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VIEWPOINT

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LEED, Energy Savings, and Carbon Abatement: Related but Not Synonymous

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Efforts to green the building industry are strongly linked to performance metrics such as Leadership in Energy and Environmental Design (LEED). Yet, despite the importance of climate impact as a driver of green building choices, such standards typically address a basket of poorly quantified "green" attributes and, when they do address energy, they focus on conservation rather than carbon emissions so that that they do not provide an efficient guide to managing the climate impact of our building stock. Standards such as LEED will enable more cost-effective emissions reductions if they distinguish carbon footprint from energy use, avoid arbitrary cost-ineffective assumptions about best paths for decarbonizing electricity, and close the loop by requiring objective measurements of real-world building performance so we can learn by doing.

LEED

LEED is a nongovernmental certification program developed by the U.S. Green Building Council and subsequently adopted around the world. Under the LEED new construction standard, projects are scored in five categories: Sustainable Sites (26 points), Water Efficiency (10), Energy & Atmosphere (35), Materials & Resources (14), and Indoor Environmental Quality (15). The certification level that a project receives depends on the number of LEED points achieved: Certified (40−49), Silver (50−59), Gold (60−79), and Platinum (80+). LEED is the most widely accepted benchmark for green buildings among North American developers and institutions, affecting design choices, suppliers of building products, and ultimately billions of dollars in construction.[1]

LEED AND ENERGY

Although energy is only one of its 5 components, LEED is often associated with energy performance.[1] Indeed it seems reasonable to suppose that many decision makers who demand LEED buildings do so with the expectation that one of the principle benefits of a high LEED score is that the building will have a low carbon footprint. However, a building could achieve LEED Gold (the second highest certification level) without any of the energy points.

Figure 1 shows the relative "popularities" of credit categories by certification level. Improvements in the energy category often have higher capital costs than improvements in other categories, so the energy category is the least popular at low certification levels for which it would be more accurate to associate LEED with water efficiency than energy performance.

ENERGY, ENERGY COST, AND CARBON

The energy category is driven by energy cost reductions. If buildings used only one source of power, cost and carbon savings would be proportional, but most buildings use gas and electricity so that a designer must trade off between the two in trying to find a way to meet the client's desired LEED certification level at minimum added cost. Energy cost and emissions are only proportional in the unlikely case that electricity and gas prices are proportional to their carbon intensities. Data on natural gas and electricity carbon intensity are available, and the LEED standard could easily use it as a base for its evaluation criterion on carbon emissions.

The difference between cost and carbon can be substantial. In 2004, electricity in Vermont was about twice as expensive and about 130 times less carbon intense than electricity in West Virginia, while natural gas prices were similar. Design teams pursuing LEED in Vermont therefore had a 2× stronger incentive to focus their energy saving investment on electricity

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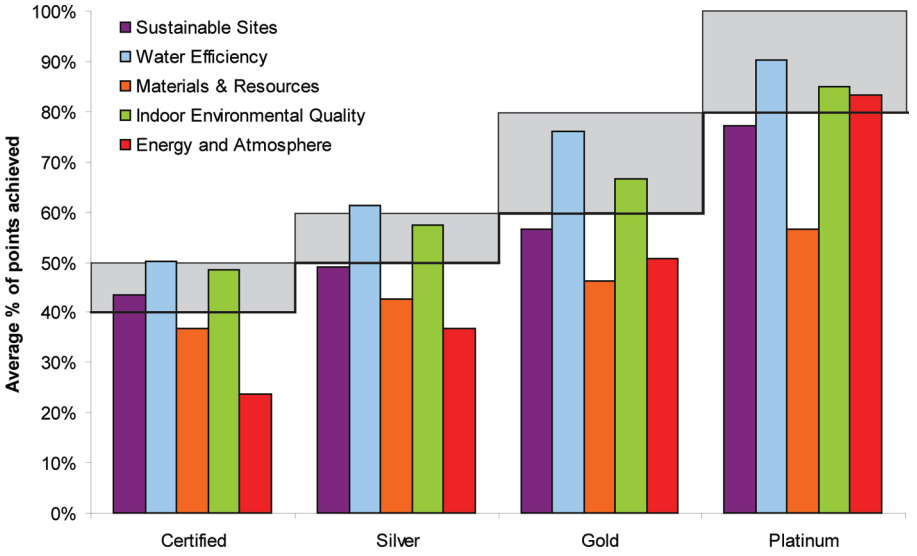

Figure 1. Average LEED points by category and certification level[2] based on 756 projects from October 2000 to October 2007 (LEED-NC versions 2.0 and 2.1). The gray boxes show the limits that define the certification levels.

than those in West Virginia, where the carbon benefits were 130× larger.

ON-SITE RENEWABLE ENERGY VS GREEN POWER PURCHASES

LEED weights on-site renewable energy much more than purchased green power. On-site renewable systems can achieve up to 7 LEED points if these have enough capacity to generate the equivalent of 13% of the annual energy cost of the building. In turn, LEED awards with up to 2 points the projects that sign a 2-year contract with a Green-e certified green power supplier for the equivalent of 35% of the building annual electricity use. In a commercial building in which about 60% of the energy cost is electricity, on-site renewable energy is awarded about 6 times more LEED points per kWh than green power purchases.

A serious effort to limit climate risk will require us to cut global carbon emissions to near zero in half a century, in an unprecedented transformation of the energy system. As we move beyond boutique applications to supply a substantial fraction of electric demand with low-carbon energy, large-scale renewables may well prove be more cost-effective and have smaller overall environmental impact than small-scale distributed renewables. Furthermore, since carbon emissions are the problem, not energy shortage, low-carbon technologies such as nuclear and CCS should be considered on their merits as options for decarbonizing electricity production.[3] Because the best choice for "decarbonizing" electricity is uncertain and contested, LEED should use an unambiguous objective such as minimizing the carbon intensity of electricity. By favoring on-site renewables, LEED has made an implicit policy choice about the best way to reduce carbon emissions in the electricity sector.

ACTUAL PERFORMANCE

LEED evaluates energy performance based on simulated energy use. Postoccupancy studies of LEED building energy performance show large differences between simulated and actual energy use.[4] Discrepancies arise from differences between the initial design and the final building, poor performance of new technologies, improper commissioning, and insufficient knowledge transfer between design team and users. Because LEED buildings are more likely to include advanced technologies, they are also more likely to face performance problems.[5]

Without monitoring there is little hope of objectively evaluating strategies for cutting emissions. The building industry is absorbing many new energy technologies, yet the industry cannot improve what it does not measure. Monitoring and feedback must be central to any plan for greening our building stock. In 2009 USGBC announced that new LEED buildings will have to submit performance data as a precondition to certification. LEED's gradual shift toward performance-based evaluation should help improve its ability to incentivize emissions reductions. The need for such performance-based evaluation was evident in recent U.S. building retrofit programs tied to economic stimulus funding; to our knowledge such programs contained no measures to drive post facto assessments of their cost effectiveness.

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