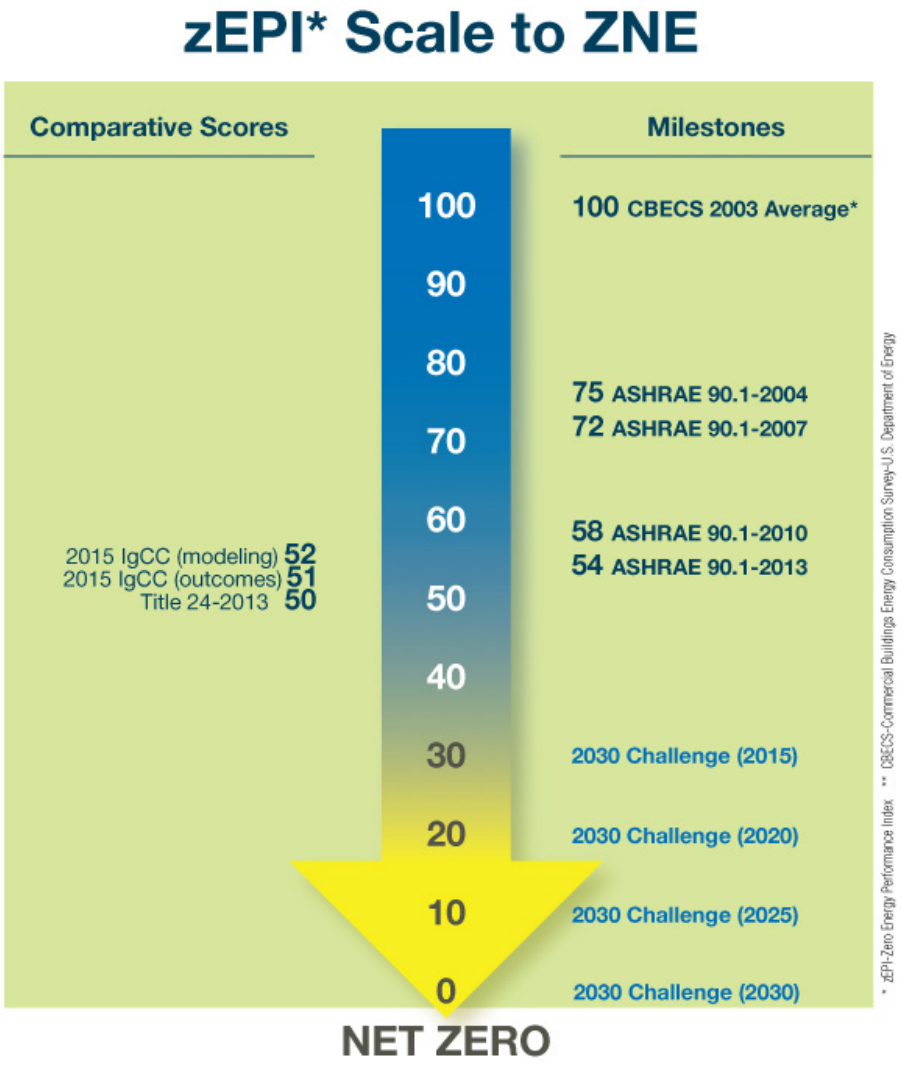
zEPI sets an energy use intensity (EUI) target for building type and is adjusted for climate. It is also the measure by which a building's energy efficiency is calculated once operational and occupied based on measured energy use data.

Why is zEPI needed?

The zEPI scale marks key energy measurement milestones as well as the performance of individual projects or policies. It permits direct comparisons in order to understand the relative performance of each of these elements in measurement of energy performance.

Comparing the energy efficiency of buildings by referencing their percent savings beyond code can create confusion:
"Which code?" "What year?" Given there have been at least six major commercial energy codes on the books at any given time in the United States since 2000, identifying the correct baseline can take some time.

zEPI sets a constant goal of zero and shifts the conversation from percent better than code to percent from zero, which is the kind of market shift that is required for buildings to achieve wide-scale net zero and exemplary energy performance.



What are the benefits of zEPI?

Charting the course to net zero. By setting an absolute scale, zEPI helps charts a clear course for energy code development. If an average building under a current energy code (e.g., based on modeled determinations by the U.S. Department of Energy) receives a zEPI score of 48 and the code-setting body would like to move their code to net zero energy in 12 years, then the performance target for each of the next four code cycles could be 36, 24, 12, and 0 on the zEPI scale. Eventually, energy codes will include a renewable energy component at those lower zEPI target levels. This component is already a part of the IgCC.

Comparing the energy efficiency of existing buildings. The zEPI scale provides powerful feedback for understanding the energy efficiency of existing buildings. The information needed to assess the zEPI score of an existing building is the same as needed for a new building, only it will use measured data or utility bills rather than from a design plan. zEPI ratings could be used to give a buyer a sense of comparative efficiency levels between buildings or as a metric for energy efficiency incentive programs.

Simplifying the development of energy modeling tools. By setting a fixed, universal baseline under zEPI, energy modeling tools and energy modeling protocols will not need to be continually reengineered to adapt to each code revision. This will reduce modeling tool development costs while speeding up code implementation times. This is similar to an exercise underway by ASHRAE called "Addendum bm."

How was zEPI developed?

The basis for zEPI can be traced back to a scale presented in a paper written by Charles Eley, an energy efficiency advocate and NBI Fellow, called "*Rethinking Percent Savings*." Eley makes the compelling case for adoption of a more stable, absolute scale to benchmark buildings as opposed to the typical percent-better-than-code metric. Code baselines are continuously shifting as more stringent rules are developed and adopted, rendering all previous better-than-code percentages meaningless. The scale establishes zero net energy as the absolute goal, making the need for a baseline obsolete. The only measurement that matters is how far a building has progressed toward zero net energy performance. The scale goes from zero to 100, with 100 representing the average energy consumption based on 2003 *Commercial Buildings Energy Consumption Survey* (CBECS) data.

How does zEPI work?

zEPI is an absolute scale with two key points:

1. A building with energy use equal to that of an average building in the year 2000 receives a score of 100.
2. A building with net zero energy use receives a score of 0.

The zEPI scale extends in a linear fashion between, above, and below those two points. For example, a building that uses twice as much energy as an average building receives a score of 200. A building that uses half as much energy as an average building receives a score of 50. The simple relationship between zEPI scores can be readily understood by code makers, architects and engineers as well as non-technical building owners and tenants. The zEPI scale is also positioned to measure buildings that go beyond net zero and produce more energy than they consume.

How does zEPI relate to an Energy Star score?

Both zEPI and Energy Star scores rate building energy performance and use information from the 2003 *CBECS*; but they do so very differently. An Energy Star score calculation uses measured energy data, but correlates only to itself. The Energy Star score essentially rates a building on a curve, where "0" is the worst grade and "100" is the best. Each Energy Star score is therefore a percentile score compared to CBECS data. A score of 100 means a building would perform in the 100th or top percentile of that building stock, or as good as the best buildings from the year 2000.

A score of 100 is the best building from 15 years ago; but that isn't a great building today as we push toward zero net energy. Since codes and many new buildings have moved significantly higher, it is difficult for the Energy Star score to differentiate between a building that is a lot better or a little better than the best buildings from 15 years ago.

Instead of using the CBECS data as both a starting and ending point for comparison, zEPI uses it only as a starting point and uses zero net energy as the ending point. A 100 is an average building from the year 2000, and 0 is a zero net energy building. The scale can therefore meaningfully compare any set of buildings to each other, even those that would congregate at the top of the Energy Star scale. And when "net

positive" buildings become the new norm for high performance buildings, the zEPI score can simply continue beyond 0 to the net positive side of the scale.

Moving to zEPI for marking a building's comparative energy efficiency will facilitate the shift in energy standards development from the current bottom-up process to a top-down, goal oriented process. Zero net energy as a policy target necessitates this top-down approach. California's CALGreen and the IgCC have already taken this step.

How do you apply zEPI to projects?

A zEPI score can be calculated for either actual performance or modeled performance. By bridging the gap between modeled and actual performance on one scale, zEPI also allows the gap between modeled and actual performance to be easily gauged.

To calculate zEPI for an existing building, the measured energy use of a building is compared to the average energy use for that building type as found in the 2003 CBECS. The building's energy use is then divided by the average baseline energy use and multiplied by 100 to calculate zEPI.

zEPI scores for new construction projects can also be easily calculated. When a building is modeled for energy code compliance, the modeled energy performance of the building is compared to a "code-clone," which is the modeled performance of that same building design if it had been built to the prescriptive requirements of the code. That building's zEPI score can be determined using the zEPI score of a code baseline, since the ratio of the building's modeled energy use to the code-clone energy use is the same as the ratio of the building's zEPI score to the code baseline's zEPI score. The building zEPI is the code baseline zEPI multiplied by the building EUI and divided by the code-clone EUI.

How does zEPI apply to policy?

The zEPI scale can be used several ways in energy policy, especially to rate and compare the energy performance of buildings and to both set and track progress toward energy goals.

Compare efficiency levels for different building types. Most existing disclosure ordinances require the disclosure of total energy use usually in the form of EUI, or kbtu/sf/yr and sometimes by Energy Star score. Howevr, neither of these is especially effective for comparing the energy performance of different buildings. Different building types use energy differently. A very efficient restaurant could use much more energy per square foot than a very inefficient warehouse. Therefore, the EUIs of different building types cannot be meaningfully compared. Using a zEPI score as the basis for rating buildings solves both problems. It allows different building types to be compared to each other, and the linear scale with clear benchmarks provides context on whether a particular score represents an efficient building.

Set and measure progress toward energy policy goals. Because it is an absolute scale, zEPI scores can be used to establish energy goals and evaluate progress toward those goals. Ratings, recognition, incentives and even penalties can all be established using just one unified scale for all buildings. This gives building energy policy clarity that enables public understanding and enforcement.

Score efficiency standards such as energy codes. Policymakers can easily compare their standard to other available standards and set goals for continuous improvement. With the traditional percent-better-than approach, 15% better represents actual energy savings that continually diminishes with each code cycle. It also makes it impossible to attain a final goal; increments of improvement continue to get smaller, until they are nonexistent. zEPI can also assess code effectiveness by comparing the zEPI of a cohort of buildings constructed under a certain code to the zEPI of that code.

Give a score to aggregated building stock. Jurisdictions or any holder of a building portfolio can assess how their entire stock of buildings is doing relative to a goal or to other building stock. In other words, a city could set a goal for its entire building stock and know exactly when that goal has been met. It could also compare its citywide zEPI to zEPI scores of other cities or the national zEPI. Also, the zEPI score of a jurisdiction's building stock before a code or other policy change could be compared to the zEPI of that building stock after a code change to assess the impact of the change.

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