



Air Purifier Technologies Comparison



Which air purifier is the best? When it comes to air purification understanding the properties of various air filters not only helps you make good decisions in choosing an air purifier for your company, but it also prolongs the lifespan help to program budget and maintenance activities of your air purifier as you'd be equipped with the knowledge of how to maintain its filters properly. Aside from air filters, you can also look into other air purification technologies designed to enhance air purifier performance, such as ionizers and UV lights, before deciding on the air purifier that suits your needs best.

The first step to choose is deep know of ? technology they strengths and limits.

While choosing the correct air purifier, never forget to consider its life-cycle sustainability.

1. Air purifier technologies

Mechanical filter: EPA/HEPA/ULPA

The most common filtering technologies. A different standard defines their efficiency. Classification Standard EN1822 Efficient air filters (EPA), high-efficiency air filters (HEPA) and ultra-low penetration air filters (ULPA filters) which used in the field of ventilation and air conditioning and for technical processes (e.g. for applications in clean room technology or pharmaceutical industry are classified and tested according to the EN 1822:2009 standard)

EN1822 Classification

Filter Group	Class	MPPS Integral Values		MPPS Integral Values		Minimum Efficiency (%) @ DOP (0,3µm)
		Efficiency (%)	Penetration (%)	Efficiency (%)	Penetration (%)	
EPA	E10	85	15	-	-	95
	E11	95	5	-	-	99,9
	E12	99,5	0,5	-	-	99,97
HEPA	E13	99,95	0,05	99,75	0,25	99,99
	E14	99,995	0,005	99,975	0,25	99,999
ULPA	E15	99,9995	0,0005	99,9975	0,0025	-
	E16	99,99995	0,00005	99,99975	0,00025	-
	E17	99,999995	0,000005	99,9999	0,0001	-

Another classification for mechanical filter is minimum efficiency reporting values (MERVs)

MERV Rating	Average Particle Size Efficiency in Microns
5	3.0-10.0 ≤ 20%
6	3.0-10.0 ≤ 35%
7	3.0-10.0 ≤ 50%
8	1.0-3.0 ≤ 20% — 3.0-10.0 ≤ 70%
9	1.0-3.0 ≤ 35% — 3.0-10.0 ≤ 75%
10	1.0-3.0 ≤ 50% — 3.0-10.0 ≤ 80%
11	0.30-1.0 ≤ 20% — 1.0-3.0 ≤ 65% — 3.0-10.0 ≤ 85%
12	0.30-1.0 ≤ 35% — 1.0-3.0 ≤ 80% — 3.0-10.0 ≤ 90%
13	0.30-1.0 ≤ 50% — 1.0-3.0 ≤ 85% — 3.0-10.0 ≤ 90%
14	0.30-1.0 ≤ 75% — 1.0-3.0 ≤ 90% — 3.0-10.0 ≤ 95%
15	0.30-1.0 ≤ 85% — 1.0-3.0 ≤ 90% — 3.0-10.0 ≤ 95%
16	0.30-1.0 ≤ 95% — 1.0-3.0 ≤ 95% — 3.0-10.0 ≤ 95%
High efficiency Particulate Air filter HEPA*	99.97% of particles in the 0.3-micron range. Particles that are larger or smaller than 0.3 microns are captured with a greater than 99.97% efficiency

Pros

- Removes dust, pollen, spores, dust mites and other allergens.
- Removes most bacteria.
- Captured solid particles are not released back into the air.

Cons

- It does not eliminate chemical fumes, cigarette smoke or odors.
- Not as effective in capturing the smallest viruses.
- Micro-organisms captured in filter can breed or reproduce, resulting in increased micro-organism populations.
- Need to be replaced frequently.
- The filters cannot be recycled.
- The filters during substitution activities need to be manipulated with attention to the risk of health injury.

Ionizing or plasma purification technologies

An air ionizer purifies the air in a room by electrically charging air molecules. Airborne particles become charged as they attract charged ions from the ionizer. The particles, in turn, are then attracted to any nearby earthed (grounded) conductors, either deliberate plates within an air cleaner or simply the nearest walls and ceilings.

Pros

- Removes ultra-fine particles as small as 0.01 microns.
- Sterilizes bacteria, viruses, smoke, and other toxic fumes.
- Very quiet because there are no fans or motors.

Cons

- Removes particles from the air, but not from the room. Particles land on floors, walls, & furniture and may be easily put back in the air.
- They can produce harmful ozone.
- Does not remove odor.
- High cost for spare parts.
- Unable to remove large particles (like those that trigger asthma).

Photo-catalysis TiO_2

Photo-catalysis is a technology that facilitates certain processes such as the oxidation of pollutants in the air. The process is activated in the presence of a photo-catalyst, which is a substance capable of activating a chemical reaction by absorbing electromagnetic radiation (light). In other words, to have a photo-catalysis process you need an activating substance and a source of light, natural or artificial. The most common photo-catalyst is Titanium Dioxide (TiO_2) which, when irradiated with UV radiation, when it comes into contact with oxygen-containing molecules (e.g., O_2 , H_2O) can, in turn, generate reactive oxidizing agents (such as the OH radical) which are able to transform polluting organic substances into carbon dioxide and water.

Pros

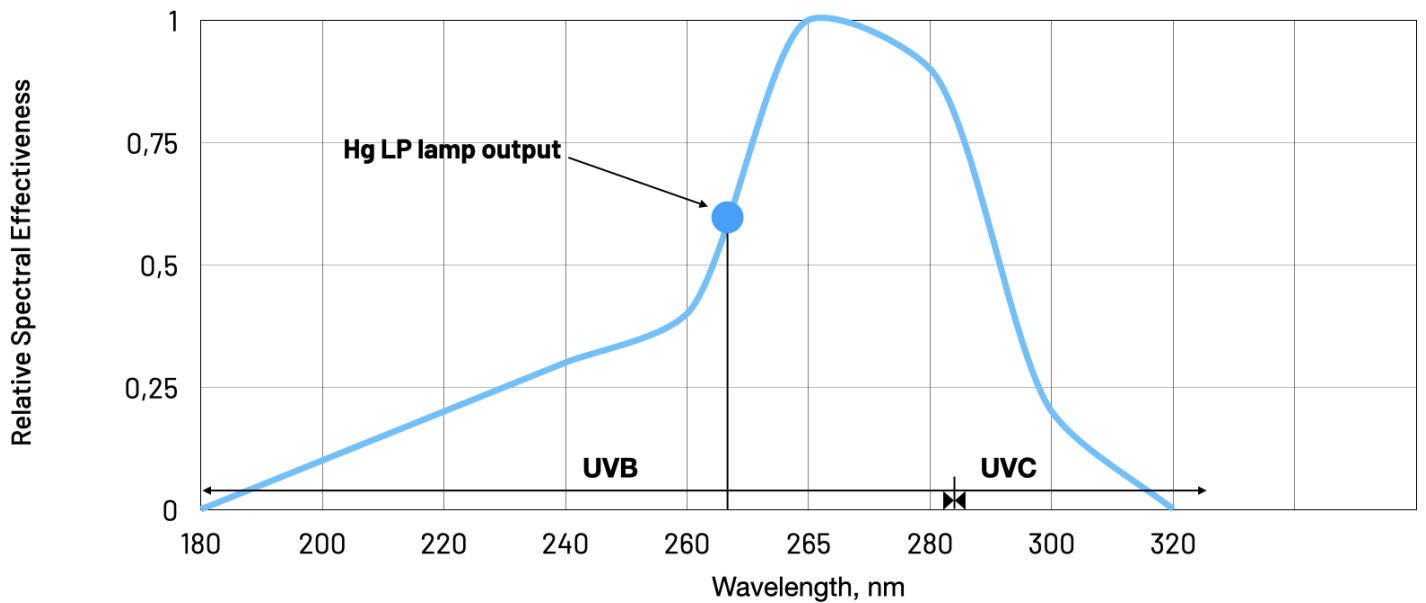
- Unlike other systems, no chemicals or external energy input are needed, except for light, which is not expensive when using ambient light or sunlight.
- It can be used safely under environmental conditions and activity relatively insensitive to moisture.
- Large capacity to fully mineralize volatile organic compounds (VOCs) to CO_2 and H_2O .
- Unlike other options, the purification of photo-catalytic air does not retain particles or contaminants, as these are eradicated or transformed in their entirety.
- Most photo-catalytic air purification systems do not require constant maintenance, with 3 years being the minimum time in most cases.

Cons

- The development of this technology is slow, as is the production of the materials needed for its operation.
- Lack of solar sensitivity with consequence lower efficiency.
- It can start to act within an hour.
- It can produce harmful ozone.
- The filter needs to be replaced.
- Risk of spare parts obsolescence.

UV: Sterilization technologies

UV light is a type of electromagnetic radiation naturally present in the sun. It can disinfect the air. A lamp or LED can emit UV. The biological effect of UV technologies: the effectiveness against microorganisms depends on the UV wavelength.*



The UV can be emitted by lamp or led, but LED lamps last longer, do not need frequent replacement.

Pros

- Ability destroys micro-organisms, such as germs, bacteria and mold.
- Helps prevent illness and disease.

Cons

- Does not remove most allergens, dust, or solids in the air
- Does not remove chemical fumes, gases, or cigarette smoke
- Do not effectively remove VOC from the air.
- Disinfection time depends on particle size; bigger particles need minutes to deactivate.
- UV can produce ozone harmful to health.
- UV lamps need to replace frequently.

* Relative spectral effectiveness IRPA 1991

Active Carbon Filter

This technology has granular activated carbon. To tackle odor issues indoors, activated carbon filters, sometimes adsorbent or deodorizing filters, are required. Carbon filter traps VOCs through adsorption, which occurs when molecules attach to the outsides of a surface instead of being soaked into it.

Pros

- The most absorbent filter available.
- Captures chemical fumes, gases, cigarette smoke, and odors.
- Does not release contaminants back into the air.

Cons

- Does not remove dust and other allergens.
- Does not remove micro-organisms.
- Need to be replaced frequently (usually every 3 months).
- Can't be recycled.

Electrostatic filter

Is an innovative filtration technology which uses the creation of an electric field to ionize polluting oily particles and separate them from the airflow, drawing them towards a specific metal plate.

Pros

- **Cost effective:** washable air filters cost. Think of it as a “permanent filter” because you don’t replace it until you’re ready to replace your whole system.
- **Save time and hassle:** Not only can you save on the cost of the filter, you can save time from having to search for the specific sized air filter you need in the store – a feat in itself – stand in line, and purchase the filter, a task that would need to repeat every three months.
- **Efficient operation.**
- **Good air filtration:** These filters do a good job of filtering air through your system, electrostatic air filters work to improve air quality when compared to pleated filters.
- **Safe maintenance:** no risk in contamination during cleaning activities.

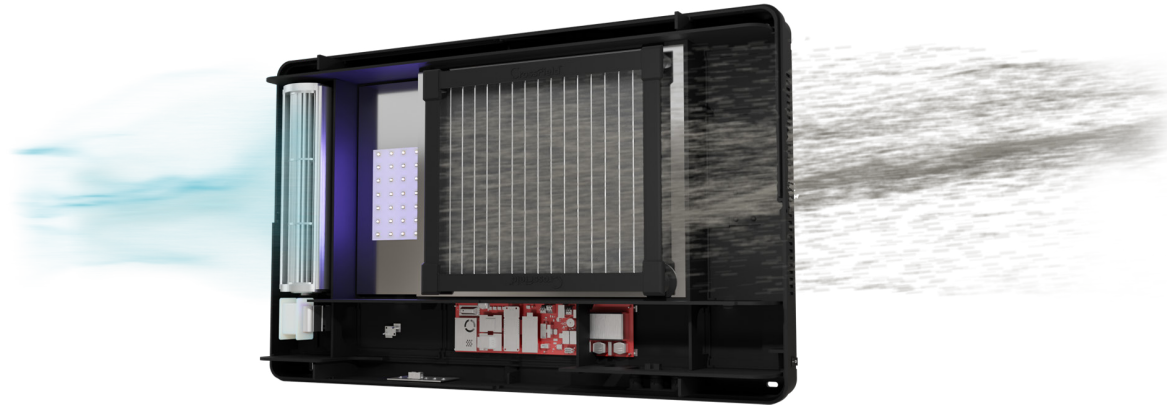
Cons

- **Monthly maintenance:** In order to be effective, these filters must be removed and cleaned monthly. If they’re not, they can stop working efficiently, put allergens and dirt into the air and your HVAC system; which can shorten your system’s lifespan.
- **Ozone:** Electrostatic air filters have the potential to produce ozone molecules.
- **If these filters are not cleaned regularly they have the potential to have a negative impact on air flow.** When a filter is not clean, it allows more dirt into the rest of the system and into your home.

Crossfield®

Medical grade unique technologies combination that allows to be effective on pollutants and bio pollutants where the other filtering technologies fail. The dirty air pass primarily through the electrostatic filter that traps pollutants and kills or damages bio-pollutant.

Then the air than pass thought UV-C rays where the sanitation process is completed.



Pros

- **SAFE AIR:** inactivation and filtering efficacy up to 99,9%.*
- **HYGIENIC:** no sanitation required.
- **OZONE FREE:** designed and tested to be ozone free.
- **QUIET:** do not disturb daily activities, sound like a puff indistinguishable from background noise.
- **POLLUTANT MONITORING:** Real-time and historical quality data indoor air to identify the level of pollution, allowing for corrective action and ensuring a healthier and safer environment.
- **APP CONTROL:** It allows you to control and/or program the switch-on times of all the associated devices
- **ULTRA-COMPACT:** all the effectiveness of AirFrame® in only 82x52x12 cm.
- **EASY INSTALLATION:** wall fixing and plug-and-play device. A template will facilitate during mounting operations.
- **ECONOMIC:** no filter to replace, so no additional cost for the purchase of parts of replacement, no risk of obsolescence.
- **SAFE AND EASY MAINTENANCE:** It is sufficient to clean the plates of the device with a damp cloth in complete safety since all the captured agents are weakened and no longer dangerous. No waste needs to be disposed of.

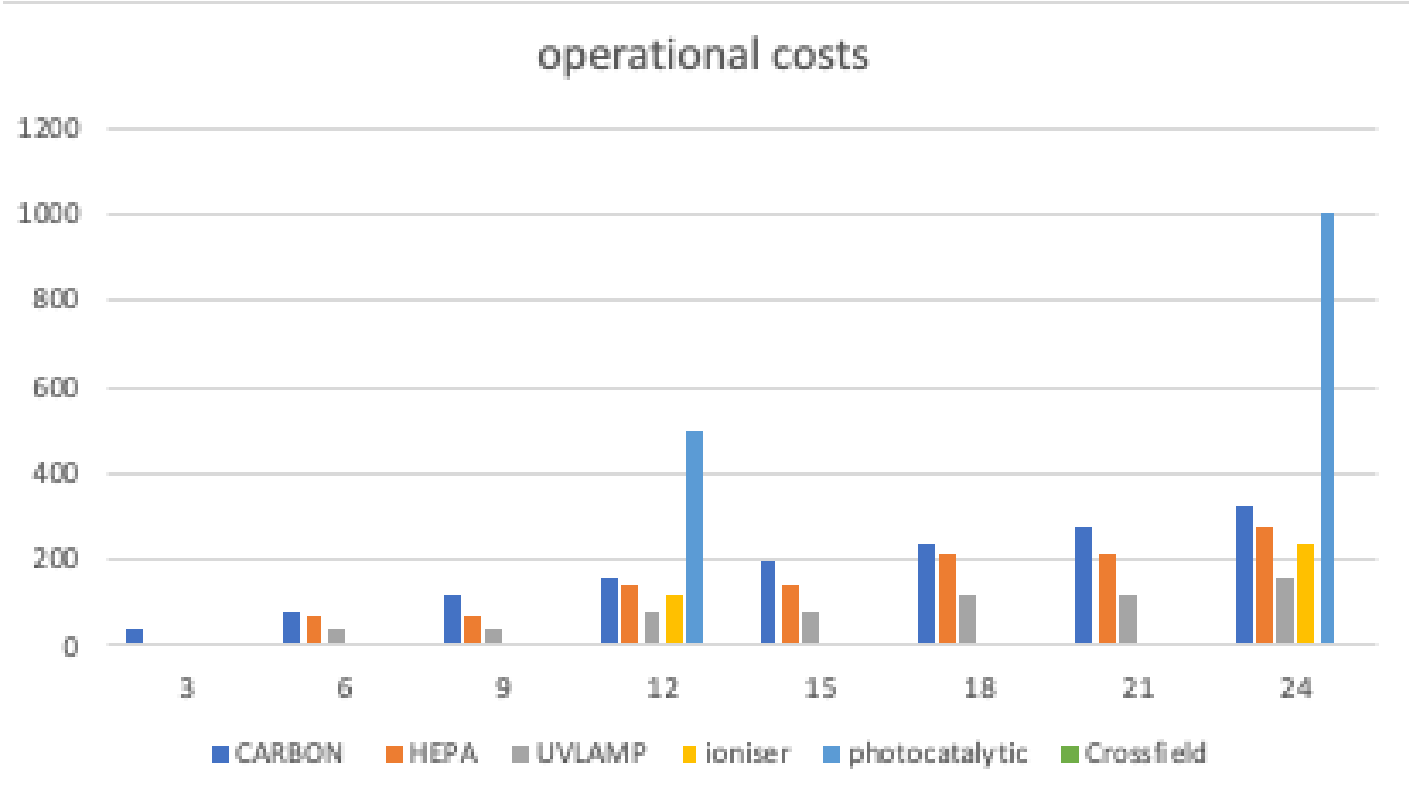
Cons

- Do not remove effectively VOC and gases.

* Test in accredited laboratories

2. Air purifier in numbers

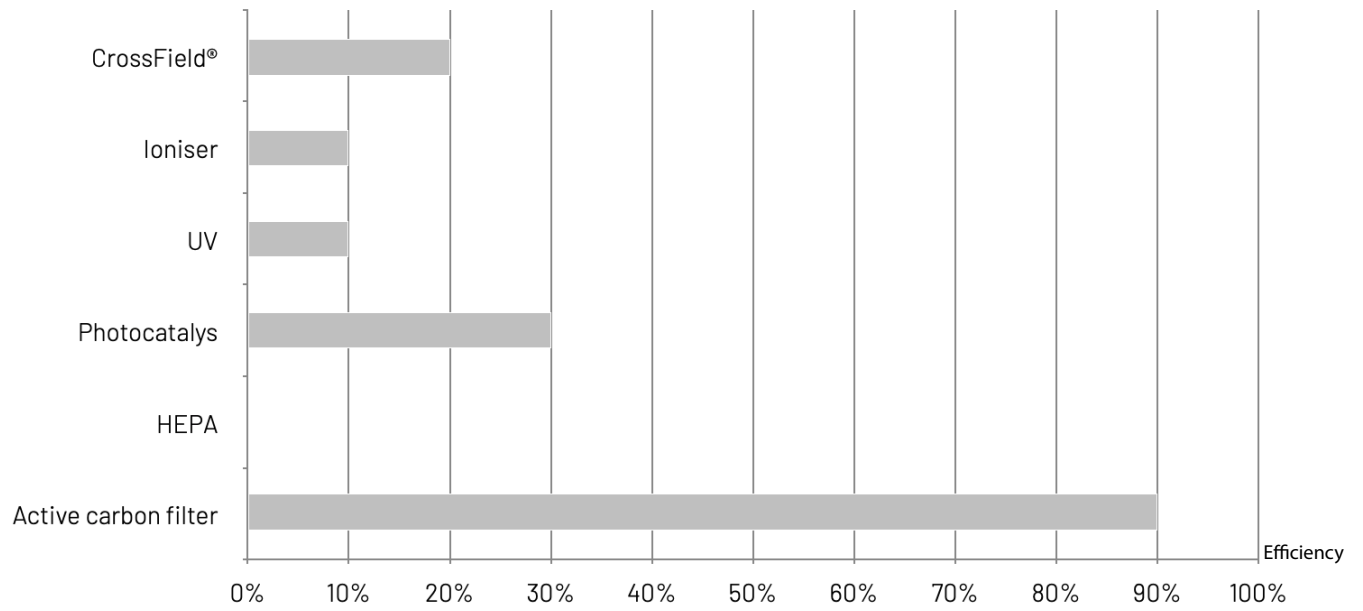
Operational cost*



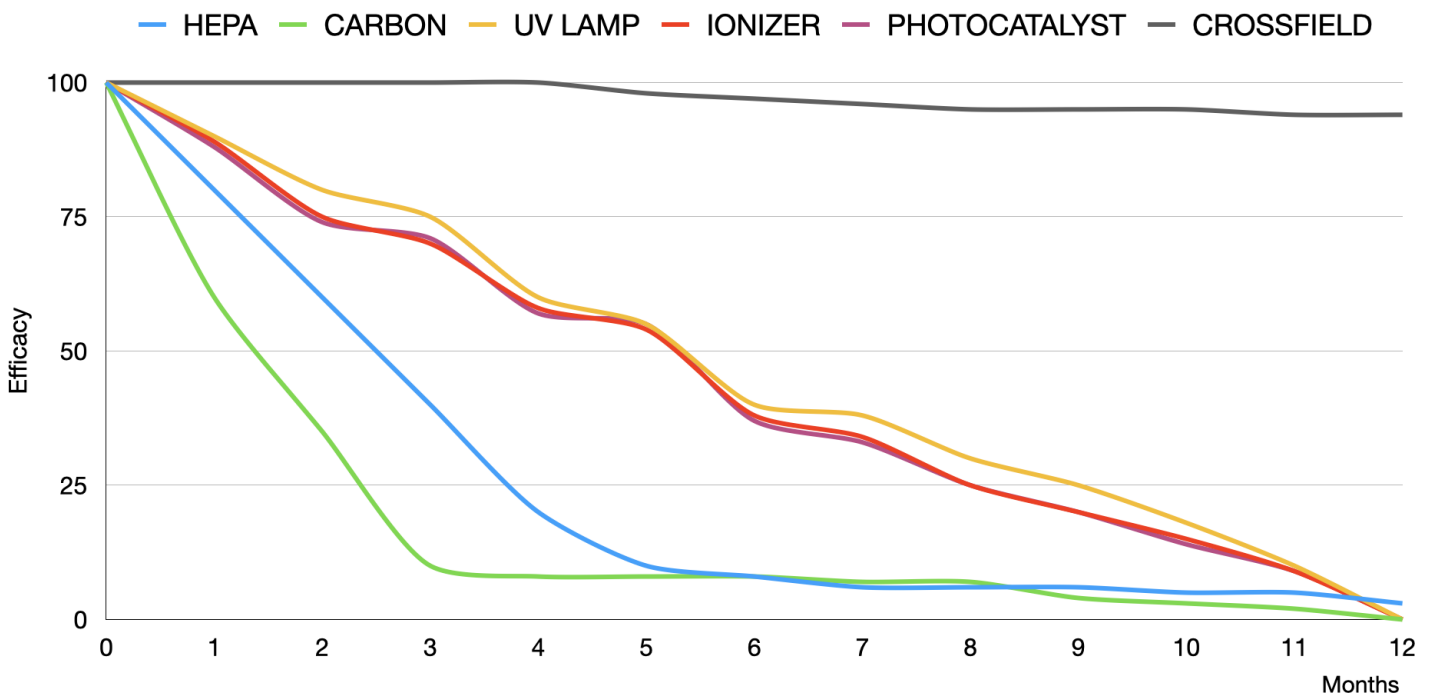
For the air purifiers with a filtering system combination, the operational cost must be considered the sum of a single system.

* The costs have been calculated as the average cost of spare parts and general indication regarding the operating hours before filter change found on the internet.

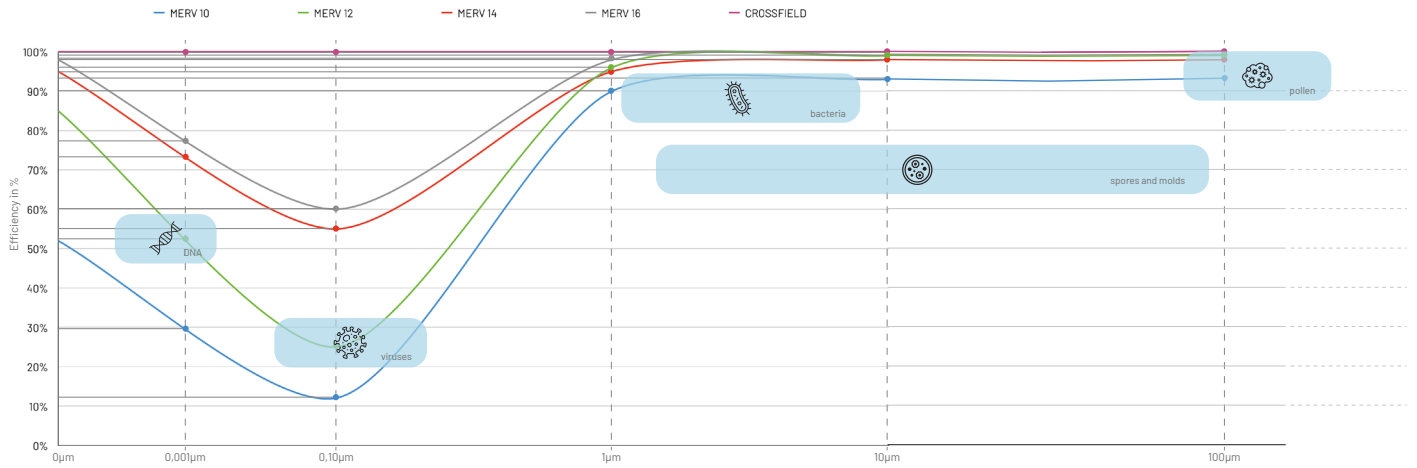
Efficiency against VOCS



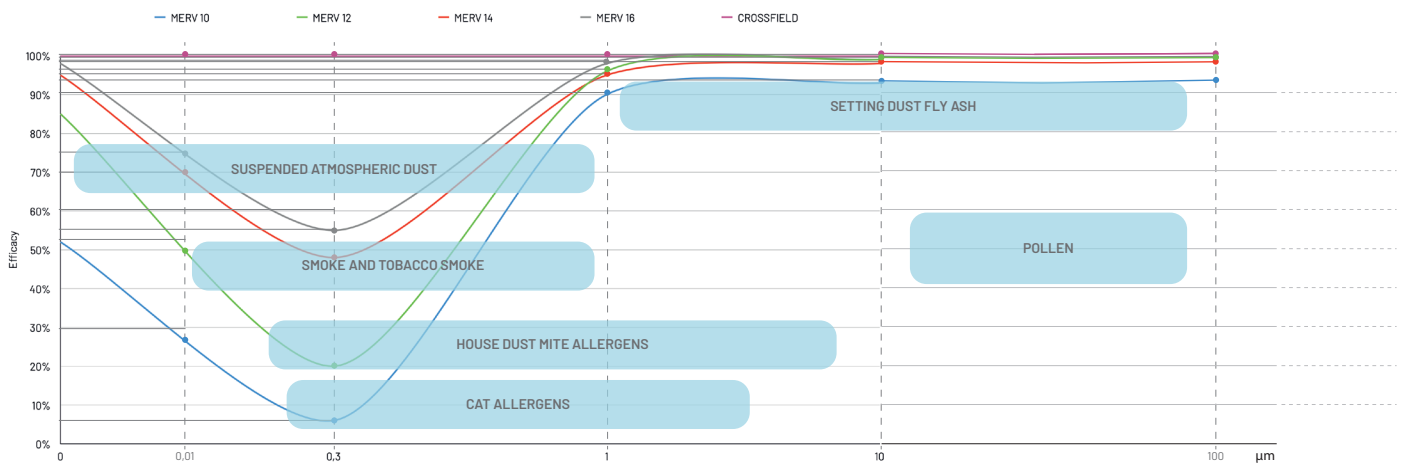
Efficiency Timing



Efficiency against bio-pollutants*



Efficiency against PM



* Filtration of Airborne Microorganisms: Modeling and Prediction W.J. Kowalski, M.S., P.E. William P. Bahnfleth, Ph.D., P.E. T. S. Whittam, Ph.D. Student Member ASHRAE Member ASHRAE