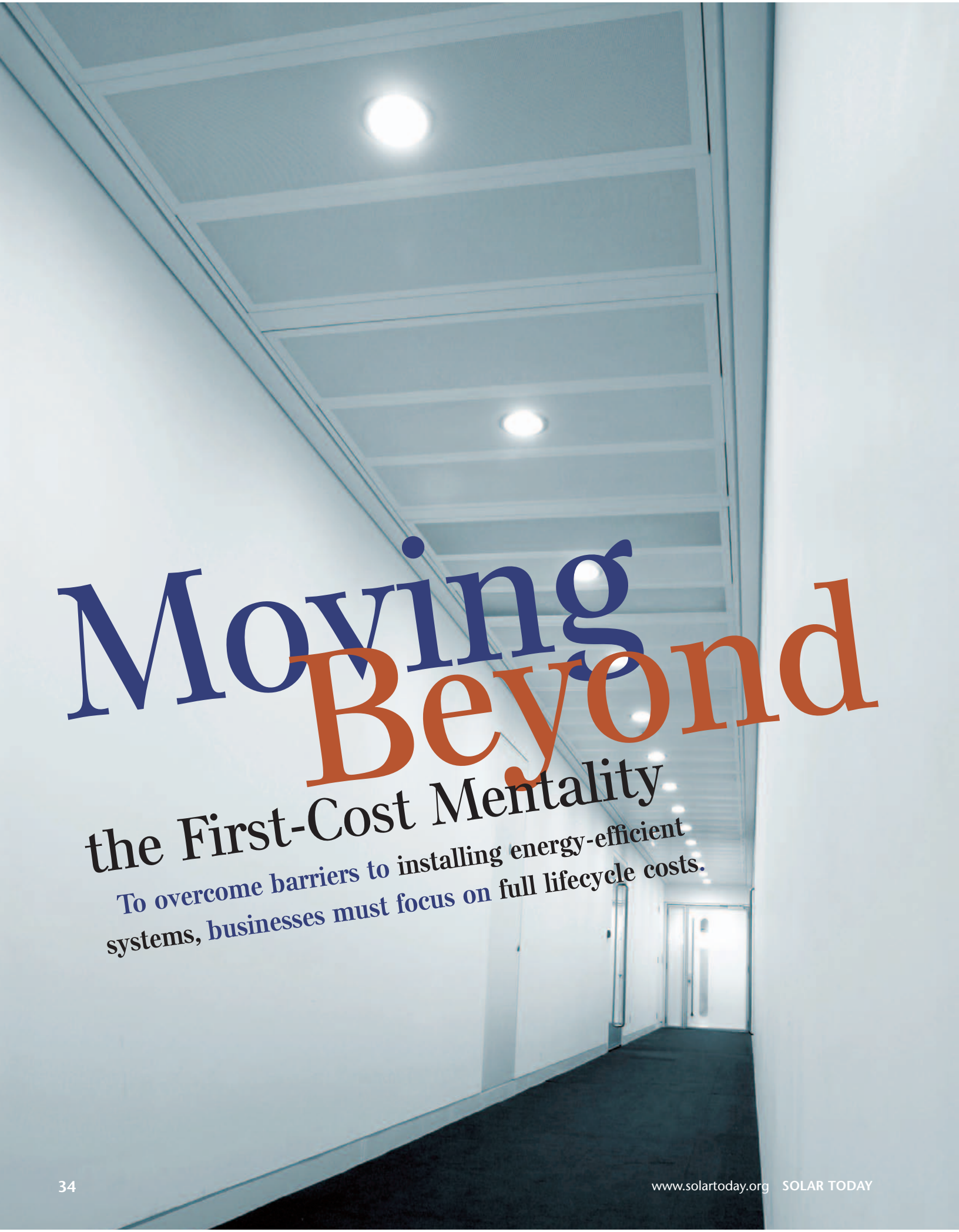

Moving Beyond the First-Cost Mentality

To overcome barriers to installing energy-efficient systems, businesses must focus on full lifecycle costs.

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During the height of the energy "crisis" in California several years ago, the facilities manager for the school district in a major city there lamented that he could get all the money he needed to pay the utility bills, but not a dime to pay for improvements that would save energy — even if the payback was short-term.

Those interested in improving overall energy efficiency often question why an organization would fail to invest in such equipment, when it can generate savings that return its initial cost many times over. Often, the answer is that decision makers focus strictly on the initial cost of this equipment, ignoring the long-term operational savings possible.

Commercial and residential buildings combined directly consumed 39 percent of the total U.S. energy usage in 2002 *(see figure 1)*. Total U.S. energy consumption is around 95 quadrillion (95 x 10^{15}) British thermal units, or Btu, and thus, commercial buildings account for around 20 quadrillion Btu. Sixty-two percent of the commercial building energy usage, or about 12 quadrillion Btu, is dedicated to primary systems such as space heating and cooling, lighting, water heating and refrigeration — systems for which equipment choices greatly affect energy usage.

If the energy efficiency of these systems were improved just 5 percent nationally, the nation would see energy savings equivalent to 180 billion kilowatt-hours of electricity. Not counting the significant savings potential in demand charges (charges on the demand for service imposed by a particular customer), at the recent U.S. average of 8.4 cents per kilowatt-hour for commercial-sector energy, this savings would translate to a potential $15 billion per year. The environmental benefits would also be significant. By reducing electricity usage by 180 billion kilowatt-hours, the nation would reduce carbon dioxide emissions by 110 metric tons at the average U.S. emissions rate for electricity generation in 2000 (U.S. Energy Information Administration data).

It is important for those concerned with the smart use of energy to understand the real-world factors involved when businesses or individuals make choices about energy equipment and systems. In this article, we describe the technical, economic, psychological and public policy barriers that impede implementation of renewable or energy-savings projects, with the focus on commercial buildings. We classify these barriers into the categories of building ownership, technical issues and economic/general public policy issues.

Decision Depends on Building Ownership

The decision-making process regarding purchase of energy-consuming equipment or installation of a renewable energy system such as a solar hot water or solar photovoltaic system differs depending on who owns the building. For commercial buildings, the viewpoint depends on whether the building is occupied by the owning entity or a lessee.

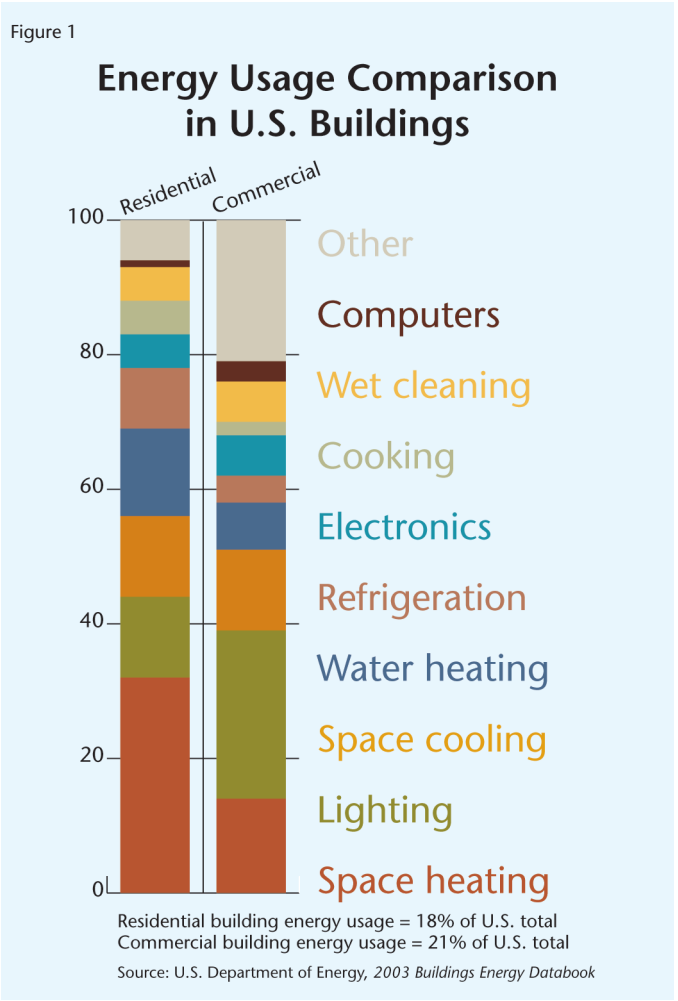
Owner-Occupied Buildings. For owner-occupied buildings, utility and capital expenses are ultimately included in one corporate budget. In an existing building, the type of business and corporate-management principles dictate the evaluation process. The decision also depends on whether equipment modification is necessary (such as when replacement is needed) or is considered purely for improved performance. More flexibility exists in new construction; necessary energy-consuming equipment must be installed anyway.

The energy-efficiency or renewable energy option being considered will be evaluated against other projects competing for capital resources. When tangible or more easily measured cost savings alone are considered, energy-saving projects often perform poorly compared to options related to the core business activity.

Leased Buildings. For a building not occupied by the owner, two economic entities are involved in the evaluation: the building owner and the leasing organization. Many times, neither party has an incentive to make the investment. Various models exist for the sharing of energy system costs and responsibilities, but a building owner will invest only if it increases the building value within the time frame in which he or she plans to own the building.

In good economic times, the market for leased space will be tight and owners can obtain attractive prices regardless of the HVAC efficiency. During economic downturns, to attract a

Figure 1



Left, 62 percent of the U.S. commercial building energy usage is dedicated to primary systems such as space heating — systems for which equipment choices greatly affect energy usage.

Figure 2

Energy-Efficiency and Demand-Response Programs by State

- States with public purpose and/or utility energy-efficiency and demand-response/load management programs
- Demand-response/load-management programs
- Public purpose and/or utility energy-efficiency programs

	Distributed energy resource options available	Gas energy-efficiency programs	No energy-management programs
Alabama	●		
Alaska			
Arizona	●		
Arkansas			
California	●	●	
Colorado			
Connecticut	●		
Delaware	●		
District of Columbia			
Florida	●		
Georgia			
Hawaii	●	●	
Idaho	●	●	
Illinois	●		
Indiana	●		
Iowa	●	●	
Kansas			
Kentucky	●		
Louisiana			
Maine	●		
Maryland			
Massachusetts	●	●	
Michigan	●		
Minnesota	●	●	
Mississippi	●		
Missouri			
Montana	●		
Nebraska	●		
Nevada	●		
New Hampshire		●	
New Jersey	●	●	
New Mexico			●
New York	●	●	
North Carolina	●		
North Dakota			
Ohio			
Oklahoma			
Oregon	●	●	
Pennsylvania	●		
Rhode Island	●		
South Carolina			
South Dakota			
Tennessee	●		
Texas	●		
Utah			
Vermont		●	
Virginia	●		
Washington	●	●	
West Virginia			
Wisconsin	●	●	
Wyoming			

Source: www.eere.energy.gov/femp/program/utility/utilityman_energymanage.cfm
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quality lessee, the owner may want to offer a building that operates efficiently and provides a quality indoor environment. Such times, however, are when the owner is most likely to want to conserve cash.

Technical Issues also Must Be Conveyed

Assuming the technology works as promised, then it must be evaluated in the context of how it will impact (and be impacted by) the building under consideration. Retrofits of renewable technologies may provide additional benefits, such as shading that reduces overall cooling loads. For any retrofit, installation and engineering costs (including the opportunity cost of "downtime" when facilities are being retrofitted) are necessary, but can be a substantial percentage of the total project cost. For new buildings, system design analyses likely will be under way, and the incremental cost differential for any additional engineering analysis may be insignificant.

Compared to standard equipment, high-efficiency and renewable energy equipment may have additional maintenance requirements. Conversely, maintenance cost savings may accrue just from replacing older equipment. Although these cost impacts may be difficult to quantify in advance, project managers should attempt to include them in the decision-making process. An organization's management also may not understand, or have the time needed to understand, the technology under consideration. Thus, they will rely on the input of others in the decision process. The result can be a reluctance to adopt high-performing (and likely higher-cost) systems, due to a degree of uncertainty by management.

Full Payoffs Can Be Hard to Quantify

Certain other economic factors apply regardless of building ownership. For example, there is a cost associated with gathering and evaluating information about new technology. The decision maker may function within other constraints, such as a lack of available capital. During economic downturns, interest rate uncertainty may be another barrier. If the downturn is accompanied by falling (or rising) interest rates, then the present value of the upgrade may also be greater (or lower).

Decision makers tend to focus best on the core aspect of their business. This focus becomes a barrier especially when the energy cost share is a small percentage of the total operational budget, as any potential energy savings will be neglected. The economic benefits of the project depend on the price of energy, which can be extremely volatile. A decision maker may fail to realize that reducing energy costs, by decreasing the percentage of total costs due to energy, helps stabilize cost variability for the business as a whole.

The distinction between "internal" costs and benefits versus "external" ones is a significant factor in this analysis. Factors that benefit or cost others or society as a whole typically are not considered. A barrier to implementation may exist even for internal costs and benefits if a business operation has difficulty in identifying or quantifying them.

Other major issues/barriers exist in the tax system and in policy factors such as local or state building codes and the degree to which these codes are enforced. For example, the installation of new equipment generally is considered a capital expense that must be amortized over time, compared to the utility bills (an

operating expense), which are treated differently for tax purposes. Thus, decision makers take on a first-cost mentality at the expense (perhaps) of increased operating costs for years to come.

As one example of the benefits of including long-term operating costs in the decision process, one of the authors was involved with the design and installation of solar hot water-heating systems for pools at three schools in California 20 years ago. The systems were installed at a cost of $500,000, but the energy cost savings paid back the system cost in just two years. The systems continue to function to this day.

Perhaps the biggest barrier for high-performance or renewable energy projects is that the full costs of not doing so (or the full benefits of doing so) are not accounted for by the decision maker or are artificially low. In the first instance, the barriers to implementation might be primarily informational or organizational. Something in the decision-making process leads to these costs being neglected.

In the second instance, where the external costs of not selecting the high-efficiency equipment are not borne by the decision maker, barriers to implementation involve economic and legal systems. Societal costs are often ignored, including environment impacts such as a potential for global warming and the political risks of obtaining oil and gas resources from unstable or even hostile countries. Though it is difficult to assign costs to these parameters, they do exist, whether as costs associated with national security, medical care due to poorer air quality or the potential for rising ocean levels.

If the energy efficiency of commercial buildings' primary systems were improved just 5 percent nationally, the nation would see the equivalent of $15 billion in savings per year.

Public Policies Can Help Overcome Barriers

The past few years have seen an explosion in the adoption of sustainable, or "green," buildings, largely due to the U.S Green Building Council's Leadership in Energy and Environmental Design (LEED) program. The industry is moving from the early adopter stage to a growing perception of LEED as mainstream, with new and existing buildings designed to meet its energy-saving guidelines.

But removing the barriers described above may best be achieved via public policy measures. Public policy measures that encourage the inclusion of both positive and negative aspects of an energy-related decision will be the most effective.

Public policy approaches vary across the different U.S. states and regions, and are influenced by factors such as energy cost and stability differences, public attitudes about energy and the environment and energy utility structure. Public policy measures to address an issue like energy efficiency in commercial buildings include regulatory methods, financial incentives, R&D program funding and other market approaches. For instance, other market approaches might include the use of lifecycle costing, rather than short-term payback analysis, in evaluating alternatives. For these methods to be a long-term success, however, they must balance the rights of individuals, cost effectiveness and benefits to society. *(See figure 2.)*

People often question whether renewable energy installations or conversion to energy-efficient equipment should rely on tax incentives or subsidies. Ideally, these systems should be able to compete with conventional design or methods. Tax incentives for renewable or high-efficiency equipment can go away quickly, and history demonstrates the negative effects that can have on a budding industry. But the use of public funds to perform R&D for the public good can be worthwhile.

The U.S. federal government funds programs in the three main energy areas: renewables, energy-efficient equipment and conventional energy technologies. The Energy Policy Act of 2005 devotes significant funding to programs focused on increasing the availability of domestic fossil fuel and nuclear energy resources, supporting industries that already are very profitable,

Societal costs and benefits of energy usage are shared by current and future generations, and thus, solutions should involve each of these. One solution being proposed in at least one state is that of *intergenerational financing*, a concept advanced by Amory Lovins of the Rocky Mountain Institute and Hank Patton of the World Steward Organization (Oregon State University presentation, "New Jobs and New Markets in Long-Term Wealth Creation, April 5, 2004). We contend that public funding for energy R&D can be beneficial, and that renewable and energy-efficiency programs should be evaluated on a level playing field with projects being considered for conventional energy resources. This concept is designed to spread the costs of renewable or significant energy-efficiency improvements over a long term through the issuance of bonds paid back by the energy cost savings realized. In general, we recommend that public policymakers require that such projects be evaluated based on a total lifecycle cost, rather than focusing on the first cost alone.

The barriers mentioned in this article can be overcome, but will require individual, corporate and societal efforts. Industry professionals can continue to encourage their companies and clients to select renewable energy and/or energy-efficient equipment and systems. Organizations like the American Solar Energy Society can provide educational opportunities to disseminate the information businesses need to make informed decisions. Recognizing that barriers exist is the first step toward overcoming the problem and reaping the significant benefits. ●

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