



Shaping Tomorrow's
Built Environment Today

ASHRAE Task Force for Building Decarbonization

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Building Operating Carbon Emissions Reductions: Roadblocks and Opportunities

Introduction

The pathway to building decarbonization involves many elements of building design construction, operation, and occupancy. The primary means for reducing building operating carbon dioxide equivalent emissions (CO₂e) will be the greening /decarbonization of the electrical grid and transition of building services traditionally served by hydrocarbon fuels, such as space heating and domestic hot water, to electrically powered or other low-carbon equivalent emitting sources. Trends aiding carbon equivalent emissions reduction are the replacement of traditional fossil fuels with combustible fuels from renewable sources such as biofuels or renewably generated hydrogen and ongoing progress in improving building energy and carbon efficiency. The Working Group on Building Operating Carbon Emission is organized around the following principles:

- Traditional methods of measuring energy efficiency are inadequate for evaluating the efficacy of carbon equivalent emissions reduction strategies in buildings. New measurement strategies that capture the impact of carbon equivalent emissions mitigation strategies in buildings on the related upstream rate of carbon equivalent emissions are required.
- Maximizing the efficiency by which space heating, domestic hot water, and other energy intensive processes are provided in buildings with all-electric systems likely will require innovative and integrated approaches to the systems that provide these services.
- Most existing buildings and some current or near future buildings will use hydrocarbon fuels to meet some of these needs. Effective strategies to transition these buildings to either all-electric operation or other low CO₂e emissions sources must be identified and implemented.
- Successful long-term mitigation of CO₂e emissions related to building operations requires consistent feedback on the outcomes of as-designed and in-operation strategies and addressing changes in the operation and use of the building. As building use and operations change over time, a consistent program that provides feedback on the effect of changes is required to assure that the building continues to operate efficiently to curtail CO₂e emissions.
- As more and more buildings become all-electric and as the percentage of grid and on-site energy production supplied from renewable sources increases, interaction between the grid and buildings can inform building operations to minimize CO₂e emissions. Systems in

buildings must be able to take advantage of the timing of the lowest CO₂e emitting energy available on the grid, either by storing energy and/or shifting loads. Energy efficiency and demand reduction are also important during periods of higher emissions (and reducing on-site emissions).

These issues have been identified as the critical elements for building design and operation to enable buildings to achieve the decarbonization goals necessary to mitigate climate change.

Working Group Organization

The Building Operating Carbon Emissions Working Group has been organized into five subcommittees based on the principles listed above. The goals of each of these subcommittees are

- to identify the needs of the ASHRAE stakeholders and to overcome the relevant challenges posed by decarbonization,
- to identify resources and functions within ASHRAE that are relevant to these challenges,
- to identify gaps within ASHRAE resources and programs on these challenges,
- to make recommendations for how existing ASHRAE resources and programs might be modified to fill these gaps, and
- to identify new ASHRAE activities that would be beneficial to the industry with respect to these challenges.

The following working groups have been developed to pursue these goals for the issues identified in the Introduction:

1. Measuring/Monitoring Carbon Emissions Subcommittee
 - Emissions intensity
 - Electricity
 - Delivered fuels
 - Refrigerant leakage
 - Upstream energy supply chain emissions
 - Marginal vs. average emissions
 - Emissions signatures (“heat maps”)
 - Anticipated future emissions
 - Appropriate scalars (carbon/CO₂e emissions per unit of what?)
 - Credit for off-site procurement of renewable energy
2. Building Systems Efficiency (All-Electric Buildings) Subcommittee
 - Enclosures
 - Building services (heating, cooling, ventilation, service hot water, lighting etc.)
 - Process loads, including “plug” loads or other user-installed equipment
 - Integration of systems (synergies that reduce overall energy use and related emissions)
3. Transition Strategies for Carbon Fueled Buildings Subcommittee
 - Existing buildings
 - General energy efficiency improvement strategies
 - Transition strategies from high-emission equipment
 - Transition strategies from inefficient equipment to more efficient equipment
 - Weaning buildings from high-emission or soon-to-be-terminated district systems

- New buildings
 - Exceptions to electrification
 - Ensuring fully decarbonized transition paths
 - Avoiding system dead-ends that preclude later decarbonization
- Decarbonization of district energy systems
- 4. Building Process/Phases Subcommittee
 - Transition – design assumptions to operating conditions
 - Initial commissioning to recommissioning
 - Adapting to current facility occupancy requirements
 - Climate change adaptation
 - Evolution of operating strategies for minimum carbon emissions
- 5. Building Systems Integration with the Grid Subcommittee (direct liaison with Grid-Building Intersection Working Group)
 - On-site renewable energy production
 - Energy storage
 - Load-shifting
 - Advanced controls
 - Regional variation of energy supply emissions, current and future

During the life of the ASHRAE Task Force for Building Decarbonization, these subcommittees will develop recommendations for these specific challenges to help ASHRAE more effectively pursue building decarbonization.