# ASHRAE Position Document on Energy Efficiency in Buildings

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## HISTORY OF REVISION/REAFFIRMATION/WITHDRAWAL DATES

The following summarizes this document's revision, reaffirmation, or withdrawal dates:

11/15/2019—BOD approves Position Document titled *Energy Efficiency in Buildings*

2/8/2023—Technology Council reaffirms Position Document titled *Energy Efficiency in Buildings*

***Note:*** ASHRAE's Technology Council and the cognizant committee recommend revision, reaffirmation, or withdrawal every 30 months.

***Note:*** ASHRAE position documents are approved by the Board of Directors and express the views of the Society on a specific issue. The purpose of these documents is to provide objective, authoritative background information to persons interested in issues within ASHRAE's expertise, particularly in areas where such information will be helpful in drafting sound public policy. A related purpose is also to serve as an educational tool clarifying ASHRAE's position for its members and professionals, in general, advancing the arts and sciences of HVAC&R.

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## ASHRAE Position Document on Energy Efficiency in Buildings

## ABSTRACT

This position document makes the case that while reduction in building energy use and improvement in equipment efficiency have both improved substantially in the past 40 years, additional energy use efficiency improvements are not only achievable but often the most cost-effective strategies in both new and existing buildings to achieve a more sustainable world. Improving energy use efficiency in both buildings and equipment should be pursued aggressively in building design and heating, ventilation, air conditioning, and refrigeration (HVAC&R) equipment selection, and before considering the implementation of any on-site energy generation. Energy codes, standards, benchmarks, ratings, and disclosure of building energy use are effective tools for improving energy use efficiency. Continued improvement of building energy use efficiency technologies is possible with the robust and sustained funding of research and development by governments, utilities, and nongovernmental organizations such as ASHRAE.

## EXECUTIVE SUMMARY

Buildings and their construction are responsible for 36% of global final energy consumption and nearly 40% of total direct and indirect carbon dioxide ($CO_2$) emissions (IEA 2019).

ASHRAE has a direct interest in and concern with energy issues. ASHRAE is one of the few organizations with the expertise, membership, and mission to directly address energy use efficiency in current and future buildings.

ASHRAE's positions are the following:

- Energy use efficiency improvement strategies and practices for both new and existing buildings should be pursued aggressively prior to implementation of any on-site renewable energy generation. These strategies are able to achieve meaningful reductions in energy consumption while being cost-effective.
- When supported by strong policy and regulatory implementation, building-related standards are effective tools for improving energy use efficiency.
- Energy codes, standards, benchmarks, ratings, and disclosure of building energy use provide significant value to building owners and managers.
- Sustained funding of research and development by governments, utilities, and nongovernmental organizations such as ASHRAE will continue to advance building energy use efficiency technologies in heating, ventilation, air conditioning, and refrigeration (HVAC&R); building envelope; and other areas to reduce energy use in buildings. Collaboration among these organizations leverages investments in research funding.
- Energy efficiency actions must not compromise health, safety, and comfort.

ASHRAE is committed to the following:

- Developing new standards and updating existing standards that provide minimum compliance requirements for building energy use efficiency.
- Developing and updating Advanced Energy Design Guides (AEDGs) to facilitate designs that significantly exceed the criteria in minimum efficiency standards.
- Working with other organizations to improve energy use efficiency through building codes, incentives, and other mechanisms.
- Supporting the adoption building codes and energy standards in developing nations.
- Advancing technologies through research and development (R&D) that enable the design and application of high-efficiency and environmentally responsible HVAC&R equipment and systems.
- Providing a range of educational opportunities to the building industry, including handbooks, guidelines, certification programs, publications, online education and websites, chapter programs and webcasts, technical seminars, and technical conferences.

## 1. THE ISSUE

Buildings and their construction are responsible for 36% of global energy consumption and nearly 40% of total direct and indirect $CO_2$ emissions. Improved access to energy in developing countries, increasing ownership and use of energy-consuming devices, and rapid growth in buildings' floor area has caused energy demand from both existing buildings and new building construction to rise at nearly 3% per year (IEA 2019). Using air conditioners and electric fans to stay cool accounts for nearly 20% of the total electricity used in buildings around the world today (IEA 2018).

ASHRAE has a direct interest in and concern with energy issues. ASHRAE is one of the few organizations with the expertise, membership, and mission to directly affect the energy use efficiency in current and future buildings.

While building energy use efficiency has increased substantially in the past 40 years, the building sector has great potential for economical energy use efficiency improvements, reduced energy cost for building owners and the associated reductions in greenhouse gas emissions. A recent ASHRAE research study (ASHRAE 2015) has shown that commercial and multifamily buildings can reduce their energy use in the near future (2030) by up to 48% compared to buildings designed in accordance with ANSI/ASHRAE/IES Standard 90.1-2013 (ASHRAE 2013). The energy use efficiency strategies investigated in the study included the highest efficiency equipment and building design practices either currently available or that could be reasonably expected to be available by 2030. The study did not address first costs, but many of these design practices and equipment choices are likely to be cost-effective by then.

There are four primary reasons for improving energy use efficiency:

- Save energy consumers' money
- Improve the economy
- Improve the environment and quality of life
- Improve national security

### 1.1 Energy Efficiency Saves the Energy Consumer Money

The business of energy use efficiency is, more often than not, a decision about capital investment. In its simplest form, if an investment of capital results in lower operating costs at a rate higher than standard investments of the same capital, then that is a good investment. Many energy use efficiency improvements have paybacks of five years or fewer. To address the issue of up-front investment cost, energy service contracts are a popular approach, in which the investment costs are repaid directly by the reduction in operating costs. Several other financing options are also available. After this investment is repaid, the building owner, and indirectly energy consumers, will reap these benefits for the remaining life of the building.

> *"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."*
>
> *(McKinsey & Company 2009)*

Furthermore, the capital costs of HVAC systems are reduced by energy efficiency measures that result from reduced building heating and cooling loads. Thus, smaller systems and equipment are needed, thereby reducing first costs. This same benefit occurs when renewable energy

systems provide some of a building's energy requirements; lower loads reduce energy demand, resulting in smaller renewable energy systems and equipment and thereby capital cost savings.

Building owners making investments in building energy use efficiency efforts will accrue increased benefits as energy prices rise. Although energy prices fluctuate over the short term, they are expected to rise over the long term. Energy use efficiency improvements increase in present worth due to this price escalation factor that compounds for the life of the improvements.

## 1.2 Energy Efficiency Improves the Economy

In its 2015 medium-term energy use efficiency market report, the International Energy Agency (IEA) stated, "To transition to the sustainable energy system of the future, we need to decouple economic growth from greenhouse gas (GHG) emissions. Energy efficiency is the most important 'arrow in the quiver' to achieve this" (IEA 2015). Energy efficiency improves the economy because more goods and services (gross domestic product [GDP]) are produced per unit of energy expended. This is illustrated in Figure 1 for the United States. The GDP has risen at a faster rate than the energy used to produce goods and services.

The United States has been decoupling GDP from energy use over the last forty years, as shown in Figure 1. The global perspective shows similar trends to the United States. Energy consumption per unit of GDP is steadily falling (IEA 2016).

## 1.3 Energy Efficiency is Good for the Environment and Quality of Life

Buildings and their HVAC&R systems contribute to greenhouse gas emissions through direct and indirect combustion of fossil fuels. Emissions are also produced from extraction, transport, and distribution of fossil fuels. Approximately 39% of total societal $CO_2$ emissions result from building energy consumption. Building energy use efficiency improvement and use of renewable energy can reduce building-related carbon dioxide emissions. Environmental harm can also be caused by releases of refrigerants. Refrigerant selection and practices can

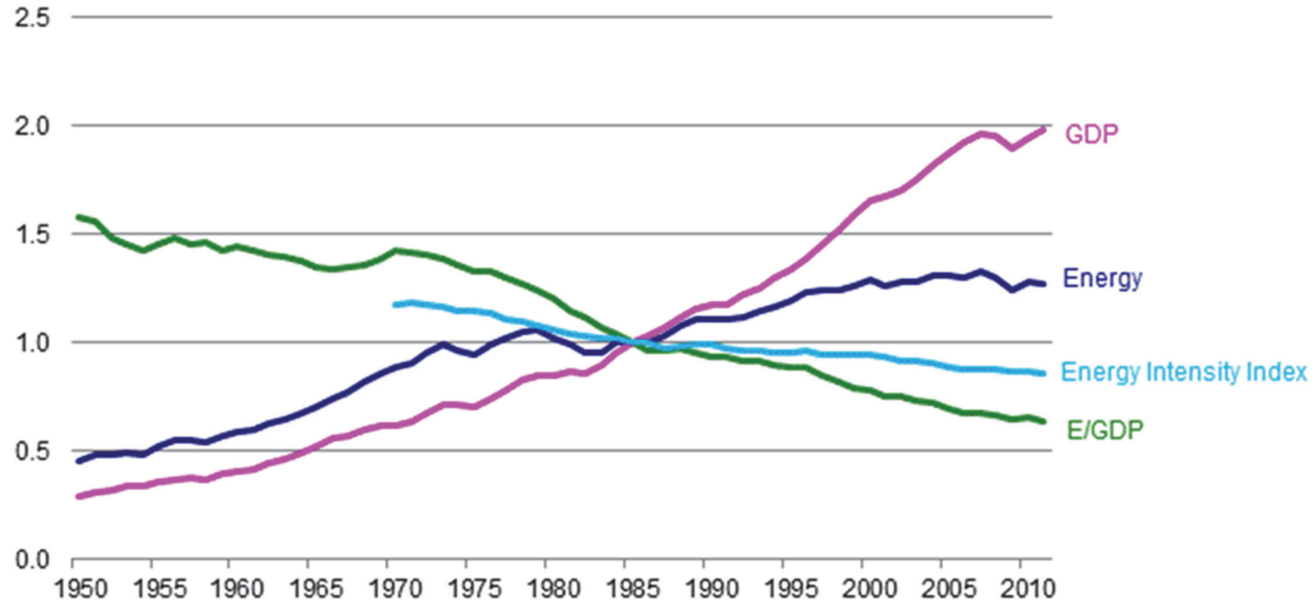


**Figure 1** Energy Use, GDP, and Energy Intensity Indexes, 1950–2011
*EERE n.d.*

further reduce the negative environmental impacts of buildings (ASHRAE 2018).

Poor indoor air/environmental quality (IEQ) can result in serious health consequences such as heart disease and lung cancer. Research also indicates that poor IEQ can result in increased absenteeism and reduced work or learning performance. In recognition of this link, ASHRAE opposes any efforts to increase energy use efficiency at the expense of IEQ, and instead encourages support of legislation that takes a more comprehensive approach to improving building performance (Persily 2015).

### 1.4 Energy Efficiency Improves National Security

National economies of all nations and their security are intricately linked in the current global economy. The flows of energy among nations are being used to influence national economies in ways that are unique in history. Nations that are dependent on energy imports are subject to fluctuations of world energy markets. Energy use efficiency can play an important role in stabilizing a nation's economic security and therefore its national security by reducing energy dependencies.

To place the global energy efficiency market in context, we note that residential buildings account for 74% of global building energy use and nonresidential buildings (notably commercial buildings) account for 26%. From 2002 to 2012, energy use in non-residential buildings grew at a faster rate (22%) than in residential buildings (12%) (IEA 2015).

At the end-use level, the combination of space heating, space cooling, and water heating are estimated to account for nearly 60% of global energy consumption in buildings. Nonresidential buildings often provide a good opportunity for energy efficiency investment, as the commercial activities undertaken typically require more active management of revenues and expenses and decisions about per-unit energy consumption are more centralized (IEA 2015).

Based on current policies, technologies, services, and projected economic trends, energy end-use in buildings is expected to change dramatically—some changes will reduce energy use (e.g,. for space heating) while others will drive it up (e.g., for electronics and appliances). Considering the factors that influence building energy use—population growth, market shifts, economic prosperity, and so on—efforts to strategically align new policies, technologies, and services within the buildings energy efficiency market can deliver significant energy savings while maintaining economic growth (IEA 2015).

## 2. BACKGROUND

### 2.1 ASHRAE Involvement in Energy Efficiency in Buildings

ASHRAE is uniquely qualified to have significant impact on the commercial sector through standards development, education and government advocacy. ASHRAE, through its research and technical and standards writing committees, has been the leading national and global developer of technical information on energy use in buildings. Information on energy use, energy use efficiency, and methods of designing, commissioning, operating, retrocommissioning, and auditing buildings is available from numerous publications and programs developed by ASHRAE.

### 2.2 Value to Building Owners and Managers

Energy codes, standards, benchmarks, rating, and disclosure for building energy use provide significant value to building owners and managers.

#### 2.2.1 Energy Use Disclosure Standardization

ASHRAE establishes standardized requirements for the following:

- The disclosure of building energy use via a rating and supporting summary documentation
- Modeling of buildings and building sites to estimate or predict building energy use for an asset rating
- Determining energy use, with metered data, of buildings and building sites for an operational rating
- Acceptable credentialing criteria for individuals applying standardized requirements and reporting building energy use
- The format and content of the rating disclosure, the label, and supporting documentation

These standardized requirements are designed to provide a method for state and local authorities to provide consistent information to building owners and managers across many jurisdictions.

### 2.2.2 ASHRAE Standards and Guidelines on Energy

ASHRAE Standards and Guidelines related to energy efficiency include the following:

- ASHRAE/IES Standard 90.1-2016, *Energy Standard for Buildings Except Low-Rise Residential Buildings*
- ASHRAE Standard 90.2-2018, *Energy-Efficient Design of Low-Rise Residential Buildings*
- ANSI/ASHRAE Standard 90.4-2016, *Energy Standard for Data Centers*
- ASHRAE/IES Standard 100-2018, *Energy Efficiency in Existing Buildings*
- ASHRAE Standard 105-2014, *Standard Methods of Determining, Expressing, and Comparing Building Energy Performance and Greenhouse Gas Emissions*
- ASHRAE/ACCA Standard 180-2018, *Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems*
- IgCC/189.1*, International Green Construction Code® powered by ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1*
- ASHRAE/IES 202-2018, *Commissioning Process for Buildings and Systems*
- ANSI/ASHRAE/ACCA 211-2018, *Standard for Commercial Building Energy Audits*
- ANSI/ASHRAE Standard 214-2017, *Standard for Determining and Expressing Building Energy Performance in a Rating Program*
- ASHRAE Guideline 14-2014, *Measurement of Energy and Demand Savings*
- ASHRAE Guideline 36-2018, *High Performance Sequences of Operation for HVAC Systems*

### 2.2.3 ASHRAE's Building EQ Program

ASHRAE's Building Energy Quotient (Building EQ) program provides a quick energy analysis, aids building owners and managers in preparation of an ASHRAE Level 1 Energy Audit, and provides actionable recommendations for improving a building's energy performance including low- and no-cost energy use efficiency measures and an IEQ survey with recorded measurements (ASHRAE n.d.).

Benefits of Building EQ include the following:

- Compares building performance via benchmarking
  - Includes metered energy data exchange from ENERGY STAR® Portfolio Manager (DOE n.d.)

  - Median energy use intensity (EUI) calculation aligned with ENERGY STAR Portfolio Manager
- Details actionable recommendations to improve a building's performance
- Streamlines and improves the audit process for tracking improvement over time
- Uses standard and consistent processes
- Provides both design and operating ratings to look at potential and actual performance
- Creates an opportunity to reassess building performance following implementation of energy use efficiency improvements to determine effectiveness (improved performance/ rating)
- Provides a Building EQ performance score (efficiency) for benchmarking
- Offers a building label to recognize high-performance buildings

### 2.3 ASHRAE Research

Each year the ASHRAE research promotion campaign raises more than $2 million to advance the arts and sciences of HVAC&R and the related disciplines. A significant fraction of this research effort pertains to improving energy use efficiency in buildings

## 3. RECOMMENDATIONS

ASHRAE's positions are the following:

- Energy use efficiency improvement strategies and practices for both new and existing buildings should be pursued aggressively prior to implementation of any on-site renewable energy generation. These strategies are able to achieve meaningful reductions in energy consumption while being cost-effective.
- When supported by strong policy and regulatory implementation, building-related standards are effective tools for improving energy use efficiency.
- Energy codes, standards, benchmarks, ratings, and disclosure of building energy use provide significant value to building owners and managers.
- Sustained funding of research and development by governments, utilities, and nongovernmental organizations such as ASHRAE will continue to advance building energy use efficiency technologies in HVAC&R, building envelope, and other areas to reduce energy use in buildings. Collaboration among these organizations to leverage investments in research funding is highly desirable.
- Energy efficiency actions must not compromise occupant health, safety, and comfort.

ASHRAE is committed to the following:

- Developing new standards and updating existing standards that provide minimum compliance requirements for building energy use efficiency.
- Developing and updating AEDGs to facilitate designs that significantly exceed the criteria in minimum efficiency standards.
- Working with other organizations to improve energy use efficiency through building codes, incentives, and other mechanisms.
- Supporting the adoption of building codes and energy standards in developing nations.
- Advancing technologies through R&D that enable the design and application of high-efficiency and environmentally responsible HVAC&R equipment and systems.

- Providing a range of educational opportunities to the building industry, including handbooks, guidelines, certification programs, publications, online education and websites, chapter programs and webcasts, technical seminars, and technical conferences.

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