

Healthy Buildings Vermont 2020

EFFICIENCY VERMONT R&D PROJECT: HEALTHY BUILDINGS

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March 30, 2021

Introduction

A building's design and how it operates directly affect occupant health and well-being. Efficiency Vermont has a long history of helping facility managers and building owners make critical energy efficiency decisions—but what impact do these decisions have on indoor air quality (IAQ) and occupant health?

Healthy Buildings Vermont 2020, an Efficiency Vermont research and development project, has answered that question by identifying (1) the effects energy efficiency improvements can have on occupant health and indoor environmental quality, and (2) the type of commercial customers who are interested in improving occupant health through energy retrofits. The project team used those identified effects and customers to design a pilot project that would quantify the impacts of a commercial building's mechanical system retrofits on occupant comfort and possible health ramifications. This summary covers pilot project activity completed in 2020 and contains plans for 2021.

Connecting Building Energy and Health

The research on the effects of buildings on occupant health and performance is steadily increasing, as is information about the underlying building design and systems factors that influence the scale of impact to occupants.¹ Given the substantial energy required to treat and move indoor air in Vermont's cold climate—and fresh air as an essential component to indoor environmental quality—ensuring the efficiency of heating, ventilation, and air conditioning (HVAC) systems is imperative to achieving comfort and cost-acceptable healthy buildings.² COVID placed a clear spotlight on the connection between building ventilation, filtration, air distribution, and occupant health.³

Prior to COVID, relatively few building owners concerned themselves with occupant health related to building performance. Barring an acute and severe issue like sick building syndrome,⁴ building-related health issues typically go undetected for years. With wide ranges in occupant susceptibility and responsiveness to environmental triggers, it can be challenging to identify and prioritize the improvement of building issues affecting occupant health.

Vermont commercial buildings whose owners were likely to have the most interest in links between building energy and health prior to COVID were assumed to be schools and State-run facilities. Neither facility type has had sufficient funding to support retrofits for building energy or health improvements. Thanks to prior energy assessments and a deep partnership with the Vermont Department of Health's Envision Program for schools and its Asthma Program,

¹ The Harvard T.H. Chan School of Public Health has compiled extensive healthy buildings research, posting useful information, news stories, and research documents on the website [For Health](#). The [WELL Health-Safety Rating](#) system by the International WELL Building Institute provides a framework for designing and operating buildings, appropriate for improving building-influenced occupant well-being.

² Lighting, security, food preparation, exterior moisture management, and materials also affect building energy and occupant health, and are not addressed in the 2020 research project. Building managers in that year generally put a priority on reducing virus transmission, because of the COVID pandemic.

³ The American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) published [COVID-specific guidelines and technical resources for buildings](#), as did the [U.S. Centers for Disease Control and Prevention](#), and the [World Health Organization](#).

⁴ The U.S. Environmental Protection Agency [fact sheet on sick building syndrome](#).

Efficiency Vermont has access to energy and health-related information for school buildings. The research team for this project was combing through these data when COVID hit.

A Pilot Is Born

Most Vermont school buildings are old, and budget constraints have resulted in deferred maintenance practices. With little funding to make repairs, school facilities personnel are innovation masters in keeping their buildings operational. Ventilation standards for schools have gone from highly ventilated classrooms of the early 1900s to tightly sealed and under-ventilated classrooms of the late 1970s and 1980s, to the value-engineered and possibly ventilated classrooms of the 1990s and early 2000s, to the demand-controlled spaces seen in today's new construction.

Vermont school buildings closed in March 2020, to help prevent the spread of COVID. Recognizing a valuable opportunity to help the schools as they closed early for the summer, Efficiency Vermont sprang into action supporting schools with vacancy procedures resulting in reduced energy consumption and meaningful work for contractors. Efficiency Vermont also worked with school administrators, facility managers, and health and HVAC experts to distill the U.S. Centers for Disease Control and Prevention (CDC) and the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) indoor air quality specifications for COVID into digestible, Vermont-specific guidance for schools and their contractor partners. Knowing schools would need to improve ventilation prior to reopening in the fall and that federal resources would become available soon, Efficiency Vermont began working with the Vermont General Assembly and the Vermont Agency of Education to secure funding for retrofitting school HVAC systems to improve IAQ. Using the CARES Act Coronavirus Relief Fund's allocation to Vermont, the General Assembly approved \$18.05 million for improving HVAC equipment in schools and providing supplemental IAQ measures where appropriate. Efficiency Vermont provided school-specific technical assistance to 311 schools across the state. Efficiency Vermont also gave 365 schools a portable air quality monitor for trending IAQ and identifying issues in real time.

The research team used this opportunity and collect pre- and post-project IAQ data on 11 schools, helping them to visualize and communicate their IAQ, identify energy efficiency opportunities and derive baselines for each school's IAQ, and further support schools in addressing IAQ issues. Efficiency Vermont installed 89 monitors in November and December 2020, and sent occupant surveys to 110 teachers, administrators, and facilities managers. The surveys thus provided baseline information about comfort and the quality of the learning environment, before the retrofit.

To Be Continued

Early results confirm that, when re-opening, schools did not operate under normal conditions in Fall 2020. Reduced occupancy rates, increased use of exterior windows and doors on cold days, and new spot air cleaners dramatically affected the team's ability to obtain useful baseline measurements. In 2021, the project team will collect the 89 IAQ monitors and analyze their data, survey occupants to obtain post-retrofit information, and discuss findings with school personnel.

The monitors and their data allowed the team to (1) identify and correct a COVID isolation room that was positively pressurized to the rest of the building⁵; (2) reduce spot air purifier runtimes during unoccupied periods, thus saving on energy use and filter replacement; (3) advise closing windows during unoccupied periods; and (4) confirm good and bad IAQ conditions in classrooms.

The Vermont Department of Health has expressed interest in supporting the ongoing research through funding and the possible longitudinal evaluation of health implications from the changes in IAQ.

⁵ Rooms that have positive pressure are helpful for patients with compromised immunity; negative-pressure rooms control the spread of infection, because they prevent bacteria and viruses from entering the HVAC system. Thus, positive-pressurized isolation rooms could contribute to, if not exacerbate the spread of, the virus.