SUSTAINABLE SCHOOLS
saving our energy for education

Ventilation System Management for Schools

Discussion between Ontario School Boards and the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

September 2nd, 2020

Every school must provide a safe, healthy, and comfortable environment to support student learning. Sustainable schools do so with the least practical environmental impact. The COVID-19 pandemic has created new challenges, but also presents win-win opportunities to deliver net energy and emissions reductions and support the economic recovery.

CLIMATE CHALLENGE NETWORK

sustainableschools.ca climatechallengenetwork.org

1 Background

As Ontario's schools prepare to reopen following the COVID pandemic shutdown, the Sustainable Schools webinar, held on September 2nd, 2020 explored a range of issues associated with restarting mechanical ventilation systems in schools to support safe and healthy indoor environments. The week prior, Ontario's Ministry of Education had announced $50 million in funding to pay for ventilation system upgrades. The webinar addressed various areas for possible improvement.

Sustainable Schools
Since 2007, Sustainable Schools has worked with school boards across Canada to build the knowledge and practice of energy efficiency in schools. It is a ground-breaking initiative, going beyond energy reporting and benchmarking to establish best practice energy targets for individual schools, and thus how much energy each school and school board can save. This knowledge of conservation potential provides the foundation and direction for effective conservation action. Sustainable Schools is a program of the Climate Challenge Network.

ASHRAE
The American Society of Heating, Refrigerating and Air-Conditioning Engineers is an American professional association seeking to advance heating, ventilation, air conditioning and refrigeration systems design and construction. ASHRAE has more than 57,000 members in more than 132 countries worldwide.

Climate Challenge Network
Climate Challenge Network is a non-profit organization which develops and manages collaborative, data-driven sectoral programs, currently for municipalities, hospitals, and school boards. The programs aim to rapidly accelerate deep reductions in building-related greenhouse gas emissions and to raise energy and water efficiency, helping their members future-proof and build resiliency in their organizations and communities. Climate Challenge Network collaborates with member organizations and industry and academic experts to conduct targeted applied research, share best practices and engage in real solutions to address climate change.

2 Participants

Two school board representatives and three members of ASHRAE served as a panel to initiate conversation and respond to questions from the more than 100 school board attendees.

Panelists:

- Kyle Hasenkox, Principal, Senior Project Manager, Rocky Point Engineering Ltd.; ASHRAE Epidemic Task Force
- Doug Cochrane, Independent consultant; ASHRAE Distinguished Lecturer, Regional Vice Chair, former ASHRAE Toronto Chapter President
- David Underwood, ASHRAE Fellow, 2015-16 ASHRAE President
- Mark Twardowski, Manager of Maintenance & Environmental Services, Simcoe County District School Board
- Norm Vezina, Senior Manager, Environmental Services, York Catholic District School Board

Moderator:
Ian Jarvis, Executive Director, Climate Challenge Network

3 Context

The discussion acknowledged the challenges faced by school boards with decision-making at a time when there is limited knowledge about the transmission of the virus and adapting to new information emerging from ongoing research around the world. Recent guidance from the ministry, ASHRAE and other sources were incorporated for reference in the webinar slide deck to help inform the conversation.

In this setting, the webinar was not intended to provide specific recommendations or achieve consensus, but rather to share information and approaches to help each board with its own decision-making. This record of proceedings presents the structure of the webinar, the issues discussed and the 55 attendee questions and responses which arose.

With the focus of the webinar directed at the immediate public health priority of COVID containment, the webinar aimed to explore the issues in the context of inevitable economic challenges following the pandemic and the ongoing global climate crisis. Trade-offs were discussed in areas such as increased outside air quantities leading to higher utility costs and greenhouse gas emissions.

The discussion also acknowledged that ventilation systems are only part of the strategy for containing the COVID virus, complementing essential occupant practices such as social distancing, hand washing and masks.

4 Ventilation operating periods

Ministry and ASHRAE guidelines are to run ventilation in occupied mode for a week under normal operating hours prior to school opening. The panel confirmed this (already in effect) and no questions were received.

Guidelines are also to run systems for 2 hours both before and after each school day at 100% outside air. Discussion clarified that these hours would be typically 6:30 to 8:30 am and 4:00 to 6:00 pm, and that some boards already operate during these periods which would mitigate additional energy use and emissions. This practice should be fairly benign in September but would become more energy intensive as we get into the heating season and may be limited by heating capacity in cold weather. Questions included the usefulness of the pre-purge after the overnight period, also whether destratification fans should be operated (see the attached Q&A).

5 Outside air volumes

While uncertainty remains over airborne transmission, ASHRAE guidance is to increase outside air volumes in order to dilute contaminants including viruses, and to disable demand control ventilation until further notice.

Questions included what minimum outside air setpoints should be used for recirculating systems during the school day. The percentage depends on total air supply and occupancy and, since damper performance is non-linear, air testing is the best way to determine this. Since there is not enough time to test all systems in the short-term, an interim setting could be used and verified by measuring outside (OAT), return (RAT) and mixed (MAT) air temperatures using the formula: OA % = (RAT - MAT)/(RAT - OAT).

Discussion around demand control ventilation (DCV) clarified that, where interior space CO2 levels are being monitored, setpoints could be lowered to increase outside air volumes. Experience indicates significant variability in occupancy between air handling systems in DCV schools Section

It was acknowledged that higher outside air volumes due to pre- and post-occupancy purging and higher occupied setpoints could significantly increase natural gas consumption and greenhouse gas emissions. The impact can be mitigated by referring to the gas savings potential of individual schools reported in the 2020 Sustainable Schools Top Energy Performing Schools Boards report. Testing high savings potential schools will highlight those which already have excessive ventilation rates, and tailoring modifications to current system operations can achieve health requirements while lowering energy costs and emissions (see Section 9).

6 Relative humidity

Guidance includes the statement that "Transmission is greater in dry air, infectivity is higher in dry air, and the ability of a human being to fight infection is impaired." Ontario schools do not generally have active humidifiers and lower occupancy combined with higher outside sir volumes will serve to reduce relative humidity levels, thus creating a trade-off between higher dilution and lower humidity. There is limited research available to date to help inform the right balance, but the weight of guidance is towards more outside air.

ASHRAE guidance also refers to use of portable humidifiers in classrooms and there were a number of questions about this. Discussion was generally unfavorable, citing concerns about tripping and damage to the building envelope.

7 Air filtration

Guidance is to upgrade filters to MERV 13 and consider increased frequency of filter changes. Discussion indicated that boards either already meet this standard or are in process of doing so subject to availability of supply. The panel discussion also addressed the range of air filtration in different schools, including central systems, makeup air units, unit ventilators, heat pumps and other terminal devices.

There were a number of questions about portable air filtration units, including whether they risk tripping hazards and blowing the virus across rooms. An example was discussed of “portable” HEPA filtration units being fixed to the wall at a determined mounting height and with discharge louvres adjusted to direct the air safely.

Other forms of air cleaning show promise, in particular UV treatment as it transitions to LED light sources. The practicality of retrofitting UV equipment into existing ventilation systems has to be further studied.

No increase in filter replacement frequency was proposed. The requirement for full PPE during filter removal and disposal was emphasised. Safe disposal and mitigating the environmental impact of used filter waste have to be addressed (see Q&A attached), and a participant observed that at least one company offers a service to incinerate used filters and avoid sending them to landfill.

8 Schools without mechanical supply ventilation

Discussion of means to address rooms with just operable windows and exhaust fans indicated these are candidates for portable air filters. The panel indicated that unit ventilators are being installed to address ventilation needs in some rooms as a more permanent ventilation solution.

9 Testing, inspection, maintenance and monitoring

Ministry and ASHRAE guidelines provide extensive checklists of operational and maintenance practices to be followed and the panel discussion validated the importance of a systematic approach to ensuring existing equipment is working correctly.

Ventilation system testing is a priority, beginning with schools identified as low gas savings potential, which may be under-ventilated now, and those with high gas savings potential (see Section 4).

The panel discussion referred to a comprehensive maintenance program for rooftop units, unit ventilators and other terminal devices to address coils, drain pans and traps as well as filters. The importance of building automation systems (BAS) with large building portfolios in facilitating reprogramming of outside air and fan controls to meet changing requirements as well as monitoring operations to detect and respond to faults which occur over time. Best practices for integrating BAS fault detection with maintenance management systems were flagged as an area for further collaboration between boards.

10 Sustainable Schools

Every school has to provide a safe, healthy and comfortable environment to support student learning. Sustainable schools do so with the least practical environmental impact. The COVID-19 pandemic has created new challenges, but also presents win-win opportunities to deliver net energy and emissions reductions and support the economic recovery.

Ventilation system modifications being discussed and recommended in response to COVID will generally increase energy use and emissions for outside air heating in winter and fan power due to longer operation and to overcome higher filter static pressures. Table 1 presents a high-level initial estimate of the potential energy, utility cost and emissions increases due to:

- additional 4 hrs/school day fan operation
- 2 hrs /day each of pre- and post-occupancy flushing with full outside air plus lowering CO2 from 1,000 to 800 PPM
- additional static pressure loss of MERV 13 vs MERV 10 filters

Table 1 Estimated additional energy use and utility costs

	Total Floor Area (sf)	# of buildings	Total Incremental Cost ($)	Total Incremental Electricity (kWh)	Total Incremental Gas (m3)	Total Incremental GHG Emissions (tonnes eCO2)
Elementary	169,574,520	3,792	$40,840,352	163,898,256	71,018,208	135,660
Secondary	113,623,108	759	$27,365,006	109,819,737	47,585,625	90,898

Total	**283,197,628**	**4,551**	**$68,205,358**	**273,717,993**	**118,603,833**	**226,558**

These additional costs can be mitigated by comprehensive testing and upgrading of ventilation systems in schools. The 2020 Sustainable Schools Top Energy Performing Boards report quantified the energy savings potential of each school board in Ontario, while the 2019 report presented results of research conducted with Union Gas that showed the largest part of the savings potential is attributed to ventilation systems. The recommended approach for consideration by the boards is:

- prioritize schools with low (possibly under-ventilated) and high gas savings potential
- conduct comprehensive ventilation testing, rebalancing and refurbishment
- install variable total and outside air control (variable frequency drives)
- implement enhanced monitoring and controls
    - CO2 and relative humidity monitoring
    - fault detection and response
- consider relocating the health room away from high traffic areas and installing dedicated exhaust to ensure negative pressurization

11 Communication with Stakeholders

With the support of provincial funding, Ontario school boards are taking decisive action to modify ventilation systems in response to COVD concerns. The panel emphasised open communications to reassure all stakeholders that appropriate actions are being taken to help keep students, staff and communities safe.

12 Questions & Answers

#	Question	Response
Topic: Operating periods		
1	Should we prohibit the operation of destratification fans in classrooms, gymnasiums or other areas where present?	The thought is that more mixing is likely better, but the science is not clear. This comes from the idea that the source of infection is likely not to be known and could be better or worse depending on location and air distribution. Based off the benefits to energy consumption and the more distributed probability the consensus is that more mixing is likely better.
2	What's the purpose of ASHRAE's building readiness guideline recommendation of pre-occupancy flushing period of 2 hours? If the virus stays in the air for a maximum of 3 hours, then what does the pre-occupancy flushing do (12 hours or more hours later)?	Pre-occupancy flushing does serve to remove residual contaminants and is recommended practice, particularly during uncertain times.
3	Is it necessary to run the systems on occupied mode for one week before the schools start?	No but with the increased staffing levels in the building for the week leading up to school start it may be warranted to run the air handling systems and thoroughly flush the building from buildup from the summer and new equipment in the rooms. The intent of this is similar to the LEED building flush.
4	What's the sense of flushing after school if we are already flushing before school?	Virus and contaminants can be introduced during the school day and there are additional staff often on site after primary occupancy.
Topic: Outside air volumes		
5	What should be the typical outdoor air damper minimum setting? I understand that the engineer's standard response is "it depends". But with 300 facilities to be done in a few weeks, we can't get air flows tested in every building in time.	Addressed in the webinar. See the record of discussion Section 5 paragraph 2.
6	Does CO2 and/or VOC level monitoring make sense for management of makeup air systems? Do demand ventilation systems make sense when we have predictable occupancy levels during various periods of time in schools?	Addressed in the webinar. See the record of discussion Section 5 paragraph 3.
7	We are changing our minimum OA damper position from 25% to 40% and increasing the occupied period to 2 hours before, 2 hours after occupancy and weekends. Thoughts on this model?	Likely good, as long as the system can handle it.
8	Is there a concern running at 100% ODA damper for two hours in the heating season, specifically with a hydronic system?	Yes, the outside air volume should be within the capacity of the system. We are trying to accomplish the best we can with the equipment that we have.

#	Question	Response
9	Is it a fair statement that we do maximum amounts of outdoor air, based on outdoor air temperatures?	There is a balancing act that needs to be maintained between risk, economic impacts and climate impacts. During the early school year where economic and climate impacts are minimal so an increased outside air volume is likely a good option. My perspective on this is that during the initial phase of the school year, the benefit of increased outside air is likely more beneficial as the kids learn to adapt to the new environment and protocols along with staff and others. At this point that support is likely more beneficial to help everyone navigate the changing environment.
10	Having air flush of the building, we are throwing building internal air into outside bigger space/system which is confined in bigger fashion, and, the germs do not get killed in our open outdoor space. Why not we plan to install some equipment which helps to kill germs, for example like H2O2 system. Something a relatively cheaper option with easy installation/maintenance features	The virus breaks down rather quickly when exposed to the air and the water evaporates and is diluted effectively once outside. There is research going on about high density areas and whether re entrainment may be an issue but to disinfect the air is not likely to be cost effective.
11	Could you provide more information on how you are integrating outdoor air volume calculation algorithms into BAS operations with the Q&A Document?	What I have been doing is taking a look at the outside air temperatures and running the outside air damper based off the supply air temperature setpoint. This lets the control valve find its own spot based off the hot water supply setpoint. The challenge is that is valve-based demand reset is used then it will trend toward the maximum and substantially increase energy use. If outside air reset is used it will increase outside air to the volume based on the reset. This is why I recommended an "enhanced air mode" in the BAS so these changes can be easily reversed. Unfortunately, much of the data is conflicting between energy conservation, health and maintenance. If we increase filtration which benefits both health and energy then maintenance is increased. If we increase outside air then energy consumption is increased. Having a simple system to balance these factors is something that I think is beneficial both in terms of SARS-COV2 and long term. During periods of mild conditions (both humidity and temperature) increased outside air rates are beneficial even for cold and flu but that balance point is a challenge between risks.
12	Is the 2-hour period pre- and post-occupancy 100% fresh air?	Yes, subject to heating system capacity. After discussion with the rest of the ETF group, the consensus is that this is around the primary occupancy so for classes that run 8:30 to 3:00 it would be 6:30 to 5:00 and it is not necessary during minor occupancy pre school and after.
13	What is the scientific basis for increasing ventilation above ASHRAE standard 69 levels? Literature (from WHO) suggests ventilation systems are not a likely source for transmission. We are also changing to MERV 13 filters, doesn't this reduce the need to increase ventilation?	Addressed in the webinar. See the record of discussion Section 5 paragraph 1.

#	Question	Response
Topic: OA impact on relative humidity		
14	Are there any plans or recommendations to improve humidity levels?	Addressed in the webinar. See the record of discussion Section 6 paragraph 1.
15	Multiple studies and clinical research trials have confirmed humidity control to be one of the most effective methods of reducing viral infections (see link below). ASHRAE has recognized this and recommends maintaining indoor humidity to 40-60% RH to reduce the spread of pathogens. That said, humidity control is not mentioned in the "Optimizing Air Quality in Schools" guidelines recently issued to school boards. What is your view on this, and do you feel that portable humidifiers could be a viable short-term option to improve air quality in classrooms?	Addressed in the webinar. See the record of discussion Section 5 paragraph 2.
16	Humidification is a long-term challenge with maintenance, operations and costs. Winter humidity levels are extremely difficult to achieve during the heating season. If the industry is going to try to promote humidification, what is being done to improve reliability and cost effectiveness of the equipment?	Addressed in the webinar. See the record of discussion Section 6 paragraph 1.
17	Would adding more plants to classrooms be a way of adding humidification and purifying air?	Possibly but also runs the risk of mold and fungal growth
18	Can condensation issues arise with humidifiers used in the winter?	Yes, this needs to be a bit of a balance. Condensation can cause other indoor environmental issues. We need to try and maintain the best we can with the systems in place.
19	To be clear, drier air is equated to less virus transmission?	No - drier air increases transmission based off current research. The exact nature of this whether it is due to increased shed rate, smaller particle size or other factors is an area of research.
20	Does anyone have any thoughts about staff bringing their own portable humidifiers?	In general, the concern is that they may not be clean, could become contaminated and could have microbial growth and could over humidify causing condensation and other growth.
21	What is a reasonable trade off between ventilation and humidity? We will not be able to maintain humidity levels if we increase ventilation rates, and it is suggested that low humidity is not a good situation with Covid.	Addressed in the webinar. See the record of discussion Section 6 paragraph 1.
Topic: Air filtration		
22	Our school board has been approached by a company proposing us the UV to be installed in the existing HVAC. The product is called Fresh-Air-UV and is designed to kill COVID-19 virus.	We have no way to find that out. Boards don't typically share that info.

#	Question	Response
	Has any other schoolboard been approached about the Fresh-Air-UV?	
23	Is ASHRAE aware of the use of UV in HVAC for killing COVID-19 virus and other viruses?	Addressed in the webinar. Indicated that they are effective but very costly to maintain. Suggested to look at LED-UV technology which would replace the quartz lamps in traditional UV systems. Note that there are other issues with UV that you should familiarize yourself with (Google UV technology issues)
24	Who can certify that Fresh-Air-UV is really effective in killing COVID-19 and other viruses as advertised?	A reputable laboratory could but you would have to pay for it unless the supplier provides it and you can verify with the lab.
25	Many schools have heat pumps or fan coil units, one dedicated per classroom. The filters are typically MERV 6 or 8 and are difficult to upgrade. Is this of concern since the unit serves only one room? Also, in general, is changing a filter to a MERV 11 or even a MERV 13 going to make any significant difference in capturing the virus, since the virus can pass through?	The virus itself is not as much concern as a droplet of water containing the virus. Since the SARS-COV2 virus is an enveloped virus, it will readily breakdown when exposed to air. However, inside a small droplet it can retain its lipid coat and remain active. Similar to the larger droplets which are of concern. What we are looking at is that the nature of small aerosols that act different than larger droplets, but both appear to be capable of conveying the virus. Once particles get below 10 microns they tend to stay "floating" instead of dropping meaning that they can potentially be conveyed over larger distances. The move to MERV 13 or higher substantially increases the capture efficiency of particles in the size range that are of concern and was why they are recommended. Depending on the unit in question it may be possible to increase filter efficiency. Many "residential" heat pumps can handle MERV 13 filters in a 2" media, the important fact is to look at the operating range of the existing filter and the initial pressure drop of the proposed filter. Many MERV 8 filters are a matt type filter and moving to a pleated filter can increase surface area, improving filtration at the same pressure drop. In some cases, it may mean going from a 1" filter rack to a 2" filter rack which may not be possible on your configuration. When researching this, we found that in most cases that it would be possible with most equipment commonly used in the educational environment which was why it was recommended. If there is a concern on a specific system, I would encourage you to get an expert to review and provide recommendations.
26	Can viruses captured in HEPA filters survive, and be released when the unit/fan is OFF?	PPE should be worn when handling filters, but I would not be specifically concerned about it being released when the unit is off as it is reliant on liquid water to be active. If the filters were handled, moved or agitated there would be a risk of the viral components travelling with the droplets but at this point there is no evidence suggesting that the virus can remain active without liquid water acting as a medium.
27	Are there situations when air purification units are most beneficial, since school boards have limited resources and a range of building & mechanical systems. Can we prioritize where to install air purifiers for example - better in older buildings that do not have mech. ventilation? Are they best used in certain classrooms - like kindergarten rooms? Are there types of purifiers that work better than others?	They are a good option in spaces where there is not currently sufficient ventilation. We are trying to increase the volume of clean air so in a room where there is perimeter heat and only operable windows this may be an option. My concern with adding purifiers in a space is that it is an additional maintenance item on an already overstressed maintenance system and a potential source of contamination if not maintained. You can refer to ASHRAE's information on infection and disinfection on different types of systems.

#	Question	Response
28	A HEPA filter with 212 CFM capability is being heavily advertised and it seems to be the choice of some boards for classroom insertion. It advertises a room size capability of 750 sf. These have a height of 46 inches and air flows through the top of the appliance, which means the air currents would be about head high to many seated students and would therefore unavoidably violate the tenet in the Ministry best practices document: Portable Air Filtration Units: "Such devices and their placement should be carefully selected … ensuring air does not flow from one person to another …" Would this device be incompatible with classroom use given all of this?	The challenge is that we do not known the location of the potentially infectious person. The filter will decrease the number of potentially infectious particles in the overall space. Its distribution could make that worse but overall, it is likely to decrease risk.
29	We are using UV disinfection units across the board. Do you have any comments on this?	UV has been shown to be very effective at deactivation of the SARS-COV2 Virus.
30	Norm, which HEPA units will you be placing into your classrooms?	See response to Q 41 below.
31	Have you researched the effectiveness of HEPA filters versus UV?	This depends on the volume of treated air versus generation rate. HEPA is 99.97% effective but UV can be too depending on dosage rate. HEPA removes particles while UV deactivates the virus so depending on application both can be viable.
32	Merv 13 Filters can cause problems for older equipment	Yes, they can, but in most applications, it is ok as the initial pressure drop of MERV 13 is the same as the operating range of most MERV 10/11 systems
33	Merv 8 is our standard. How far can we go Merv 11-13 before too much restriction on air handler?	Depends on the system but most VFD or ECM fans likely have the available BHP. If uncertain ask a HVAC professional to evaluate the fan curve for the stall range. It is often in your maintenance manual.
34	If MERV 13 catches particles .3 micron and the virus is .16 micron, are MERV 13 able to catch the virus particle?	The virus is primarily only a risk when inside a droplet as it is not capable of being airborne, based on current research
35	How many times do they change filters every year?	It is recommended to consider demand-based filtration changes based on the pressure drop of the filter.
36	You cannot install MERV13 on all systems. For example, most of our Heat Pumps can only go to MERV8 as per manufacturer specifications	Depends on the fan curve and needs to be evaluated based on the piece of equipment.
37	Are the filters then handled as contaminated and require special equipment to change	ASHRAE recommends that PPE be worn during filter changes and the filters be bagged and disposed of. A bleach solution can be sprayed onto the filters to mitigate risk. Refer to ASHRAE recommendations for more information
38	Thoughts on UV lamps on the supply side of units?	Addressed in the webinar. See the record of discussion Section 7 paragraph 3.
39	Any issues with the noise on these portable units?	Check with manufacturer and get a sample from them to verify. The ones we use are variable speed and very quiet at lower speed.
40	Which rooms would be prioritized for the portable air filtration units?	At YCDSB, any classroom where supply air is less than 500 cfm.
41	Norm, how much per unit?	$720 including screens, delivery and one year's worth of filter changes.

#	Question	Response
42	What about portable classrooms & use of filtration units?	Suggest testing and maintenance of unit ventilator first
43	How effective is UV?	Addressed in the webinar. See the record of discussion Section 7 paragraph 3.
44	How many filter changes are necessary during the 10-month period?	Addressed in the webinar. See the record of discussion Section 7 paragraph 4.
45	What are the recommendations for operation/service/rework of ERVs and HRVs as it relates to COVID and the safe opening of schools?	Response 1: Filtration is not a concern with 100% OA systems. Testing and optimizing air volumes is required. Response 2: HRVs will need no rework but ERVs should be shut down if there is any possibility of cross contaminating air streams.
46	Q-Air Environmental offers a service to incinerate used filters to avoid sending them to a landfill	Good to know.
47	Is there any researched on the efficiency of ionized hydroperoxide in-duct unit (REME HALO®) as opposed to UV-C lights system	I have not seen anything specific to ionized peroxide, but I would wonder how that would work as if it were ionized It would not be hydrogen peroxide. I have seen vaporized hydrogen peroxide systems for disinfection but not in duct. Hydrogen peroxide is known to have disinfectant properties but there is concern of vaporizing due to it being a respiratory irritant. Bipolar Ionization technology is an emerging field but to date the data is insufficient to support the claims. I would be interested in seeing third party independent testing where irritants, especially ozone were monitored but I have not seen anything.
48	What is the maximum acceptable ozone level we can produce without creating a health issue (OSHA, ASHRAE, etc…)?	OSHA states that Ozone levels should not exceed 0.1 ppm for exposure over an 8-hr period. ASHRAE standard 62 references 0.107 ppm. In general, the concern is that ozone can combine with water in the lungs and create a caustic environment which can damage the lungs and be a respiratory irritant. The levels at which it is an irritant are typically lower the level that would be needed for disinfection which is why it is not generally a recommended method of disinfection.
Topic: General		
49	How can schoolboards be protected against people selling useless products pretending to help against COVID-19?	Due diligence – i.e., verification of information provided by the supplier.
50	Are there any scientific studies and data that substantiate the claim that the COVID-19 virus can be spread through an air handling system and are there cases directly attributed to infections caused by mechanical ventilation?	Addressed in the webinar. See the record of discussion Section 5 paragraph 1.
51	What lessons were learned on cruise ships where we were able to see the impact of long-term confinement of both healthy and ill occupants in a closed cruise ship for a prolonged period of time? Are cruise lines implementing any additional ventilation management measures? How will you measure effectiveness?	The panel is unaware of any changes instituted by cruise lines.

#	Question	Response
52	How are people addressing the "Isolation Rooms"? Is this an application for the portable HEPA units?	Response 1: The recommendation is for compliance with ASHRAE standard 170 so while HEPA could be used, the room should be maintained at negative pressure to reduce the probability of particles leaving the area. Response 2: The units we purchased can be adapted with an 8 in duct so it could be used for isolation rooms (mounted outside the room)
53	Is it better to open windows or not?	Yes, within the limits of heating capacity, while paying attention to safety and avoiding drafts which can increase occupant comfort complaints and may promote transmission within rooms
54	What impact does the amount windows can open have (is 4" sufficient?)?	It should be, subject to number and size of windows in a given room. Match to exhaust fan capacity with a suggested maximum air speed through the window of 250 fpm.