

AIChE JOURNAL Highlight

Chemical Engineers are Needed to “Green” the Building Industry

Unlike almost every other artifact produced by modern industrial society — such as automobiles, aircraft, and electronic devices — the design, construction, and operation of buildings is still highly fragmented and comparatively unsophisticated. Materials of construction, coatings, cladding, as well as electrical, mechanical, and other components can be selected independently with little, or no, thought given to their interactions and the effects of their coupling on the building’s performance. As a result, many buildings are highly inefficient energy consumers.

New buildings are being designed to meet a higher level of quality, such as that set by the Leadership in Energy and Environmental Design (LEED) rating system, but even these buildings underperform, says Pennsylvania State Univ. chemical engineering professor Henry Foley. “The bigger problem that we face, however, is in the approximately five million commercial buildings in the U.S. that occupy a total of 71,658 million ft² of space and that are highly deficient in terms of their energy efficiency,” Foley says. “If nothing is done, these buildings will continue to over consume and waste energy for decades to come,” he warns.

In the March *AIChE Journal* Perspective article, “Challenges and Opportunities in Engineered Retrofits of Buildings for Improved Energy Efficiency and Habitability,” Foley discusses the technical challenges associated with effectively retrofitting buildings and points out that chemical engineers have the training, insight, and disciplinary culture to tackle these challenges.

The primary goal of engineered retrofitting is to increase the energy efficiency of the commercial building sector by as much as 50% in 10–15 years, and to do so with better economics than are represented by doing nothing. This goal will not be met with small improvements to the current methods used by the industry, Foley says. Rather, a real solution will require breakthroughs and

innovations based on completely new and deeper thinking about the problem.

“Engineered retrofitting of commercial buildings must be taken on by professionals who are used to dealing with complexity, as well as to designing and controlling systems of systems, using model-based design principles, and operating within tightly coupled economic constraints,” Foley says. Chemical engineers fit this bill of requirements and are familiar with the unit operations of importance to energy consumption in buildings — heating, ventilation, and air conditioning.

One way chemical engineers can contribute to building retrofits is in the use of virtual design. Process simulators that have been developed over the last 30 years have significantly streamlined the design process, especially for plant retrofitting. The building industry, on the other hand, uses relatively rudimentary design tools. This is not to say that efforts have not been made to create useful simulation tools. Building information management (BIM) tools, for example, are available for construction management.

However, Foley believes, BIM and other tools still leave much to be desired compared to the model-based design tools used by process engineers in the chemical industry. There simply seems to be no equivalent in the building industry to the computer-aided simulation

and design tools used by chemical engineers.

“An immediate need is for highly integrated building simulation tools that approach the levels of sophistication that chemical engineers have come to expect with process simulators. Without such modeling tools, it also becomes very difficult to do rigorous control of the building once it is constructed,” Foley says.

In addition to better design tools, engineered retrofitting will also require economic analyses, better control systems and operation, and an integrated approach to the business model for building retrofits, Foley notes.



▲ The Empire State Building has undergone an extensive retrofit to increase its efficiency and earn a rating of LEED Gold — symbolizing the new level of performance that can be achieved for older commercial buildings.