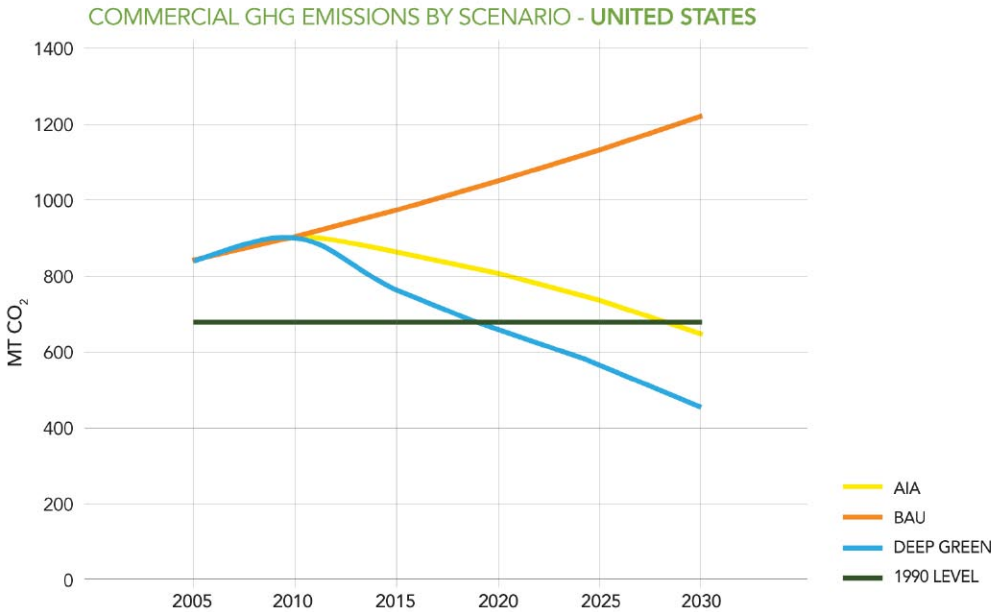


Real Mitigation of Climate Change: The Path to Zero Net Energy Buildings

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Under the 2030 Challenge, target energy performance levels for each milestone year are a percentage reduction of the regional average for the particular building type, as follows:

- 50% reduction - Immediately
- 60% reduction - 2010
- 70% reduction - 2015
- 80% reduction - 2020
- 90% reduction - 2025
- 100% reduction = Zero GHG emissions - 2030

This all started (more or less) back in 1973. The *Energy Crisis* with its sudden fury, fracturing economic and political security, erupted with gas lines and our first experience of surging energy prices. In smart circles, the fix was seen to be higher energy efficiency in our cars, buildings and machines. For whatever sensible and probably necessary reasons, the approach taken was primarily prescriptive: ASHRAE standards nationally and Title-24 in California.

Even though energy prices were rolled back over the following twenty years, leading to a strangely dead period of interest in things related to our very real (as it turned out) energy peril, the detailed, prescriptive treatment of buildings and energy settled in and became the norm. Even the so-called performance approach, which theoretically modeled building energy use, was prescribed in ways often unrelated to the building's actual energy use.

It is little surprise, then, that, with the emergence of the societal sensibility about *sustainability* in the early 1990s and the founding of the USGBC, a strongly prescriptive approach would be the basis for LEED certification. And that's when the whole approach to the problem of energy use in buildings went wrong.

First of all, in the absence of a national energy code, LEED became the method of choice across the United States, ensuring that its approach to lowering energy use in buildings would become the standard. This happened in spite of documentation requirements that were soon perceived to be onerous and substantial fees to cover the cost of certification review. As might be expected, the pace of change within the industry has not been dramatic. Even now, according to the USGBC, only about five to six percent of all new commercial construction is even registered for basic LEED certification.

But the fundamental problem with the reliance on LEED is that it simply has had no effect on the actual energy use of its certified buildings and, perhaps even more fundamentally, does not address aggressively enough the most pressing environmental and political energy issues of our day: climate change and the international politics of fossil fuel resources.

Climate change is the real issue, and it is, more than anything else, a building design issue. Nationally, buildings are the largest consumers of energy at 40% of total use (in California, transportation beats out buildings, but not by much), accounting also for 70% of all electric energy consumption. Since this energy use equates directly to greenhouse gas (GHG) emissions, the

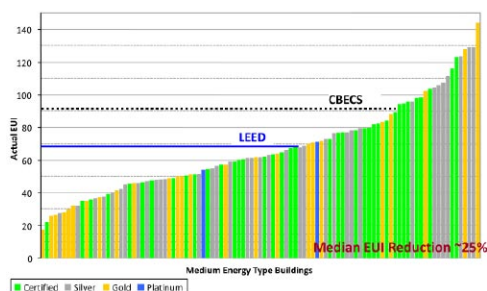
driver of climate change, building design is both the problem (current design) and the solution (future design). To drive this point home, consider that three-fourths of the coal-fired power plants on the drawing boards in the U.S. right now will go to operate new buildings designed to current standards.

LEED and Energy Use Reduction: No Correlation

The LEED approach to energy use is packaged within its larger approach to sustainability, and it began by trying to address all site and building issues more or less equally, or so it seems. Thus, there are points for site, water conservation, recycling, indoor air quality, and energy use. Of the 110 points possible in the current version, only 33 are concerned with energy use and on-site, renewable energy supply. This is only a 7% increase (from 23% to 30% of total possible points) for reduction of fossil fuel use compared with Version 2.2. That is, the one sustainability issue that is at crisis level—climate change and its primary causal agent, GHG emissions—merits only a nominal increase in importance and has a fractional effect on the overall LEED rating.

Reliance on LEED to make significant headway on climate change is further brought into question by the fact that LEED-certified buildings have performed relatively poorly after being occupied. They show no pattern of reduced energy use, whether they are Platinum-rated or just plain Certified. A 2008 analysis by the New Buildings Institute (NBI) of the energy performance of new non-residential buildings that were LEED-certified over the previous nine years revealed these surprising facts. As Edward Keegan notes in the October 2008 issue of *Architect* magazine, the study found that only half the buildings studied had any actual performance data for that period of time and, for the ones that did, the calculated Energy Star score was “shockingly low.”

The accompanying chart shows the distribution of actual energy use performance for all levels of LEED certified buildings in the NBI study. Note that the two LEED Platinum buildings are out-performed by a number of simple LEED-certified buildings at the left of the array, which is arranged from left to right by energy performance.



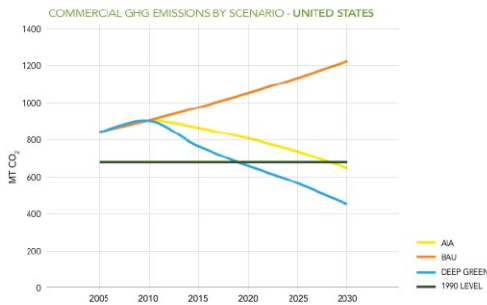
If LEED is not the fast-enough track to a solution, what is? Ratcheting up the building energy standards and codes would help, but these changes typically lag behind the pace that the building industry needs to keep. In addition, regulation requires analysis methods that use uniform assumptions about building operations, and typical current code requirements cannot go beyond the permit issuance point, which means that there will be little or no correlation between building energy use models and actual performance when occupied. Standards and codes constitute another approach that falls short of the results needed.

The 2030 Challenge and the Path to Zero Net Energy Buildings

There is really only one approach that is aggressive and effective enough to meet the critical timeline set by the scientific community (see J. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?*, 7 April 2008, Columbia University Earth Institute and NASA/Goddard Institute for Space Studies), which is also technically feasible and realistically achievable for the design professions right now: the *2030 Challenge*.

Announced only three years ago by Architecture 2030 and the AIA, the 2030 Challenge sets a series of target energy use performance levels starting immediately, which get progressively reduced until 2030, when every new building and existing building retrofit designed from that year forward will be *carbon neutral*. That is, at that time every new design will use *zero* GHG-emitting energy (fossil fuel based energy) to operate. These new buildings that everyone in the profession will be designing after 2030 if the Challenge succeeds are even now developing a buzz under the name *Zero Net Energy Buildings* or ZNEBs.

What makes these milestone targets for net annual energy use feasible is not only the reduction of net energy loads in the building through better design, but the gradual replacement of the fossil fuel energy sources with on-site renewable sources of energy (primarily photovoltaic systems), off-site renewable sources, or the purchase of a limited amount of carbon offsets. The ultimate goal, the ZNEB, is the designed balance between the minimized energy loads and the



right-sized renewable energy production system.

These 2030 Challenge targets, soundly based on scientific and economic studies, will drive GHG emissions down to 1990 levels by 2030, as shown in the accompanying graph. This is the goal for arresting the climate change phenomenon.

The 2030 Challenge will actually achieve the targeted reductions in energy use, because it is a design approach based in the real-performance world rather than a prescriptive or regulatory approach based in the model world. Because it is based on actual performance after occupancy rather than what a prescribed energy model says, these reductions will be real. (In fact, the energy use performance during this post-occupancy period will be so important to clients that the traditional set of phases for professional services could be affected.)

While the 2030 Challenge is the right map to the right goal, is it really plausible that the design professions are up to the task? With a year to go to the first milestone, can the professions routinely deliver new buildings one year from now that use only 50% of the energy of the general existing building stock and 0% in 2030?



Police Substation, San Diego Community College District
Greenworks Studio, Harley Ellis Devereaux
A zero net energy project now on the boards.

The California state government seems to think so.

The CPUC and the Energy Commission have adopted the goal of all new commercial buildings constructed to ZNE levels by 2030, consistent with the 2030 Challenge. Following this lead, in its *Climate Change Proposed Scoping Plan*, the California Air Resources Board has also targeted 2030 as the beginning of the era of Zero Net Energy commercial buildings (ZNE homes in 2020). In addition, the California Division of the State Architect, which regulates and controls plan approval for all K-12 schools and community college buildings in the state, has announced that, beginning in December 2010, all building plans must show designs that are “grid neutral,” i.e., zero net electric energy. Like the 2030 Challenge, no prescriptive methods are given, just the design targets.

The design professions simply need to focus on the design methods needed to achieve the target performance for each 2030 Challenge milestone, using a holistic process rather than a piecemeal approach. The design tools exist to evaluate design concepts for daylighting, natural displacement ventilation, and human comfort in ambient environments and to present them in strongly visual ways for communication and decision-making. This holistic process is leading to a greater integration and participation of technical disciplines from the beginning of the design concept. Architects need to embrace this change and take advantage of the outcomes. (They will also need to find and work with engineers who are comfortable with the design process as architects know it.)



IDeAs Z2 Office Renovation, San Jose, EHDD
The Z2 (zero energy zero carbon) office design turned a windowless 1960s bank building into a high-performance daylight office building for the electrical engineering firm IDeAs (Integrated Design Associates, Inc.). Photo by David Wakely.

Looking toward the ultimate goal, we have twenty years to hone the process and make the design of Zero Net Energy Buildings a routine practice. Using the design tools available today, a number of firms are already blazing the trail to this goal. In the competitive market of architecture, these firms have an important head start and will win new clients interested in the value-added proposition of entirely eliminating their utility bills while doing their part to save the planet.

Now that’s an attractive idea, too. ●