



The Key to Energy Efficiency in Buildings

ASHRAE's Response to the McKinsey Report "Unlocking Energy Efficiency in the U.S. Economy"

Energy Efficiency offers a vast, low-cost energy resource for the U.S. economy—but only if the nation can craft a comprehensive and innovative approach to unlock it. Significant and persistent barriers will need to be addressed at multiple levels to stimulate demand for energy efficiency and manage its delivery across more than 100 million buildings and literally billions of devices.

--Unlocking Energy Efficiency in the U.S. Economy

As the premier technical society focused on the energy efficiency of buildings, the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE), commends McKinsey & Company for their ongoing analysis of the economic and policy barriers to the further utilization of energy efficiency. As policymakers, the buildings industry, and the public consider opportunities to overcome these barriers, ASHRAE is pleased to offer the technically sound solutions to address these barriers.

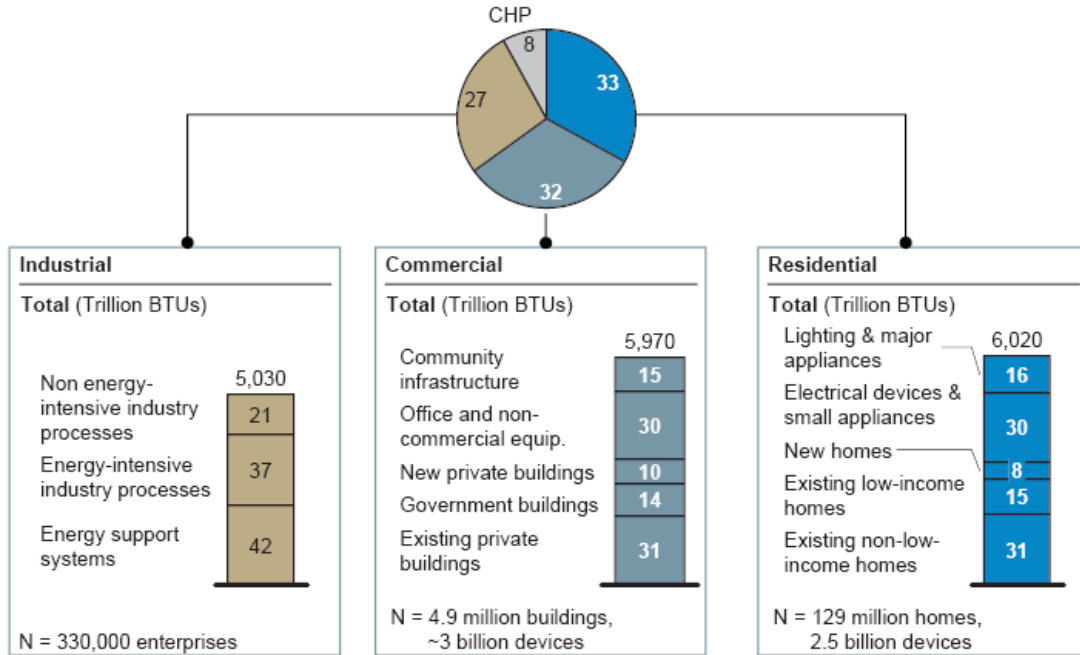
Opportunities in the Commercial Sector

Our nation's buildings account for 40 percent of our primary energy use—more than either transportation or industry. They are responsible for 72 percent of the electricity consumption and 39 percent of the total U.S. CO₂ emissions. These CO₂ emissions approximately equal the combined total emissions of Japan, France, and the United Kingdom.

To achieve the goal of producing market viable net-zero energy buildings (NZEBs), the energy use of existing and new buildings must be addressed—largely through increased energy efficiency, but also the introduction of on-site renewable energy. The McKinsey report identified the potential in commercial buildings (Figure 1), the critical barriers that need to be overcome to reach these goals, and the technologies and practices with the greatest opportunities (Figure 2—red outlines indicate areas of ASHRAE member expertise). ASHRAE is pleased to report that efforts are underway for both technical and policy based solutions.

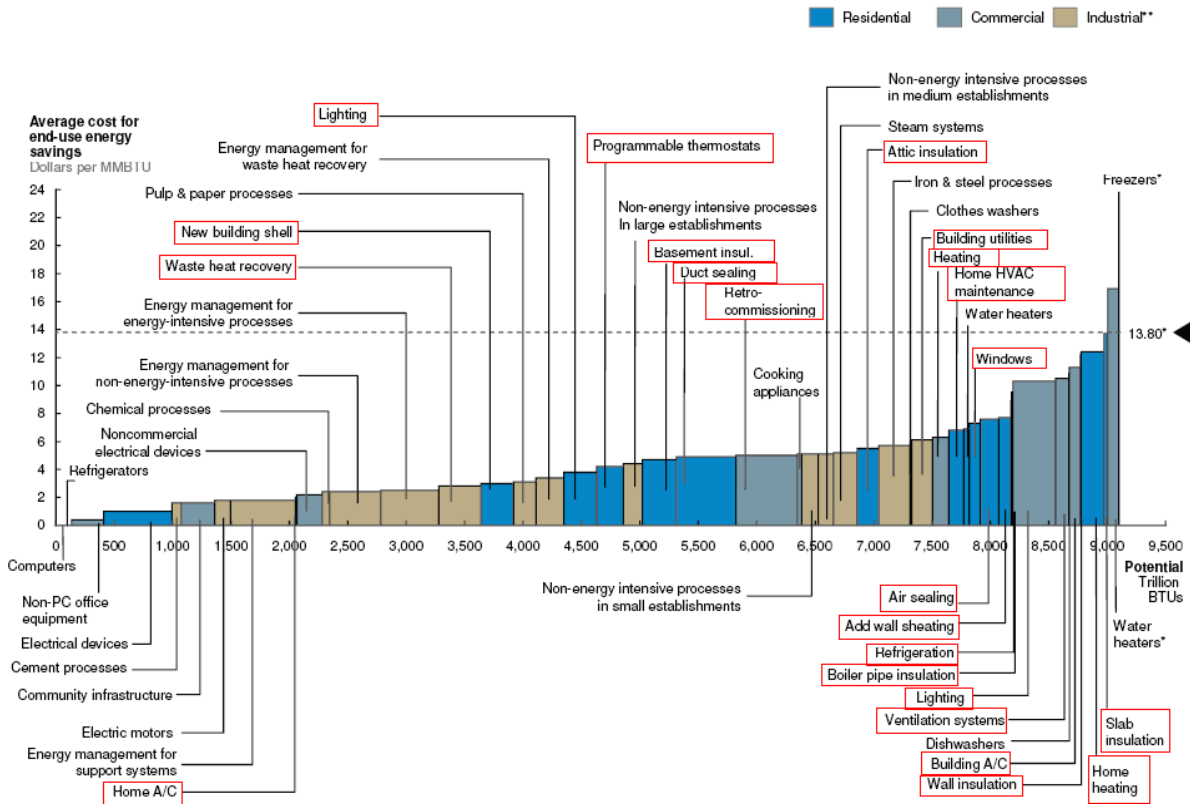
Figure 1: Clusters of efficiency potential in stationary uses of energy -- 2020

Percent, 100% = 18,410 trillion BTUs of primary energy



Source: EIA AEO 2008; McKinsey analysis

Figure 2: U.S. energy efficiency supply curve --2020



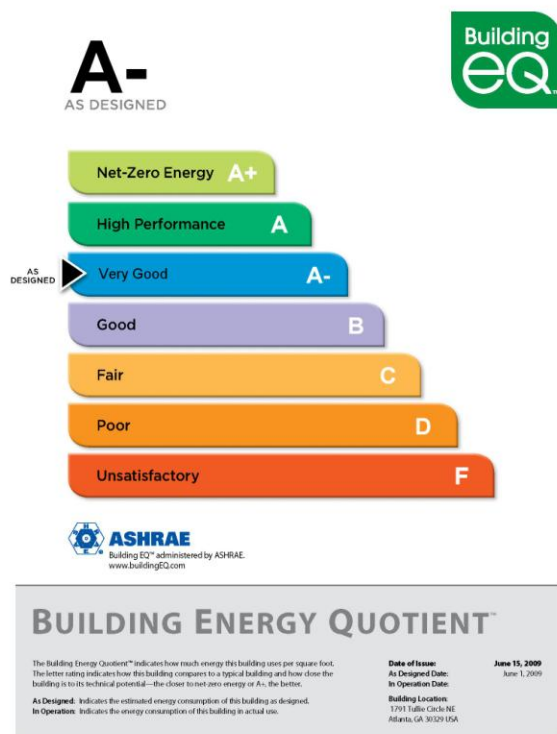
* Average price of avoided energy consumption at the industrial price; \$35.60/MMBTU represents the highest regional electricity price used; new build cost based on AEO 2008 future construction costs
 ** Our 49th source of savings, refining processes, offers no NPV-positive savings
 Source: EIA AEO 2008, McKinsey analysis

Existing Private Commercial Buildings

Approximately 70 to 80 percent of the buildings standing in 2030 already exist today. These buildings represent a significant opportunity to decrease energy use. Overcoming the barriers of split incentives and lack of energy information will be necessary and activities associated with the strategies to overcome these barriers are already underway.

Benchmarking and providing building owners and tenants, perspective owners and tenants, and the general public with information on the actual energy use of buildings will provide a significant incentive for building owners to invest in energy efficiency and realize the amount of energy saved through these investments. To encourage this benchmarking and energy disclosure as part of a technically sound and understandable program, ASHRAE has developed the Building Energy Quotient (bEQ) labeling program. The label would be applicable to both new and existing buildings and provide information on the design of the building and the energy use in actual operation. A certificate with additional information useful to the building operations and maintenance staff also will be provided. A copy of the label generated appears as Figure 3 and more information on this program is available at www.buildingEQ.com.

Figure 3: ASHRAE Building Energy Quotient Label



In a separate but related project, ASHRAE is identifying a common set of benchmark metrics and protocols that can be used across buildings to allow comparisons and conversations with understood and accepted metrics.

In recognition of the need for technical guidance on achieving energy efficiency in existing buildings, ASHRAE developed Standard 100: Energy Conservation in Existing Buildings, which is now *American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.*

undergoing revision to respond to the increased need to address energy use in existing buildings. Re-commissioning or retro-commissioning at the time of sale would help assure that new building owners are purchasing properly installed and operating equipment. ASHRAE Guidelines 0.2P and 1.2P will provide guidance for the commissioning of existing buildings and equipment.

An upcoming document based on the Advanced Energy Design Guide series (more details below) is focused on existing buildings. *Energy Efficiency Guide for Existing Commercial Buildings: The Business Case for Building Owners and Managers* will provide guidance on how energy efficiency improvements in existing buildings can be beneficial to a business' bottom line. Additional volumes in the series are planned.

Periodic energy audits either on a regular schedule or as part of a change in ownership should be used to identify potential energy savings opportunities and allow perspective building owners to make choices regarding their purchase. The publication "Procedures for Commercial Building Energy Audits" provides three levels of audits that could be performed to identify energy savings. Such audits could also be conducted as part of the application process for the Building Energy Quotient label.

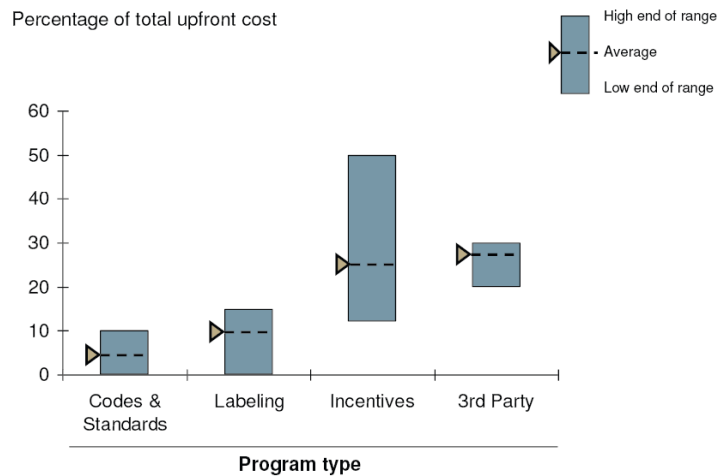
The Commercial Building Tax Deduction has provided incentives for undertaking energy saving retrofits and has been supported broadly by the building community. However, the documentation requirements and available funding have limited the cost-effectiveness of the deduction. Energy legislation currently being considered in both the House of Representatives and the Senate establishes a more accessible approach with a sliding scale of incentives depending on energy savings achieved. Also, unlike existing incentive programs focused on individual components, this program allows focus on the entire building and requires measured results. ASHRAE and others within the building community have supported this shift. Programs like the BuildingEQ label and other benchmarking tools can be used to verify these savings.

Additional policy opportunities to encourage replacement include realistic depreciation schedules for existing building systems (and even greater reward for installation of more efficient systems). Such realistic depreciation schedules will allow businesses to replace older, less efficient equipment with new equipment on a schedule that more accurately reflects the equipment's useful life. Currently, commercial HVAC systems are depreciated on a 39 year schedule—much longer than the equipment is expected to last—thus discouraging replacement with more efficient systems. Legislation in Congress and supported by ASHRAE and other building community organizations would reduce the depreciation schedule to 25 years for standard equipment and 20 years for equipment with higher efficiency ratings. Similar legislation is being considered to set reduced depreciation schedules for energy efficient roofs.

As the McKinsey report recognizes, a comprehensive approach focused on improving codes (including enforcement), providing information through labeling programs, implementing incentive programs, and encouraging third party provider programs must be implemented. ASHRAE has focused on providing the overall least cost and technically sound methods for improving efficiency—development of codes and standards and a building energy labeling program. The administrative

costs for such programs have been shown to be low to achieve the associated energy savings (see Figure 4).

Figure 4: Program Cost Ranges by Program Type

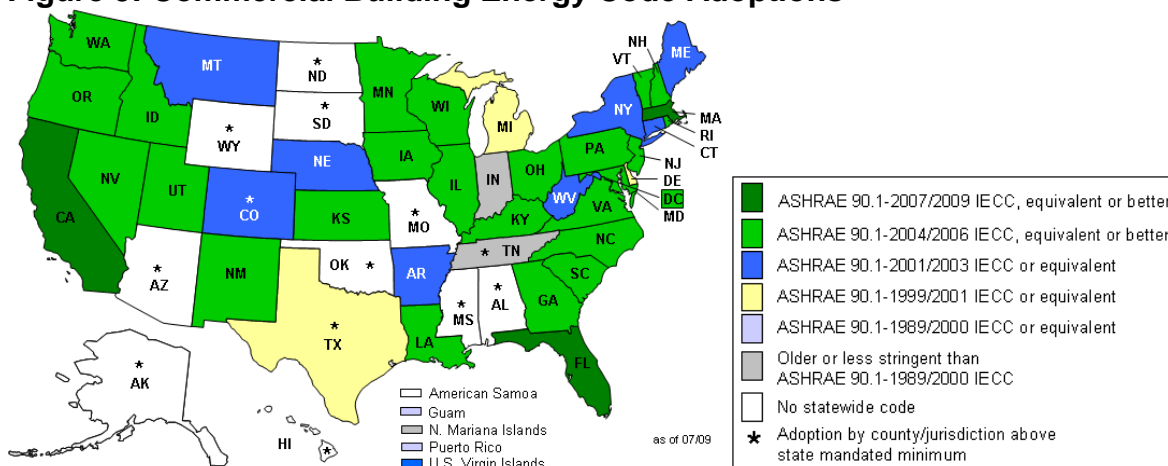


Source: Scenarios for a Clean Energy Future, Interlaboratory Working Group, 2000; McKinsey analysis, EIA, ACEEE, From 861 filings

Privately Owned New Buildings

As McKinsey recognizes, new buildings provide an excellent opportunity to reduce energy use compared to the effort and cost required to accomplish the same level of savings in existing buildings. The majority of these savings can be accomplished through the development, adoption, and enforcement of building energy codes. Since the energy crisis of the 1970s, ASHRAE has developed the consensus based standard that serves as the national model energy code for commercial buildings. Unlike in the residential sector, states are “required” to adopt a commercial building energy standard at least as stringent as ANSI/ASHRAE/IESNA Standard 90.1-2004. This requirement is largely ignored as there is no real mechanism to enforce it. Figure 5 illustrates the diversity of versions of Standard 90.1 adopted by states.ⁱ

Figure 5: Commercial Building Energy Code Adoptions



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A N I N T E R N A T I O N A L O R G A N I Z A T I O N

Assuring states and localities adopt and then enforce the latest energy codes is critical to achieving the energy savings identified in the codes. State and local building departments must be provided the funding, tools, and training to adequately enforce the code. Legislation like the Community Building Code Administration Grant Act will provide the funding necessary to accomplish this enforcement.

ASHRAE is in the process of increasing the stringency of future versions of Standard 90.1 while working within the existing consensus process. Additionally, Standard 189.1P will provide a code adoptable standard for the Design of High-Performance Green Buildings with opportunities for even greater energy savings.

In order to provide building owners with simplified tools to achieve energy savings beyond code minimums, ASHRAE with the participation of other building groups has developed a series of Advanced Energy Design Guides (AEDGs). Currently, these guides target a 30 percent improvement over ASHRAE Standard 90.1-1999 for highway lodging, small warehouses and self-storage buildings, K-12 schools, small retail, and small office buildings. Guides targeted at achieving 50 percent energy savings are currently in development. The AEDGs address the need for simplified design solutions for smaller commercial buildings, so that complex simulations are not necessary to implement the 30% above code recommendations.

Incentivizing incorporation of energy saving features rather than visible features when a building is first constructed can be encouraged by making the energy saving features visible. If building tenants and the public place value on knowing whether the developer has invested in energy efficient options, developers will be willing to invest more in these options. A disclosure program like the Building Energy Quotient program along with an educational campaign to raise awareness can allow a value to be placed on the energy saving features. Recognition of this value and the reduced risk of high energy prices by the insurance and finance community will help further encourage implementation of energy saving features.

Proper installation and commissioning of buildings upon completed construction and periodically once in operation is essential to realize the full potential of the energy saving features of the buildings. Commissioning should be conducted following procedures outlined in ASHRAE Guideline 0: The Commissioning Process and building operations personnel should be provided documentation on these features as indicated in ASHRAE Guideline 4: Preparation of Operating and Maintenance Documentation for Building Systems. Increased enforcement of building energy codes through inspections can help encourage greater attention to the proper installation of building components.

Installation of building systems should be in accordance with requirements established by a recognized organization such as the Air-Conditioning Contractors of America's Quality Installation Program.

Whole-Building Design

The widespread utilization of whole-building design or integrated design will be critical to realizing the greatest energy savings. Engaging architects, engineers, contractors, building owners, operations

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and maintenance staff, and the commissioning agent early in the design process will allow the early establishment and understanding of owner expectations and the identification of the greatest opportunities for energy savings. ASHRAE is developing a publication outlining the procedures for effective implementation of integrated design to realize energy savings.

The further development and widespread utilization of Building Information Modeling (BIM) will contribute to the broader use of whole-building design and identification of the impact design decisions will have on the energy use of the constructed building.

Education, Training and Job Creation

Providing the types of education and training necessary to achieve the envisioned energy savings will be a key area of focus. ASHRAE has an extensive educational program for building designers on complying with building energy codes, producing high-performance buildings, and other key needs for moving toward the widespread design and construction of net-zero energy buildings. However, education and training programs will be needed across the spectrum of professions involved in building design, construction, and operations and maintenance. As we look to continually reduce the energy use of our buildings, they will become even more complex. Building operations and maintenance personnel will need the training to keep these complex systems operational.

Ensuring workers in these areas have the requisite knowledge and experience to properly perform these jobs will be essential. ASHRAE has developed certification programs to help identify individuals that have the necessary knowledge base. Current programs include High-Performance Building Design Professional, Operations and Performance Management Professional, and Commissioning Process Management Professional. Additional programs are being developed including one for building energy modeling professionals.

Conclusion

Energy policies affecting how energy is used, but that are generally out of the control of the building community, including decoupling energy sales from revenues for utility companies, implementing demand response programs, and establishment of the Smart Grid also are required to fully realize the potential of energy efficiency in buildings.

As policymakers and members of the building community consider the issues identified by McKinsey and possible methods for overcoming these barriers, ASHRAE continues to remain at the forefront in the development and implementation of solutions. We look forward to continued work with the building community to develop technically sound and cost effective policies and practices for reducing the energy use of buildings.

ⁱ The figure contained within the McKinsey report is of the residential sector rather than the commercial sector, but illustrates the issues related to the diversity of versions adopted.