Submission to the VENTILATION TECHNICAL ADVISORY PANEL on appropriate and affordable technologies for COVID-19 Recovery and future Indoor Air Quality challenges in BC's Educational Facilities

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SITUATION SNAPSHOT

From what we heard at the EFMA Conference and have read, we believe the following statements synthesize the situation and challenges faced by School Districts and the Ministry for Education:

1. Closing schools to delay epidemic spread has to be seen as an exceptional measure. There are significant 'unintended consequence' effects of closing schools on families, workers, and the well-being of children and youth**.**
2. Schools need to be a safe and healthy learning and workplace environment for students and teachers and staff. This is a reasonable demand of parents, caregivers and those working in educational facilities**.**
3. The COVID19 pandemic and other recent extreme environmental events such as wildfires and heat domes showed that improvements need to be made to schools' HVAC systems. This includes 'future proofing' against such situations happening again. Given points 1. and 2. above, the economic business case for such investments is now much more apparent**.**
4. What has been done in BC's schools so far to improve indoor air quality has (mostly) been a good first step, but more needs to be done to identify the best and most affordable solutions to a wide range of differing circumstances.

   Some participants from school districts that commented during the panel session on *The Future of Ventilation* at the EFMA conference noted:

   - Upgrading the mechanical filters in HVAC systems to MERV 13 rated filters and increasing outdoor air supplies (as recommended by ASHRAE in its early pandemic response advice[1]) can have negative consequences.
     - Depending on the type, some MERV 13 filters increase pressure drops, which decreases air flows and increases energy consumption. They can load quickly so need replacing frequently. If they are the type that utilizes electrostatically charged filter material, they can quickly revert to the performance of a MERV 8 filter which has a **0%** efficiency rating for sub-micron (<1 µm) particles and only 20% for 1-3 µm.
     - Significantly increasing the amounts of outdoor air within HVAC systems has the consequence of extra energy costs for heating and air conditioning (if this is provided). There may also be the need for expensive capital upgrades to increase the capacities of the

[1] Note that ASHRAE's initial advice will be updated in the soon to be released report Design Guidance For Education Facilities: Prioritization For Advanced Indoor Air Quality from its Technical Committee 9.7.

heating and air conditioning equipment. Moreover, outdoor air may need to be reduced during wildfire smoke events

Even with 'as new' performance, MERV 13 filters are only rated at **50%** efficiency for <1µm particles, and 80% for 1-3 µm particles. The particle sizes related to the current two prime concerns are 0.1-0.5 µm for airborne viruses like SARS-CoV-2 and 0.4-0.7 µm for wildfire smoke[2]. While it was correct for ASHRAE to say that MERV13 filters could be efficient for viruses, this needs to be seen in the context of by comparison with the then standardly used MERV 8 filters. 50% is not high efficiency in the context of providing protection against sub-micron pathogenic microorganisms.

5. There are significant differences in circumstances between schools in BC. These can be related to:
   - **geographical location**, which affects summer and winter temperatures, and incidences of extremes including wildfires and heat events.
   - **age and design of buildings**, which affects the types of heating, air conditioning and ventilation systems in classrooms, including in portable classrooms.

   This means that solutions to the challenges must be tailored to the circumstances of each school district and each school.
6. Schools are more than classrooms. They include washrooms, hallways and other rooms where students, teachers and staff can congregate that are not conducive to social distancing and where attempts to maintain small cohorts can be compromised. These can need special attention.
7. Addressing the challenges set out above is the task taken up by the Ventilation Technical Advisory Panel which is to advise the Ministry of Education on ways forward including on priorities and funding implications.

TECHNOLOGY SOLUTIONS

Placing more emphasis on particle size considerations needs to be a priority. Ideally, filtration and disinfection systems should have the highest practicable efficiency for particle sizes <1 µm. While it is correct that some viruses and some smoke from wildfires can present as particles >1 µm, this will only ever be a percentage of the total particles. Recent studies of the size distribution of SARS-CoV-2 particles show a high percentage are in the <1µm size range.[3]

In practice, dealing with particles <1 µm is very challenging to accomplish with existing HVAC systems. This suggests that standalone systems that are designed to perform with very high efficiency for particles <1 µm are needed to complement the existing HVAC systems, starting in high priority areas. These existing systems can then primarily be for what they have always been intended for, providing thermal comfort and sufficient levels of outside air to maintain CO_2 concentrations conducive for learning environments and to dilute internally generated pollutants.

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[2] It is also possible for these particles to be larger. Virus particles can be carried along on respiratory droplets that are 5-10 µm. Wildfire smoke particles tend to aggregate into larger sizes as they travel and age.

[3] e.g. see: Santarpia J.L. et al (2021): The size and culturability of patient-generated SARS-CoV-2 aerosol https://www.nature.com/articles/s41370-021-00376-8.pdf and
Tomisa G et al (2021): Real-life measurement of size-fractionated aerosol concentration in a plethysmography box during the COVID-19 pandemic and estimation of the associated viral load
https://www.journalofhospitalinfection.com/article/S0195-6701(21)00312-1/fulltext

The types of **most appropriate technologies** well proven over decades are:

- **High efficiency mechanical filters** that remove particles from the air streams flowing through them. These would include filters with a MERV 16 rating (95% efficient at 0.3 µm) or HEPA filters (99.97% efficient at 0.3 µm).

- **Ultraviolet germicidal irradiation** (UVGI) systems that use UV-C radiation to kill or inactivate pathogenic microorganisms such as viruses and bacteria in the air they treat and can achieve efficiencies of >99.9 % (as long as they provide sufficient doses of UV-C either in a single pass or in multiple passes of recirculated air).

These technologies can be used in combination to maximise the benefits of each. UVGI systems do not require the ongoing costs of replacing high efficiency filters. But these alone would not address wildfire smoke particles, where this is a priority concern.

The main **practical issues** in any given application are:

- how the systems are located in the room (e.g. ceiling mount, wall mount, floor mount) and the direction of air flows into and out of the devices. These flows should work with, not against, the air flows from the existing HVAC systems. Most importantly, they should not cause discharge air to blow across persons within the 'occupied zone' as this can potentially cause transmission between individuals and negate the precaution of social distancing.
- the air changes per hour (ACPH) in the room space from the device(s) at the fan speed setting that is most likely to be used given noise level considerations.
- the serviceability of the devices, in particular for routine periodic maintenance such as replacing filters or UV-C lamps. If this is difficult and time consuming it is more likely that routine maintenance will not be done on the recommended schedule and the performance of the devices will degrade.

We expect that **affordability** will be one of the key criteria for the Ministry of Education and School Districts. This needs to be assessed on a multi-year basis, including the equipment cost, the installation costs (including professional advice costs if applicable), and the parts and labour cost of any routine scheduled maintenance. The example of ink jet printers where the costs of the replacement ink dominate a multi-year cost analysis is relevant here too.

GREENLIGHT CANADA'S COMMITMENT

We are a socially responsible business focused on providing modern certified technologies that can help address the most pressing environmental and social issues faced by institutional clients in the health care, elderly care, day care and education sectors.

We feel that the experiences of the last two years show that now is the time for a 'future proofing' refresh of schools infrastructure. We are committed to work closely with School Districts as they choose the best approaches to deal with the new challenges and improve air quality in their buildings in a long term and sustainable manner.

Our product line currently includes **UV-C and HEPA** technologies packaged in a range of ceiling mount, wall mount and floor mount configurations. These all meet the latest UL or CSA standards, including those updated in the last two years to take account of the latest applications given COVID-19.

The products include models that have been designed and will be fabricated by us in BC, as well as products from international supply chain partners. We work directly with the manufacturers and place bulk container load orders shipped by sea freight. We strive to provide the most affordable prices possible to our clients.

We will continue to increase our product offerings so as to best serve the applications of our clients. This will include looking at the fresh air supply needs, including with heat recovery to pre-heat (or precool) supply air with exhaust air.

For more technical information please see the following technical briefing notes downloadable at www.greenlightcan.ca:

(i) Use of UV-C Disinfection Chambers and Air Purifiers in the Education Sector

(ii) Facts and FAQs – Can Air Cleaners Effectively Remove Airborne Viruses in Rooms?

(iii) A Cautionary Tale: Using Air Purifiers to Control Airborne Viruses in Schools – Recent Experience in the United States with "Emerging Technologies"

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