# Reframing environmental performance goals for buildings

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**Abstract**

Although profound changes in buildings and human settlement patterns are unlikely until there is a fundamental shift in societal values and expectations, performance targets are critical in communicating an aspiration and providing guidance for building design. The dramatic and visible increase in unusual and often extreme weather events, floods and storm activity, and the reported enormous social and economic costs associated with such disasters, are creating a more urgent context for concerted action. New goals are being proposed that both capture this emerging sense of urgency and translate it into new directions for building design.

The paper specifically compares the performance goals implicit and explicit in current building environmental assessment methods and the emerging notions of 'zero' energy and carbon 'neutral' buildings. These goals represent qualitatively different aspirations, different ways of relating to the building industry and making links with prevailing societal concerns. Moreover, whereas the former were premised on incremental improvement, the latter accepts that significant performance leaps are required.

The primary aim of the paper is to compare the potency of different goals to act as catalysts for positive change in building performance and, more importantly, to transform market expectation.

**Keywords:** assessment methods, carbon neutral buildings, ecological footprint, performance targets, regulation, zero energy buildings

# 1 Introduction

Now is a time of greater scientific understanding of human induced stresses on natural systems as well as of unprecedented individual and collective access to information about these impacts. Surprisingly, the substantive evidence over the past few decades on the extent and rate of environmental degradation — encroaching deserts, deforestation, acid precipitation, soil oxidation and erosion, species extinction, ozone depletion, greenhouse build-up — has struggled to generate the necessary public and political commitment to change. Similarly, despite the demonstrated evidence of the considerable resource use and ecological loadings associated with buildings and current patterns of human settlement, it has been difficult to instill a sense of the importance and urgency of improving their environmental performance. A host of factors have contributed to this situation:

- A significant disjuncture has existed between the current understanding, both general and scientific, of environmental issues and the priority placed on concerted and effective action.
- Information is only a means to an end — it has to be interpreted and translated into effective decision-making, be it in the political realm or within the day-to-day activity of building design and construction. The interpretation and translation of environmental information into action occurs through the filter of human values. "Our values, theories and preconceptions," Holling (1998) suggests, "determine the problems we perceive, the knowledge we seek and the actions we take." If a sense of importance is value dependent, then users of information must be predisposed to the issue that it relates.
- Many people have ingrained biases that tend to favour countering notions. For example, they often lack the "systems thinking" necessary to seek solutions to complex problems that involve multiple scales of influence and timeframes; they typically underestimate large uncertainties and under-invest in measures which follow the precautionary principle; and they are transfixed with the immediate — the here and now — at a time when many environmental problems have global and trans-generational consequences (Gladwin, et. al., 1997).

But things seem to have begun to change over the past few years. The dramatic and visible increase in unusual and often extreme weather events, floods and storm activity, and the reported enormous social and economic costs associated with such disasters, are creating a more urgent context for concerted action. Environmental and related issues are increasingly given a higher priority within the public consciousness and, more significantly, within the political realm. While in the past continuous improvement in human wealth has been assumed to be uninhibited by natural limits, the critical interdependence of social and economic systems and natural processes is becoming increasingly evident. Although profound changes in buildings and human settlement patterns are unlikely until there is a fundamental shift in societal values and expectations, a number of initiatives and activities have recently occurred that both capture this emerging sense of urgency and translate it into new directions for building design.

This paper is concerned with the change that is occurring in environmental performance goals for buildings. Lowe (2006) offers several important requirements when setting energy performance targets and which have significance to this paper. These include:

- Their relationship to regulation and other change mechanisms.
- Their relationship to currently available technology — energy targets must challenge but not overwhelm the capacity of industry to deliver improved performance.
- That they be dynamic, with clear programmes for revision.
- That they take account of the lead times of the systems and industries that they affect.
- That they increase rather than reduce the range and diversity of business opportunities.
- That they maximize the tendency for integration throughout the industry, including the design process and the supply chain.
- That they are set within an overarching long-term environmental agenda established by government.

This paper specifically compares the goals implicit and explicit in current building environmental assessment methods and the emerging notions of 'zero' energy and carbon 'neutral'. These goals represent qualitatively different aspirations, different ways of relating to the building industry and different ways of making links with prevailing societal concerns. Moreover, whereas the former were premised on incremental improvement, the latter accepts that significant performance leaps are required. The primary aim of the paper, therefore, is to compare the potency of different goals to act as catalysts for positive change in building performance and, more importantly, to transform market expectation.

# 2 Regulatory mechanisms

Legislation, if possible to enforce, has historically been viewed as the most appropriate means of combating acute, localized environmental transgressions, particularly if sufficient information is available to formulate workable regulations, set targets and measure their effectiveness (Aggeri, 1999). The regulatory approach assumes that increased international attention and public concern surrounding environmental issues will translate into political intent. This will then manifest as more demanding environmental policy and subsequently as increasingly stringent regulations related to building performance requirements. Environmental standards and regulations related to buildings can be very effective but usually only define a minimally acceptable level of performance and are not, therefore, normally a vehicle for encouraging high levels of performance. Moreover, regulation typically only covers specific environmental performance issues such as energy use.

Building codes are moving away from prescriptive requirements towards performance-based approaches to enable greater flexibility in the design of buildings. Perhaps more importantly, the notion of sustainability is emerging as an explicit issue in the building codes arena. While building codes currently focus on the health and safety of building users and evolve primarily in reaction to past catastrophes, Eisenberg (2005) advocates a much broader and positive emphasis, extending the notion of health and safety to embrace the broader and intergenerational environmental consequences of buildings. He suggests "re-envisioning building departments as not just governmental agencies responsible for preventing the worst practices, but as true community resources for the best design and building practices" (p.8).

# 3 Performance goals in assessment methods

By far the most significant improvements in building environmental performance over the past decade have occurred through voluntary mechanisms, as evidenced by increased discussion and application of 'green' building practices, despite the absence of any significant or demanding building energy or environmental regulations.

Voluntary building environmental assessment and labeling programs have the primary objective of stimulating market demand for buildings with improved environmental performance. An underlying premise of voluntary assessments is that if the market is provided with improved information and mechanisms, a discerning client group can and will provide leadership in environmental responsibility and others will follow suit to remain competitive.

Many countries either have or are in the process of developing their own domestic assessment system, e.g., the US Green Building Council's Leadership in Energy and Environmental Design — LEED (USGBC, 2005); the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) in Japan. Each system has its own distinct structure, emphasis, and performance requirements necessary to achieve certification:

- LEED, for example, organizes performance criteria into five distinct categories: Sustainable Sites; Water Efficiency; Energy and Atmosphere; Materials and Resources; and Indoor Environmental Quality. Building performance is summarized by an overall environmental rating of 'Certified', 'Silver', 'Gold' or 'Platinum' (USGBC, 2005). The explicit omission of 'bronze' as a performance level has its roots in the negative cultural connotations.

- CASBEE, by contrast, explicitly distinguishes between the Environmental Loading (resource use and ecological impacts) and Environmental Quality and Performance (indoor environmental quality and amenities), scoring them separately to determine the Building Environmental Efficiency, i.e. the ratio of Environmental Quality and Performance to Environmental Loading. Building performance is summarized by an overall environmental rating of 'C', 'B-', 'B+', 'A' or the highest, 'S' (Sustainable).

Voluntary assessment protocols must serve two conflicting requirements — they must function as an objective and sufficiently demanding metric to have credibility with the general public, and particularly the environmental activist community, while simultaneously being attractive to building owners who require a positive, obvious benefit to show for any effort that they have placed on environmental performance. Satisfying these twin requirements invariably compromises where the benchmarks are set before performance points are earned and certification awarded (Cole, 1999).

Green building practices have been institutionalized within building environmental assessment methods (Cole, 2005; Cole, 2006). Building environmental assessment methods have provided definitions of 'green building' and associated best practice. But change occurs through the use of such tools, raising a host of questions regarding the demands they make, the challenging of norms, the acquisition of new knowledge and skills and, more broadly, how they affect the culture of all those responsible for delivering buildings.

Transformation of the market requires a more fundamental understanding of how assessment tools create and effect change. Whereas most assessment methods are offering both, an important distinction must be made between methods/metrics to create change and methods/metrics to assess progress emerges as a critical issue within this debate.

# 4 Absolute performance goals

Whereas the majority of current building environmental assessment methods use scoring systems that evaluate performance relative to typical practice, shifting the debate to sustainability assessment raises the more challenging prospect of using absolute metrics and targets. The extent to which an assessment tool can reference its metrics to climate stabilization, for example, may prove decisive in the tool's relevance within a context of increasing societal concern around climate change.

Lowe (2006) explores using global carrying capacity as a means to define 'absolute' limits on environmental impacts from the built environment and critiques and exposes the multiple and unavoidable uncertainties associated with a series of theoretical approaches for quantifying of global carbon constraints. When these are coupled with complex relationships, e.g., between the built environment and electricity supply systems, the value of this approach diminishes, Lowe concludes that the "absolute level at which targets are set is less important than the direction in which they point" and that the "measure of the effectiveness of such targets is their impact on innovation, not the degree to which they embody an absolute external measure of sustainability" (p412) While accepting the need to understand long term external constraints to human activity, Lowe suggests that a 'developmental approach' based on the "internal, short to medium term dynamics of the built environment itself" (p414) that are set pragmatically and regularly revised may prove to be the most valuable basis for setting targets having the potency to stimulate progress and innovation. From this viewpoint, "the future emerges from a series of short and medium term decisions and the importance of the long term global analysis is largely symbolic" (p414).

There are three absolute measures currently being used as goals for building environmental performance:

- Net Zero Energy
- Carbon Neutral
- Equable Ecological Footprint

## 4.1 Net Zero Energy

The fundamental expectation of a zero energy building is it can meet all of its energy requirements from low-cost, locally available, nonpolluting, renewable sources. In an ideal setting, a zero energy building generates enough renewable energy on site to equal or exceed its annual energy use. With Net Zero energy comes the perceived marketing benefit of zero operating energy cost to occupants although this is dependent on a host of contextual factors. Torcellini, et al (2006) make a distinction between:

- Net Zero Site Energy: A site Net Zero Energy building produces at least as much energy as it uses in a year, when accounted for at the site.
- Net Zero Source Energy: A source Net Zero Energy produces at least as much energy as the 'source' energy it uses in a year, i.e., the primary energy used to generate and deliver the energy to the site.

A site Net Zero Energy can be easily verified through on-site measurements, whereas source energy Net Zero Energy buildings cannot be measured directly because site-to-source factors need to be established and applied (Torcellini, et al., 2006).

### 4.2 Carbon Neutral

Similar to net zero energy, a net-zero emissions building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources. Clearly, the calculation becomes more complex given the regional variations in the fuel mix in electrical energy production. Again, as in the case of net zero energy, the current practice mainly focuses on operating energy and associated emissions and does not typically account for embodied energy and emissions; commuting energy & emissions or those associated with food and other consumables.

Given the increasing public and political awareness of global warming and climate change, aggressive measures regarding carbon emission reductions have emerged over the past year. In the UK, the declaration that all new UK houses must be designed to be carbon neutral by 2016 (DCLG, 2006) and requiring that at least one carbon neutral development must occur with each of the London Boroughs by 2010, would have been inconceivable a decade ago (LDA, 2007). In North America, the 2030 Challenge has been presented that sets a target of all new building achieving carbon neutrality by 2030 with staged intermediate levels from now until then. This is accompanied by the 2010 Imperative that aspires to the goal of achieving complete ecological literacy in design education by 2010 (Architecture2030; 2007).

### 4.3 Equable Ecological Footprint

Wackernagel and Rees's Ecological Footprint has emerged as a primary indicator of environmental sustainability and measures the area of land and water ecosystems required to produce all services that support an individual's life-style — from food and travel to buildings, infrastructure and waste disposal — wherever on earth the relevant land/water may be located (Wackernagel and Rees, 1996). The disparities between national ecological footprints are considerable — from less than 3 ha/person in most developing countries, to between 6 and 12 ha/person in developed countries. Moreover, since the majority of countries far exceed their own domestic carrying capacity, they must appropriate resources and waste assimilation capacity globally.

Unlike other leading green building projects that are often referenced by having met a high performance score on the national building environmental rating systems, e.g., an 'excellent' BREEAM rating, the UK Beddington Zero Energy Development (BedZED) references a globally equable 'ecological footprint' of 1.9 hectares/person as a performance aspiration. Desai and Riddlestone (2002) illustrate that this is only attainable through new approaches to building that permit, and are accompanied by, life style changes by its occupants.

## 5 Discussion and conclusions

There are a number of key differences in the performance goals described in Sections 3 and 4 above. These include:

- The performance targets in assessment methods are unique to buildings (e.g., LEED Platinum, BREEAM Excellent etc.) whereas carbon neutral is an aspiration that can be applied to an individual lifestyle, a business, a city as well as buildings, albeit that it would be achieved differently (e.g., use of offsets).

- Whereas the performance goals/benchmarks (e.g., LEED 'Platinum'; BREEAM 'Excellent'; CASBEE 'Sustainable' etc.) are unique to the assessment systems, net zero and ecological footprints are universal in recognition.

- Whereas other targets derive largely from the motivational value of 'zero' rather than science, an equitable ecological footprint is the single measure that links the core notions of social equity and environmental limits.

Building environmental assessment methods evaluate performance across a broad range of environmental issues relative to explicitly declared or implicit benchmarks whereas Net Zero Energy and Carbon

Neutral currently relate to building operating energy. In North America, developments of the next generation of LEED will merge the carbon neutral requirements with the performance benchmarks (Certified, Silver, Gold and Platinum). Whereas, users can currently select the ways they achieve a given score, the operating energy use associated with difference overall certification levels be more demanding, they will also be required, i.e., a building must be carbon neutral to attain a 'Platinum' designation.

Over the past decade or so, building environmental assessment methods have been remarkable successful in providing an important focus for green building debate and practice during a time of modest public and political interest in environmental issues. The context appears to be changing, and changing rapidly, as the evidence and consequence of climate change. Given the pressing time-scale of anticipated significant climate change, it is also difficult to imagine that a sustainable system of production and consumption will emerge from simply tweaking current practice (Manzini, 1997). As such, the once assumed path of incrementally ramping building performance requirements is, by necessity, being displaced by a call for significant leaps.

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