CIMETRICS GUIDELINES FOR COVID-19 RESPONSE

Revised September 1, 2020

Workers in commercial buildings may be at risk for exposure to the virus that causes coronavirus disease (COVID-19). The coronavirus SARS-CoV-2 is not yet fully understood, and as such, guidelines and recommendations on risk mitigation are constantly changing. Air distribution through HVAC systems may be a transmission vector of coronavirus.

The purpose of this document is to summarize current recommendations in the United States from ASHRAE and CDC related to air distribution systems, quantify the financial and operational impact of those recommendations, and demonstrate how building analytics can be used to facilitate decision-making and operational management. This document will be revised as recommendations are updated and new technology is developed and tested.

While the below recommendations relate only to HVAC systems, Cimetrics recognizes that the most effective means of mitigating risk of infection is to limit person-to-person contact, so consideration should be given to methods of minimizing contact such as workflow modifications to minimize occupancy and revised spatial configuration, as well as replacing high-touch surfaces (e.g. touchless door locks & elevators, single-serving items), and adherence to surface cleaning and hygiene protocols.

HVAC TRANSMISSION MITIGATION METHODS

Ventilation

What ASHRAE & CDC say:*

- Maximize air exchange rates by increasing outdoor air ventilation as high as possible (open outdoor air dampers as high as 100%) while maintaining thermal comfort and safety.
- Bypass energy recovery systems that leak potentially contaminated exhaust air back into the air supply.
- Disable demand-controlled ventilation (DCV).
- Keep systems running longer, at least 2 hours before and after scheduled occupancy, 24 hours if possible.
- Open windows, unless doing so poses a safety or health risk.
- Increase total airflow supply to occupied spaces.
- Adjust diffuser & damper positioning and supply and exhaust flow rates to create “clean” ventilation zones that do not include higher-risk areas such as visitor reception.
- In VAV systems maximize the total supply air flow in each VAV terminal when the system is in full economizer mode.
- For Dedicated Outdoor Air Systems (DOAS) that are being replaced, size unit capacity for at least 150% of code minimum flow.

Cost considerations:

- Energy use due to additional equipment runtime.
- Energy use due to elimination of energy recovery.
- Heating and cooling energy due to increased outdoor air.
- Utility rate structure

Other considerations:

- Heating and cooling system capacity to maintain occupant comfort
- Keep humidity below 60% to control mold.

Air Filtration

What ASHRAE & CDC say:*

- Improve central air filtration to MERV-13 or the highest compatible with the filter rack, and seal edges of the filter to limit bypass.
- Consider portable room air cleaners with HEPA filters.

Cost considerations:

- Filter cost
- Equipment maintenance
- Increased filter pressure resulting in higher fan energy

Other considerations:

- Noise & space factors for portable room air cleaners

Ultraviolet Radiation (UVGI/UV-C/GUV)

What ASHRAE says:

- Both Upper-room and in-duct UVGI can inactivate some disease-transmitting organisms and affect disease transmission rates.
- Upper-zone UVGI inactivates infectious agents locally and can be considered in public access and high-traffic areas such as cafeterias and waiting rooms.
- At air change rates greater than 6-10 ACH, upper-room UVGI may be less effective than particle removal by ventilation.

What CDC says:

- The efficacy of high intensity UV radiation against COVID-19 virus is not known, and therefore it cannot confirm under what circumstances such products might be effective against the spread of COVID-19.
- UVGI lamps in upper rooms and AHUs can be considered as a supplemental control measure for air disinfection.

Cost considerations:

- Additional routine maintenance
- Increased electricity use due to bulb operation
- Reduced supply fan electric energy and improved cooling performance due to cleaner coils
- Bulb replacement
- Increase in cooling energy and decrease in heating energy due to bulb heat

Other considerations:

- Safety hazards to eyes and skin if improperly used.
- Degradation of HVAC materials by UV-C. The primary change in polymers is mass loss; photodegradation is dependent only on the total energy of UV exposure.
- Ensure no UV lights shall shine on filters.

Temperature & Humidity Control

What ASHRAE says:

- Although the weight of evidence suggests that controlling relative humidity can reduce transmission of certain airborne infectious organisms, a broad recommendation cannot be made on indoor temperature and humidity control for the purpose of controlling infectious disease.

Cost considerations:

- Heating and cooling energy
- Utility rate structure

*At the time of this writing, CDC guidelines for ventilation and air filtration are derived from ASHRAE position documents.

ADDITIONAL REOPENING GUIDELINES

The following are additional precautions for safe reopening:

- Treat water systems for Legionella.
- Review equipment schedules and sequences of operations to eliminate setbacks where appropriate.
- Ensure proper building pressurization.
- Ensure the building does not have mold after a prolonged shutdown.
- Ensure changes in electric use due to modified equipment operation does not affect sensitive instrumentation.

SHUTDOWN GUIDELINES

Cimetrics offers the following suggestions to minimize energy use during period of reduced occupancy:

- Facilities and/or EH&S walk-through labs to ensure fume hood sashes are closed and chemicals are properly stored.
- Set building equipment to unoccupied mode and review setback sequences.
- Turn off equipment in buildings that are not in use.
- Turn off lights and elevators where possible.

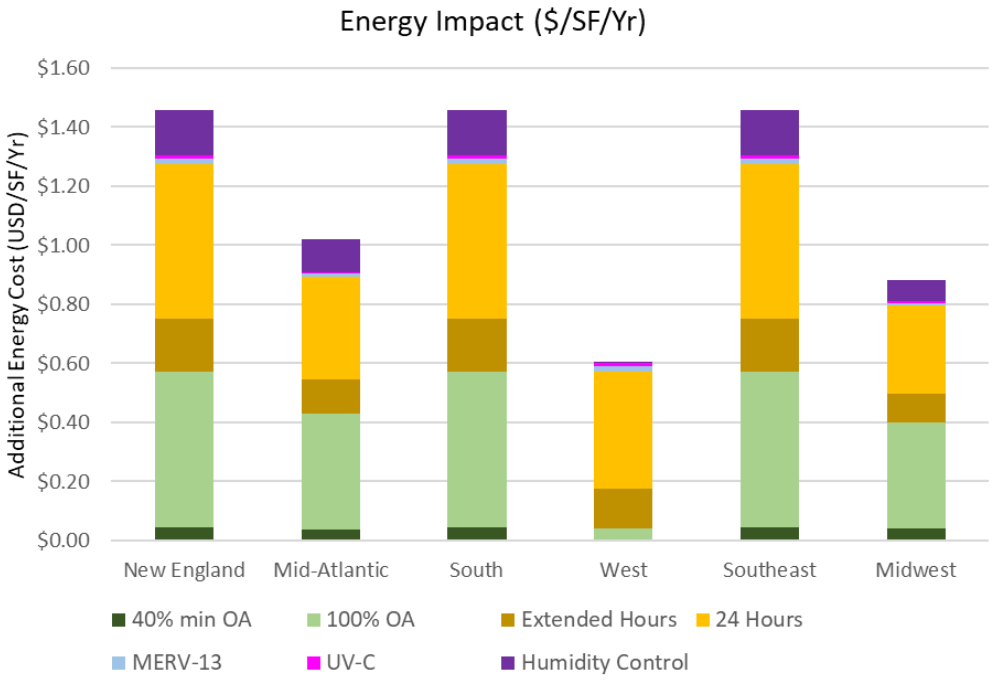
RECOMMENDATION SUMMARY

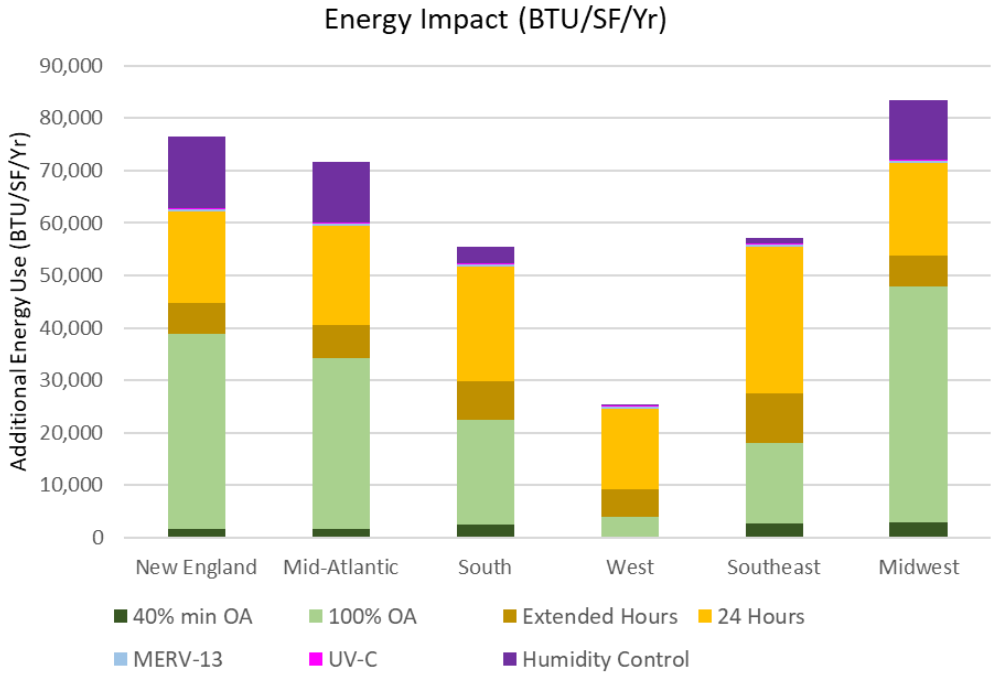
The following table summarizes the evidence and considerations presented above with respect to ongoing energy cost, initial installation cost, expected maintenance effort, and relative effectiveness. Some of these measures may have added costs not represented in the figure, such as equipment retrofits required to meet any increase in heating or cooling demand due to limitations of the installed equipment.

	Ultraviolet Radiation	Ventilation	Air Filtration	Temperature & Humidity Control
Energy Cost	$	$ $ $	$ $	$ $
Installation Cost	$ $ $	$	$ $	$
Maintenance				
Relative Effectiveness				

ENERGY IMPACT OF RECOMMENDED MITIGATION MEASURES

The following figures compare the annual energy and cost impact of the above measures. Energy impact was calculated using TMY3 data for representative cities in each region and assumes standard operating conditions. The impact of each recommendation is calculated in isolation and does not factor in the cost of other measures such as eliminating heat recovery or disabling DCV. Installation and maintenance costs are not included, nor are any potential upgrades required to accommodate increased airflow & cooling/heating demand.





During these unprecedented circumstances, Cimetrics' Analytika service continues to monitor our customer sites and support any changes to facility operations.

During building shutdowns, many facilities reduced their on-site staff and eliminated non-essential maintenance, but Cimetrics continued to be their watchdog for critical equipment faults. Cimetrics will also continue to monitor building spaces for unusual conditions that would normally be reported by the occupants.

Upon reopening, Cimetrics will confirm that equipment operation is consistent with best practices; monitor space conditions such as temperature, humidity, and CO_2 levels; and quantify the impact of adherence to ASHRAE and CDC guidelines. We will evaluate the capacity of existing mechanical systems relative to the increased energy demand. Cimetrics will additionally provide energy cost calculations associated with COVID-mitigation measures using real-time operational data.

Shutdown, reopening, and transmission mitigation measures come with a hefty price tag. A focus on maintaining efficient systems and identifying energy savings opportunities wherever possible can help offset the cost of these measures.

ANALYTIKA FOR SHUTDOWN

Support for CARES Act Health Care Provider Fund Application

At a 6.6 million square foot multi-campus health care organization, Cimetrics calculated the total excess COVID-19-related energy cost for a 3-month period to be $29,527. Costs were associated with increased outside airflow, increased supply airflow, and HEPA filter replacements. The excess energy calculations were used as part of an application for reimbursement available to health care providers for health care related expenses or lost revenues that are attributable to coronavirus.

Equipment Operation Verification & Energy Savings Calculation for Equipment Setback due to Reduced Occupancy

The following figures were provided by Cimetrics to verify some of the setbacks deployed at a 380,000 square foot government lab building. The AHUs serving the auditorium (AHU-14) and the cafeteria (RTU-1) were turned off while those spaces were vacant (Figure 1). The AHUs that serve critical lab areas (AHU-1 and AHU-2) continue to run 24/7, but the lab exhaust fan airflows were reduced (Figure 2).

Cimetrics additionally calculated the energy reduction due to reduced equipment operation. This information will be used to adjust future energy projections as well as to quantify the efforts of the facilities team to minimize energy use. Total energy savings during the two-month shutdown period was over $37,000.

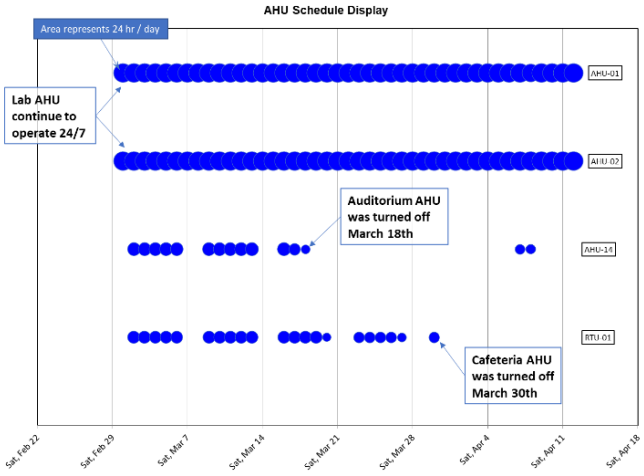


Figure 1

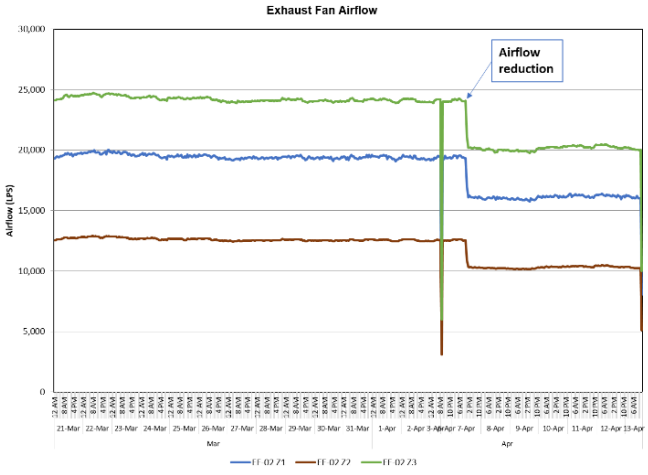


Figure 2

ANALYTIKA FOR REOPENING

Cost Calculation for Sequence Modifications

At a 550,000 square foot research school of a large university in Boston, Cimetrics calculated the projected annual cost for modifying the equipment sequences to run the return air systems with the outside air dampers 100% open for one year. Maximizing the air exchange rates is one of the methods they are considering to help minimize the risk of infection. The estimated additional energy cost of the modified equipment operation is $205,000 for the one-year period.

Filter Replacement Optimization

Predictive maintenance can be used to calculate the optimal time to replace the filter to minimize the cost of both T&M and increased fan pressure based on the measured differential pressure across the filter (Figure 3). When the filter is replaced, data shows the differential pressure dropping, which verifies that the replacement was done correctly. The data can be further used to determine which filter manufacturer performs best in different conditions.

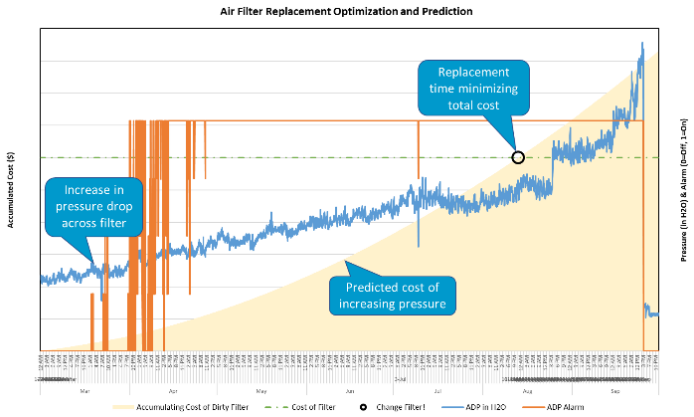


Figure 3

Identification of Equipment Operation that Violates Best Practices

The Analytika automatic fault detection & diagnostic (AFDD) system can be used to identify equipment operating outside of the ASHRAE and/or CDC guidelines.

The following figures taken from the Analytika Portal show an example AFDD fault of an AHU that has insufficient outside air based on the measured airflow (Figures 4 & 5). Insufficient airflow was detected on multiple units in a 100,000 square foot engineering instructional building of a large university campus in the South.

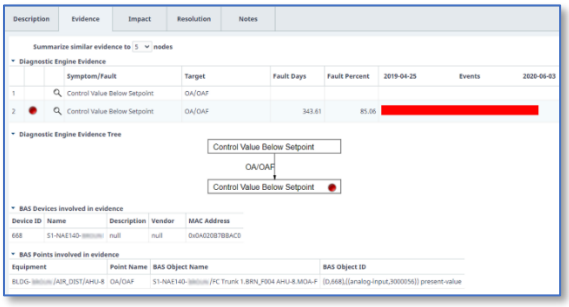


Figure 4

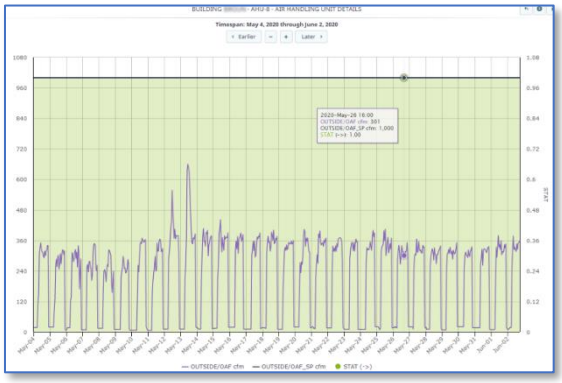


Figure 5

The following figures, also taken from the Analytika Portal, show an example AFDD fault of an AHU that was detected to be off when scheduled to be on (Figures 6 & 7). Similar issues were detected in 30 AHUs across multiple buildings of this large New England university campus.

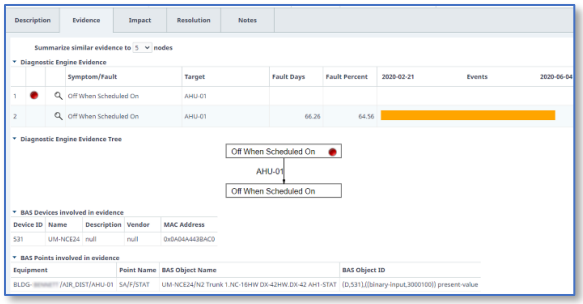


Figure 6

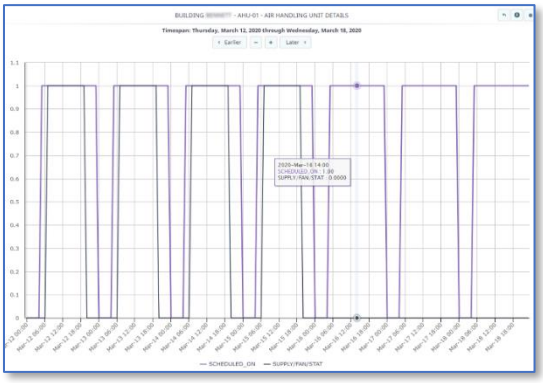


Figure 7

Equipment Monitoring

Cimetrics' expertise in networking technology makes us uniquely positioned to read and analyze nearly any type of building equipment, including UVGI controllers and airborne monitoring devices.

Data collected from UVGI controllers can be used to detect command/status mismatches for equipment that is not running according to sequence, compare operating run hours to manufacturer recommended run hours, and analyze operating power.

Data collected from airborne monitoring devices includes CO_2, VOC, particulate matter counts, and bioaerosol presence. This data can be correlated with HVAC operational data to ensure appropriate ventilation.

ABOUT CIMETRICS

Founded in 1989, Cimetrics is a world leader and innovator in the field of physical world analytics and is a supplier of cybersecurity and networking technology for automation systems in buildings and facilities. Cimetrics' flagship solution, Analytika, is a hardware and software monitoring-based commissioning platform that mines an extensive set of BAS data and runs thousands of algorithms to help identify opportunities to address facility issues and save energy. It also has a value-added function of highlighting potential operational issues that may be of concern, and more importantly the underlying causes so they can be addressed. Analytika provides energy savings, sustainability and tenant comfort to energy, facility and sustainability managers in the Pharmaceuticals & Life Sciences, Higher Education, Healthcare and Government market sectors. Cimetrics' BACnet products provide cybersecurity and networking technology, including hardware, embedded software and consulting services for building automation systems as well as to BAS OEM manufacturers and their channel partners.

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