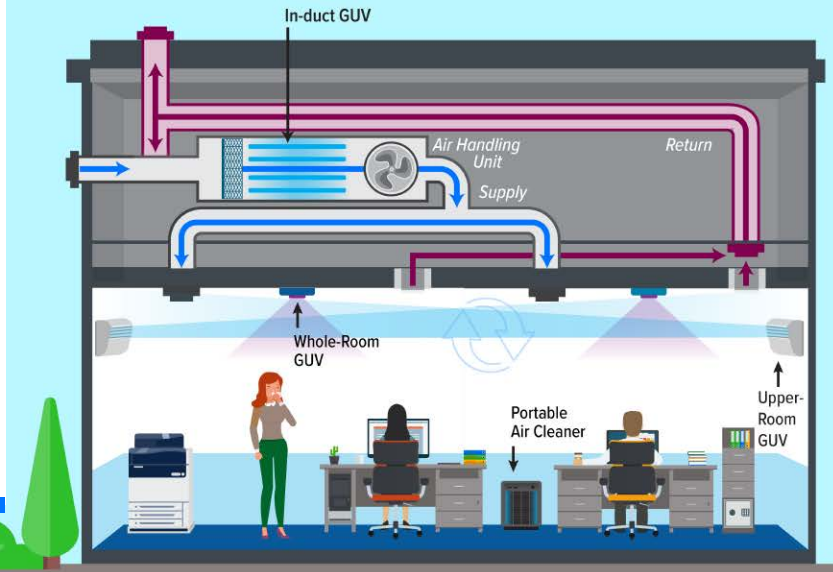
U.S. Department of ENERGY | Office of Energy Efficiency & Renewable Energy

GUV Air Treatment:

Overview, Types, and Technologies

Germicidal ultraviolet (GUV) air treatment has been used in settings like hospitals for decades, and GUV became a hot term during the COVID-19 pandemic. But what is GUV, how is it being used, and how can it make for healthier buildings?



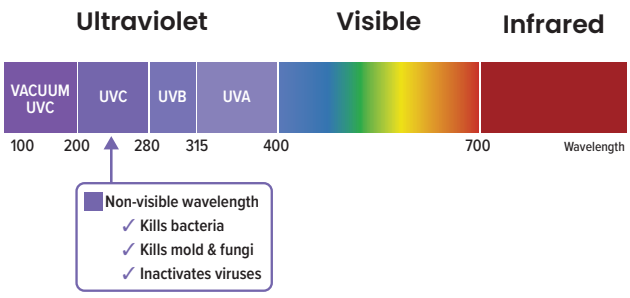
Benefits of GUV Air Treatment

GUV used in combination with building ventilation and filtration can be highly effective, energy efficient, and safe for reducing airborne disease transmission. However, GUV systems must be designed, installed, and maintained by a trained professional and to the latest industry standards to ensure effectiveness and safety. The use of GUV can reduce pathogen concentration in the air using less energy than mechanical solutions, such as increasing outdoor air ventilation.[1]

GUV should always be applied as a supplemental measure in combination with building ventilation and filtration. Ventilation and filtration to minimum ASHRAE standards are necessary to provide acceptable indoor air quality for building occupants.

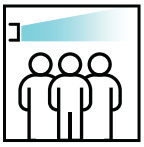
Germicidal Ultraviolet Basics

GUV air treatment inactivates viruses and kills bacterial and fungal organisms, preventing their replication. The UV spectrum ranges from 100 nm to 400 nm, and while all UV has some germicidal properties, UV-C (especially in the range 200–280 nm) is the most effective at inactivation of infectious pathogens.



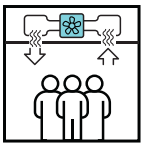
GUV Product Types

Various GUV systems are commonly used for air treatment in buildings.



Upper-Room GUV devices are mounted to upper walls or ceilings to treat air above occupants, allowing for safe use of the room when the device is operating. These systems require sufficient air mixing between upper and lower portions of the room.

Whole-Room GUV devices are mounted to ceilings to treat air and surfaces throughout the room. Systems intended for use when rooms are occupied should be designed not to exceed UV exposure safety limits; those designed for unoccupied spaces may exceed safety limits and need safeguards to prevent operation when rooms are occupied.



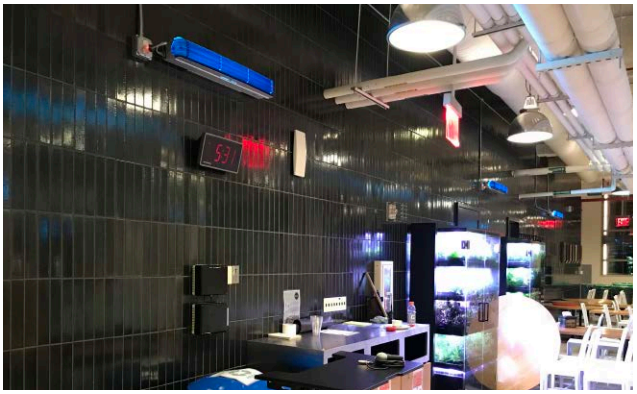
In-Duct GUV devices are installed inside HVAC equipment, typically within or near the supply of an air handling unit to treat recirculated air and to reduce mold growth on cooling coils. Like other central HVAC measures, in-duct GUV helps ensure that recirculated air has lower pathogen concentration, but may not be as effective against person-to-person disease transmission as the in-room measures, which treat air in the same space where disease transmission occurs.

GUV Room/Portable Air Cleaners (R/PACs) use a fan to draw air into a chamber and then reintroduce treated air into a room; UV is contained inside the chamber, allowing for use in occupied rooms. GUV portable air cleaners are currently most common, but fixed-location room units are also available and can be ceiling or wall mounted. GUV air cleaners can be effective in smaller spaces, but since their clean air delivery rate may be lower than other GUV technologies, they can be less practical for larger spaces.[2] Other considerations of R/PACs include noise, drafts, and recapture of just-processed air.

References

1 Faulkner, Cary A., et al. "Comparison of effectiveness and energy use of airborne pathogen mitigation measures to meet clean air targets in a prototypical office building." Building and Environment 257 (2024): 111466.

2 Illuminating Engineering Society. ANSI/IES RP-44-21, Recommended Practice: Ultraviolet Germicidal Irradiation (UVGI). New York: IES; 2021.



Example of wall-mounted, louvered upper-room GUV luminaires (emitting some blue light) in the field.
Photo by PNNL

GUV Technologies

Several UV-C source technologies are commercially available.

- **Low-pressure mercury (LPM) lamps** (peak wavelength at 254 nm) are most common due to their high radiant efficiency and germicidal effectiveness. They are primarily used in upper-room applications.
- **Krypton-chloride excimer lamps** (peak wavelength at 222 nm) are becoming more popular due to their higher exposure safety limits and are typically used in whole-room applications.
- **UV-emitting LEDs** (peak wavelength at 260-280 nm) are currently not as common in germicidal applications due to their lower radiant efficiency, shorter lifetime, and higher cost, but are continuing to improve. LED advantages include design flexibility and directionality without the need for efficiency-reducing louvers that are generally required for upper-room LPM luminaires.

Additional Information
https://www.energy.gov/eere/ssl/germicidal-ultraviolet-air-treatment

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