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Net Zero Energy Buildings by Innovation or Legislation

By David L. Handwork

Looking ahead 30 years, what will our buildings look like? Not in reference to architectural appearance, but in the context of energy consuming systems. A possible means of considering the future is to look back 30 years and review building science advancements.

In 1981, large building HVAC systems were controlled with pneumatics and consisted of constant air volume. Low emissivity (low-e) windows had not yet been introduced. Incandescent and T-12 fluorescent (with magnetic ballast) were the design norm. The most complex lighting control system was rheostat dimming. All plumbing fixtures were manual operation, with a typical toilet expending up to 3 gallons of water per flush. Even if building codes allow the use of these examples of building systems today, the advancements of technologies since 1980 have made these options economically obsolete.

Of course, current codes strictly prohibit these outdated technologies. Did the codes and standards drive the advancement in building technologies? Absolutely not. The codes and standards responded to federally prescriptive minimum efficiencies, industry best practices, and free market advancements in technologies. Codes and standards generally ensure irresponsible building owners and developers do not revert to outdated systems.

EXPECTATIONS FOR THE FUTURE

Therefore, looking ahead to the year 2040, what can we expect? That should be clearly be left to imagination. In 1980, could most building designers and engineers envision microprocessor base controls (accessible via the Internet), variable frequency drives, LED lighting, occupancy-based controls for lighting and power systems, and many other advances now taken for granted? Even so, it is reasonable to foresee buildings in 2040 equipped with systems that harness energy from sustainable resources such as solar, wind, biomass, and geothermal. This hypothesis is justified by thousands of successful building examples.

THE CODES AND STANDARDS RESPONDED TO FEDERALLY PRESCRIPTIVE MINIMUM EFFICIENCIES, INDUSTRY BEST PRACTICES, AND FREE MARKET ADVANCEMENTS IN TECHNOLOGIES.

Most of these buildings are classified as site Net Zero Energy Buildings (NZEBs), defined by integrated alternative energy systems that produce at least as much energy as is consumed. Due to the success of NZEBs, the building industry and building owners have started focusing on their feasibility with increasing interest. Unfortunately, the barrier to widespread or exclusive construction of NZEBs is entirely economic. This author hopes—and dares to predict—that free market innovation will remove this barrier by 2040. As wide as the technology leap between pneumatic and Web-based DDC controls, building owners should expect at least an equal leap in renewable energy technology.

OTHER INITIATIVES

There are activities that may not rely on innovation solely to develop NZEB technology. Instead, these activities are proposing mandates via codes and standards to legislate NZEB construction. The most prevalent action is U.S. Senate bill SR 1000, titled "Energy Savings and Industrial Competitiveness Act of 2011." The bill establishes a goal for commercial and residential NZEBs by 2030, less than 20 years. The bill also gives the Department of Energy secretary authority to review existing energy conservation codes and standards, specifically ASHRAE Standard 90.1 and International Energy Conservation Code, providing input, and possibly directives, on revisions to achieve the 2030 NZEB goal. The secretary furthermore has authority to establish a DOE-produced national energy code if these documents fail to meet the 2030 goal. These two bill provisions alone create unprecedented federal legislation, if maintained and passed. Assuming the provisions are removed, the legislation would improve national energy efficiency standards and fund initiative for innovation.

Parallel to the federal arena, the American Institute of Architects (AIA) and American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) have noble and ambitious goals of Zero Carbon Emission and NZEBs by 2030. Being composed of industry leaders and design professionals, both AIA and ASHRAE will pursue the 2030 goal primarily via innovation and advanced technology utilization. Unfortunately, the size and diversity of both organizations has proven too slow and/or stall such pursuits with intrinsic bureaucracy.

ULTIMATELY, ALL BUILDING OWNERS SHOULD ASPIRE TO DESIGNING, CONSTRUCTING, AND OCCUPYING HIGHLY SUSTAINABLE BUILDINGS.

Smaller and more focused organizations are arising to address the 2030 goals in support of the AIA and ASHRAE initiatives. However, the speed of advancement of activities with codes and standards, led by the smaller organizations, may be outpacing the current state of building industry innovation.

A recent example is the New Buildings Institute (NBI). NBI has been effective in developing high performance and NZEB design guidelines and promoting sustainable buildings. In 2010 revision cycle, NBI, with support of AIA and the Department of Energy, proposed revisions to the International Energy Conservation Code to advance energy efficiency more than 30 percent than the current IECC version. Part of the proposal removed any reference or alternate path using ASHRAE Standard 90.1, which is the most recognized building energy efficiency standard. Although this removal was rejected by ICC, it identified possible competing agendas for promoting ultimate building energy efficiencies. NBI is overt in their goal of promoting NZEBs as a basis for all new construction.

Ultimately, all building owners should aspire to designing, constructing, and occupying highly sustainable buildings. Someday, hopefully before 30 years, renewable energy and NZEBs will be as common as a digital thermostat. For the sake of cost-effective buildings, it is this author's hope that NZEBs are achieved through innovation and not legislation.

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