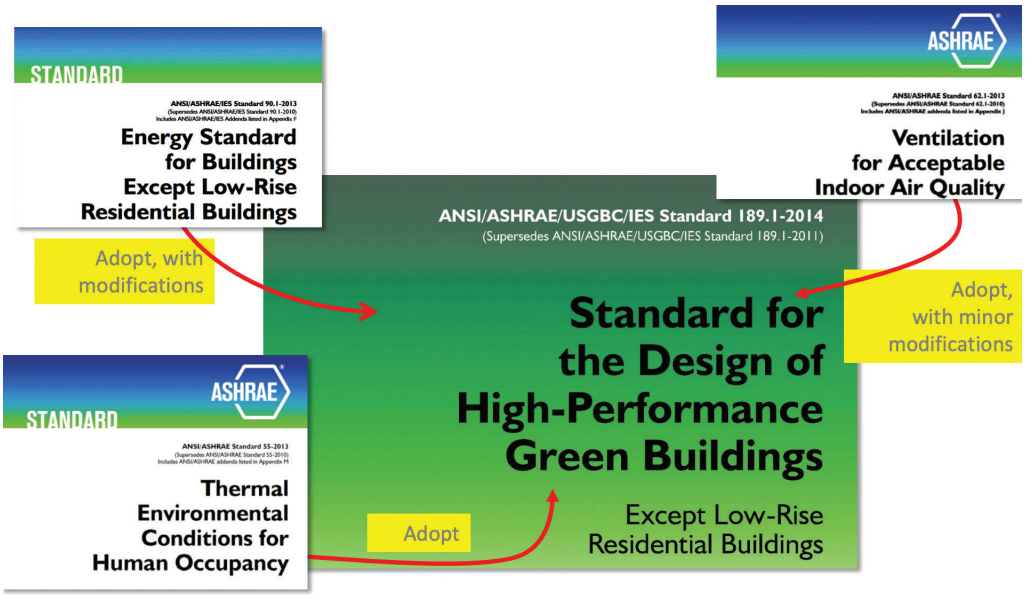
ASHRAE 189.1: A HIGHER STANDARD FOR HIGH-PERFORMANCE GREEN BUILDINGS

By Nick Agopian

In the quest to build more sustainably, different organizations have set forth a variety of standards and certifications to realize high-performance green buildings. The chief among these is Standard 189.1 created by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

Standard 189.1 provides stringent green-building parameters to achieve the most sustainable buildings possible. Many factors are incorporated to create a green building, with energy recovery ventilation at the core of the standard's requirements to design healthier structures that use less energy.



Source: U.S. General Services Administration

Why is 189.1 a higher standard for high-performance green building? This white paper addresses that question by looking at what building green means, what's covered in Standard 189.1 and how energy recovery ventilation technologies play a key role in making green buildings a reality.

Hurdles to Cross When Building Green

Residential and commercial buildings face two main challenges in the pursuit to reach green status. First, as structures become more airtight, contaminants are locked inside, thus impairing indoor air quality (IAQ). Second, buildings are incredibly wasteful and use tremendous amounts of energy to run, which is harmful to the environment and leads to substantial costs.

Let's look at IAQ. When indoor air contaminants increase, this results in deficient IAQ, which can impair people's health, productivity, cognitive function and wellbeing. This is especially concerning since people spend about 90% of their time indoors where concentrations of some pollutants are often two to five times higher than typical outdoor concentrations.[1]

Now, onto the energy issue. Residential and commercial buildings in the U.S. are energy hogs and use about 40% of the energy and 70% of the electricity in the country,[2] and produce about 40% of the CO2 emissions.[3] What's more, they waste about 30% of their energy input,[4] so there has to be a better – and more efficient – way to operate a building.

Certainly there are more optimal methods for creating healthy and energy-efficient buildings, but it's complicated since so many factors are involved. That's a central question ASHRAE deals with, and the association does this by establishing building standards to increase sustainability in the built environment.

Realizing Green Buildings via ASHRAE Standard 189.1

For many years, ASHRAE has created numerous standards to make better buildings, and they've all culminated in 189.1, the "Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings." It's the most stringent standard to date for realizing green buildings.

In fact, according to ASHRAE, Standard 189.1 "provides a 'total building sustainability package' for those who strive to design, build and operate green buildings."[5] From site location to energy use to recycling, 189.1 sets a higher standard for high-performance green buildings.

How is this done? Standard 189.1 sets the foundation for green buildings by addressing site sustainability, water use efficiency, energy efficiency, indoor environmental quality and the building's impact on the atmosphere, materials and resources.[6]

[1] "Indoor Air Quality: What are the trends in indoor air quality and their effects on human health?," U.S. Environmental Protection Agency (EPA), https://www.epa.gov/report-environment/indoor-air-quality.

[2] "About the Building Technologies Office," Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, https://www.energy.gov/eere/buildings/about-building-technologies-office.

[3] "Benefits of Green Building," U.S. Green Building Council (USGBC), May 2018, https://www.usgbc.org/articles/green-building-facts.

[4] "About the Building Technologies Office," Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, https://www.energy.gov/eere/buildings/about-building-technologies-office.

[5] "Advanced Energy Design Guide FAQs," ASHRAE, https://www.ashrae.org/technical-resources/aedgs/advanced-energy-design-guide-faqs.

[6] Ibid.

Further, the reason that 189.1 is the authority for green-building design is because it's the pinnacle of several other ASHRAE standards. These include Standard 90.1, "Energy Standard for Buildings Except Low-Rise Residential Buildings," Standard 62.1, "Ventilation for Acceptable Indoor Air Quality" and Standard 55, "Thermal Environmental Conditions for Human Occupancy,"[7] among others.

Standard 90.1 as the Foundation for Standard 189.1

Standard 189.1 builds upon several previous standards, but the real cornerstone is Standard 90.1. This is because of 90.1's total focus on reducing building energy consumption. In fact, 90.1 has been a benchmark for commercial building energy codes in the U.S., and a key basis for codes and standards around the world, for more than 35 years.[8]

However, 189.1 goes even further than 90.1 and is broader in scope with the goal of creating a completely sustainable building. In 189.1, the goal is not just energy efficiency, but also a balance of environmental responsibility, resource efficiency, occupant comfort and wellbeing, community sensitivity and responsible development.[9]

Standard 189.1 Optimizes Energy Efficiency

Bolstering building energy efficiency is at the core of Standard 189.1. In that spirit, when it was first unveiled in 2010, its goal was to increase building site energy efficiency by 30% compared to Standard 90.1-2007.[10] In addition, it seeks to enable buildings to be ready to become net zero – which means zero net energy consumption – by 2020.[11]

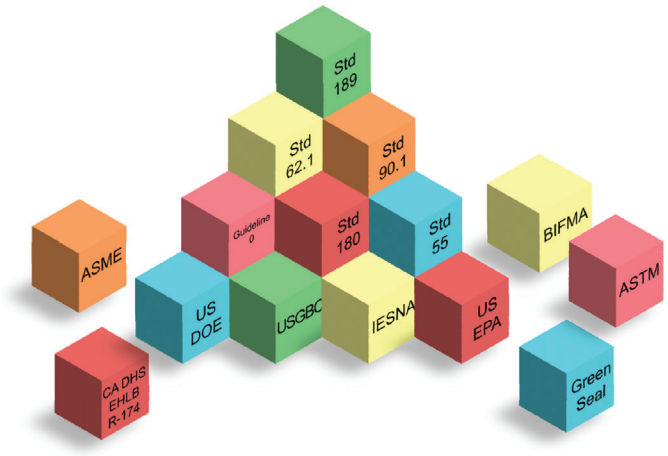
The standard has an entire section dedicated to energy efficiency, and it touches on areas such as renewable energy, lighting and energy-consumption management. It also includes energy-efficiency prescriptions for HVAC systems, including:

- Based on Standard 90.1, but modified to gain improved energy performance over minimum code standards.
- Demand control ventilation (DCV) for occupied spaces with a lower occupancy threshold.
- Economizers shown for equipment size and climate zone.
- Restricts amount of reheated or re-cooled air.[12]

Standard 189.1 is constantly evolving and adding ever-stricter energy-efficiency requirements. The 2017 edition of Standard 189.1 made several additions in the energy-efficiency section, including:

- Updated requirements to reflect changes in ANSI/ASHRAE/IES Standard 90.1-2016, including reference to Climate Zone 0.
- Updated lighting tables with improved efficiencies.
- Updated equipment efficiency tables.

Standard 189.1 Building Blocks



Source: Metropolitan Washington Council of Governments

- Revised envelope requirements.
- Updated CO_2 emission factors for different energy sources.
- New requirements for automated demand response.
- New informative appendix with an energy-compliance path that builds on the International Energy Conservation Code (IECC) instead of Standard 90.1.[13]

Standard 189.1 Enhances Indoor Environmental Quality (IEQ)

Another key component of Standard 189.1 is establishing a cleaner and healthier indoor environment, which starts with improving IAQ. The section on IEQ sets requirements for the following areas: outdoor airflow, tobacco-smoke control, outdoor-air monitoring, filtration and air cleaning, day lighting, thermal comfort, acoustics and vibration.[14]

For IAQ, Standard 189.1 sets requirements for materials that may emit volatile organic compounds (VOCs). It looks at them either as a total amount or as individual compounds, such as formaldehyde. Particular contaminant sources it covers include: adhesives and sealants, paints and coatings, floor coverings, composite wood, wood structures and agricultural fibers.[15]

The 2017 edition of 189.1 made several updates to support IEQ and IAQ. These include new requirements for control of soil gas entry, material emissions, acoustical control, day lighting, control of moisture associated with envelope infiltration and HVAC systems, venting of combustion products to the outdoors, IEQ surveys of building occupants and glare control.[16]

[7] "Standards and Guidelines," ASHRAE, https://www.ashrae.org/technical-resources/standards-and-guidelines.

[8] "Standard 90.1-2016 -- Energy Standard for Buildings Except Low-Rise Residential Buildings," https://www.ashrae.org/technical-resources/bookstore/standard-90-1.

[9] "ASHRAE Technical FAQ," ASHRAE, https://www.ashrae.org/File%20Library/Technical%20Resources/Technical%20FAQs/TC-XX.XX-FAQ-94.pdf.

[10] "Modeling Energy Savings (in Guide to Standard 189.1)," ASHRAE Journal via ResearchGate, June 2010, https://www.researchgate.net/publication/297994661_Modeling_Energy_Savings_in_Guide_to_Standard_1891.

[11] "Standard 189.1: Structure, Requirements and Energy Savings," Western University Canada, February 27, 2017, http://londoncanada.ashraechapters.org/news17/2017-02-27-Standard%20189.1%20London%20Western%20University.pdf.

[12] "ASHRAE Standard 189.1," ASHRAE India, October, 2013, http://www.ashraeindia.org/pdf/Standard_189%201_oct09.pdf.

[13] "2018 International Green Construction Code (IGCC)," International Code Council, Inc. and ASHRAE, May 2018, https://www.ashrae.org/File%20Library/Technical%20Resources/Bookstore/2018-IgCC_preview_1102.pdf.

[14] "ASHRAE Standard 189.1," ASHRAE India, October, 2013, http://www.ashraeindia.org/pdf/Standard_189%201_oct09.pdf.

[15] "Standard 189.1: Structure, Requirements and Energy Savings," Western University Canada, February 27, 2017, http://londoncanada.ashraechapters.org/news17/2017-02-27-Standard%20189.1%20London%20Western%20University.pdf.

[16] "2018 International Green Construction Code (IGCC)," International Code Council, Inc. and ASHRAE, May 2018, https://www.ashrae.org/File%20Library/Technical%20Resources/Bookstore/2018-IgCC_preview_1102.pdf.

ERVs & DOAS: Key Components of Standard 189.1

The chief consumer of building energy is the HVAC system. In fact, it's responsible for about 40% of the total energy used, with lighting coming in a distant second at 25%.[17] Out of this HVAC energy, the number one contributor is the powering of fans for ventilation at 34%.[18] Therefore, to realize high-performance green buildings, the place to start is improving HVAC – centering on ventilation – efficiency.

RenewAire's Energy Recovery Ventilators (ERVs) and Dedicated Outdoor Air Systems (DOAS) boost HVAC efficiency by reducing ventilation energy use. This is achieved by reusing otherwise-wasted total energy (heat and humidity) from the exhaust airstream to precondition fresh and filtered outdoor air coming inside.

The results of this process are enhanced IAQ, decreased energy consumption, downsized equipment and HVAC ventilation loads cut by up to 70%.[19] ASHRAE recognizes the crucial role ERVs and DOAS play in improving both the human condition and the bottom line, as well as protecting the environment. Therefore, the systems are required in several standards and most rigorously in 189.1.

In that light, Standard 189.1 incorporates all of 90.1's energy recovery requirements and then some. Both 189.1 and 90.1 require ERVs in several instances based on climate zone and percent of outdoor air at full design airflow rate,[20] and with each new update, more ERV requirements are added. For example, in 2016, 90.1 – and hence 189.1 as well – raised the minimum exhaust air energy recovery threshold.[21]

Where 189.1 goes even further than 90.1 is in energy recovery effectiveness. Currently, 90.1 requires ERVs to have at least 50% energy recovery effectiveness.[22] In 189.1, the energy recovery system has to have a minimum of 60% energy recovery effectiveness.[23]

Since ERVs and DOAS create cleaner and healthier indoor air while optimizing energy efficiency, they also play key roles in the most stringent green-building standards and certifications. For example, they're required by LEED, Green Globes, ENERGY STAR, Net Zero, Passive House, PHIUS, Living Building Challenge, HVI, AHRI and WELL Building Standard, to name a few.

Why DOAS is Critical for Standard 189.1

Commercial buildings require outside air whenever a space is occupied to meet ventilation standards and maintain IAQ. Incoming ventilation and make-up air typically account for more than 80% of a building's dehumidification load.[24] Hence, decoupling outdoor-air demand and interior-load demand allows each system to operate independently to achieve optimized operational efficiency.

A revolutionary idea proposed two decades ago was to handle the outdoor air (OA) and return air separately in building HVAC systems. This new concept describes the application of DOAS for delivering dehumidified air to buildings to improve IAQ and thermal comfort. Research concluded that DOAS provided many potential advantages compared to conventional HVAC systems.

Due to DOAS' unique ability to enhance IAQ while reducing energy use, the units are required in ASHRAE's building standards, such as 189.1. Utilizing a DOAS ensures compliance with proper multiple space ventilation and adequate IAQ. And specific codes do call for DOAS-type products to deliver 100% outdoor air. In addition, DOAS with energy recovery is a mandated feature for most U.S. code jurisdictions.

Benefits of Implementing ERVs, DOAS and Standard 189.1

A high-performance green building sounds impressive, but what does it really mean and, most importantly, what are the benefits? Essentially, by adhering to the high standards of 189.1 – and implementing ERVs and DOAS – the result is a building that supports the three pillars of sustainability: people, planet and profit.

Here's how this is possible: 1) With enhanced IAQ, indoor occupants' health, cognitive function, productivity and wellbeing are strengthened, 2) Reducing the amount of energy buildings use when ventilating backs sustainability efforts and protects the environment, 3) Optimizing energy efficiency reduces HVAC loads and downsizes equipment, which can cut ventilation energy costs by up to 65%.[25]

Introducing the RenewAire DN Series DOAS with Energy Recovery

Due to the fact that DOAS systems are one of the most energy-efficient means of enhancing IAQ, and are required by the toughest green-building standards, RenewAire has developed a full line of these units. The latest in the DOAS group is the RenewAire DN Series with Energy Recovery, which is a perfect complement to Standard 189.1.

The RenewAire DN Series DOAS effectively conditions outdoor air with efficient and sustainable technology. By enabling HVAC units to operate independently, depending on building load, our DN Series DOAS unit incorporates fixed-plate total energy recovery and a wide array of features and configurations.

The DN Series will optimize your ventilation strategy, downsize equipment, decrease capital costs and generate significant operating savings. Specific benefits of the RenewAire DN Series DOAS include:

- Improved humidity control.
- Ability to use heating and cooling systems that don't provide ventilation and/or dehumidification (e.g., radiant panels, chilled beams, VRF).
- Reduced installation costs.
- Reduced energy consumption.
- Simplified ventilation design and control.

[17] "HVAC Energy Breakdown," Australian Government, Department of Environment and Energy, September 2013, https://www.environment.gov.au/system/files/energy/files/hvac-factsheet-energy-breakdown.pdf.

[18] Ibid

[19] All data pertains to a RenewAire HE2XINH ERV when compared to conventional exhaust equipment at 1,500 CFM of OA in Minnesota using DX cooling and gas heat. Future energy costs calculated based on current energy costs.

[20] "Preliminary Energy Savings Announced for ASHRAE/IES 2016 Energy Standard," ASHRAE, February 14, 2017, https://www.ashrae.org/about/news/2017/preliminary-energy-savings-announced-for-ashrae-ies-2016-energy-standard.

[21] Ibid.

[22] "ANSI/ASHRAE/IES Standard 90.1-2016: HVAC," Building Energy Codes Program, U.S. Department of Energy, March 2017, https://www.energycodes.gov/sites/default/files/becu/90.1-2016_HVAC_Final.pptx.

[23] "Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings," ASHRAE, 2011, https://www.ashrae.org/File%20Library/Technical%20Resources/Standards%20and%20Guidelines/Standards%20Addenda/189_1_cdehjko_20120112.pdf.

[24] "ASHRAE Handbook of Heating, Ventilating and Air Conditioner Applications," 2015, https://books.google.nl/books?id=351iDwAAQBAJ.

[25] All data pertains to a RenewAire HE2XINH ERV when compared to conventional exhaust equipment at 1,500 CFM of OA in Minnesota using DX cooling and gas heat. Future energy costs calculated based on current energy costs.

In Sum

ASHRAE is constantly seeking to guide the industry with the latest in green-building best practices, and Standard 189.1 is at the peak of those efforts. To make this rigorous green-building standard possible, energy recovery ventilation technologies, such as ERVs and DOAS, are at its core and required in many building applications.

Therefore, by following the prescriptions of Standard 189.1, and implementing ERVs and DOAS, the results will be the highest-performance and greenest buildings on the market today. And, going forward, you should be on the lookout for a growing number of ERV and DOAS code requirements since the systems are so effective at enhancing IAQ and saving energy.

To find out more about RenewAire's energy recovery ventilation technologies, and how they help realize high-performance green buildings via Standard 189.1, contact us today.

Nick Agopian *is Vice President, Sales and Marketing at RenewAire. For 35 years, RenewAire has been a pioneer in improving people's health, cognitive function, productivity and wellbeing by enhancing IAQ via energy recovery ventilation technologies. This is done energy-efficiently, cost-effectively and sustainably via fifth-generation, static-plate, enthalpy-core Energy Recovery Ventilators (ERVs) and Dedicated Outdoor Air Systems (DOAS). For more information, visit: www.renewaire.com.*