Alavy M, Siegel JA. 2019. IAQ and energy implications of high efficiency filters in residential buildings: A review (RP-1649). *Science and Technology for the Built Environment*, **25(3)**, 261-271. DOI: 10.1080/23744731.2018.1526012

Abstract

Exposure to airborne particulate matter (PM) in residential buildings can cause adverse health risks for building occupants. One approach to mitigate this exposure is the use of filters in HVAC systems. In this article, we present an integrated picture of the overall performance of higher efficiency residential filters by assessing the impacts of their use in residences that incorporate a forced air recirculating HVAC system. We answer two major research questions in this article: (1) What is the effectiveness of higher efficiency filters in reducing residential PM concentrations? (2) What is the impact of higher efficiency filters on system energy use? The results show that a high efficiency filter can be effective in reducing indoor PM concentrations if HVAC system runtime (the fraction of time an HVAC system operates) is high and if particle removal by the filter is greater than deposition and ventilation losses. In addition, higher efficiency filters generally only slightly change system energy use. Cost–benefit analyses of filters in residences show that increasing filter efficiency may not be as fruitful compared to doing so in commercial buildings due to operational differences of residential systems. Overall results suggest caution when assuming that higher efficiency filters perform better in residences when compared to lower efficiency filters.

Main findings

1. Filter effectiveness could be high if HVAC system runtime is high, and if particle removal by the filter is greater than deposition and ventilation losses.
2. Filters generally slightly change HVAC energy use.
3. Increasing filter efficiency may have less benefits in residences than in commercial buildings.
4. Overall results show that filter efficiency is weakly correlated with its energy and particle removal impacts in residences.

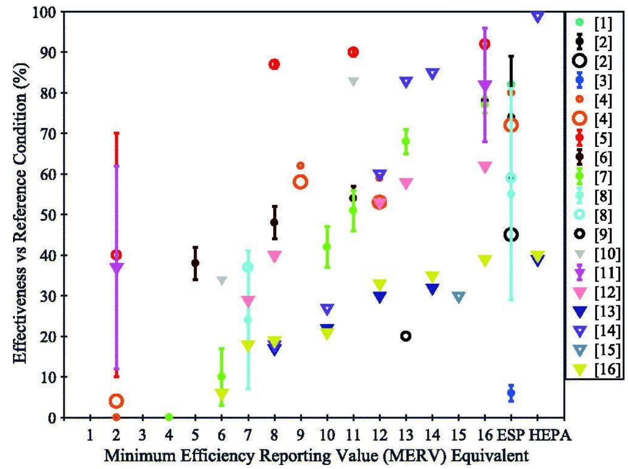

Figure 1. Residential filter effectiveness versus filter efficiency classification. Circles represent measurement studies and triangles represent modeling studies. Filled symbols represent studies with more than one building in their sample, and unfilled symbols represent studies with one building. Small symbols represent studies on submicrometer particles, larger symbols represent studies on fine (<2.5 µm) particles, and the largest symbols show studies on coarse (>2.5 µm) particles. ESP = electrostatic precipitators; HEPA = high-efficiency particulate air filters.

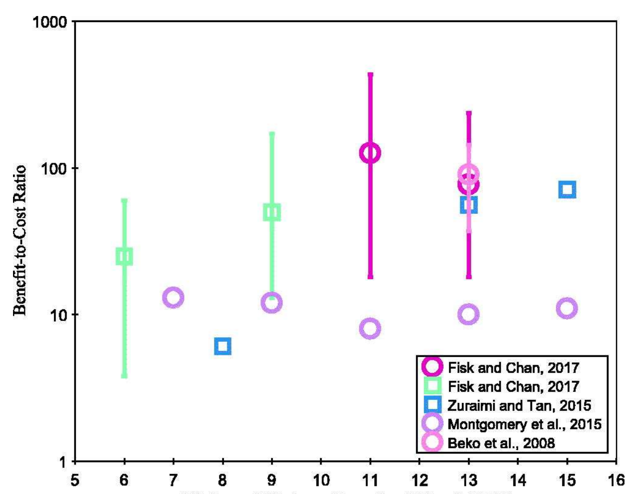

Figure 2. Benefit-to-cost ratios as a function of MERV for different benefit–cost analysis modeling investigations. Residential studies are shown with squares. Commercial studies are shown with circles.

Support provided by: