EXECUTIVE SUMMARY

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Starting in the 1970's environmental movement, engineers and architects have designed buildings to be more energy efficient (e.g., reduced electricity, cooling, and heating demands) through techniques such as building sealing, improved insulation, material selection, and ventilation changes. Many schools take advantage of these techniques, for example, by opting for reduced ventilation rates to conserve electricity, thereby creating fewer air changes per hour, through a design implementation called Demand Control Ventilation (DCV). DCV works by ventilating a room when it is occupied by reacting to sensor changes to environmental parameters, such as carbon dioxide (CO_2) or temperature. DCV also requires calibrated sensors and a working damper system that allows fresh ambient air to enter a room with the goal of reducing CO_2 build up.

Schools are often under ventilated, with rooms reaching CO_2 concentrations well above the American Society for Heating and Refrigeration Engineers (ASHRAE) recommended level of 1000 ppm. High CO_2 concentrations are also linked to human health impacts on cognition, academic performance, and attention. Ventilation can affect indoor air quality (IAQ) depending on the rate, the presence of clean and efficient filters in the HVAC system, and indoor pollutants from pests, furniture, and combustion sources. Specific ventilation system design and controls can improve IAQ, but precautions are necessary to consider the ambient conditions, occupancy levels, recirculation, and outdoor air supply balanced by humidification and temperature control.

Beyond indoor air quality, ventilation systems play a role in mitigating airborne infectious disease. In a documented case study for tuberculosis, increased air changes per hour led to reduced transmission at a university. In a recent case, researchers identified a ventilation system in recirculation mode with little additional outdoor air as the source of a SARS-CoV-2 virus transmission in a restaurant in early 2020, leading to the onset of COVID-19 disease cases in multiple diners within the airflow path of the ventilation unit. Given the priority of the Commonwealth of Massachusetts to improve ventilation in schools during the COVID-19 pandemic, classrooms remain an important aspect of the reopening and risk reduction strategies of schools throughout the world. Documentation from ASHRAE and EPA, supplemented by scientific publications (see Annotated Appendix), makes recommendations for diluting indoor air with increased outdoor air supply from windows, fans, and HVAC systems, adding engineering controls to HVAC systems, and filtering air through high efficiency filters as allowed by the building system.

The dual benefits of increasing ventilation and improving HVAC systems can be realized in improved indoor air quality for academic performance and potential for reduced risk transmission of infectious diseases. The Town of Andover and Andover Public Schools can leverage its continuous monitoring data for high school classrooms and to determine where to investigate internal CO_2 and temperature sensor issues, damper and unit ventilator function, and ventilation capacity within rooms in Andover High School. The high quality and availability of data provide an opportunity for Andover to be a leader in Massachusetts and serve as an example of the collaboration to improve indoor environmental quality for students, teachers, and staff in Andover High School. The attached documents include a report from CO_2 and temperature data analysis in classrooms with plots, a policy memorandum summarizing the findings, and an Annotated Appendix with resources and documents from government agencies and publications.