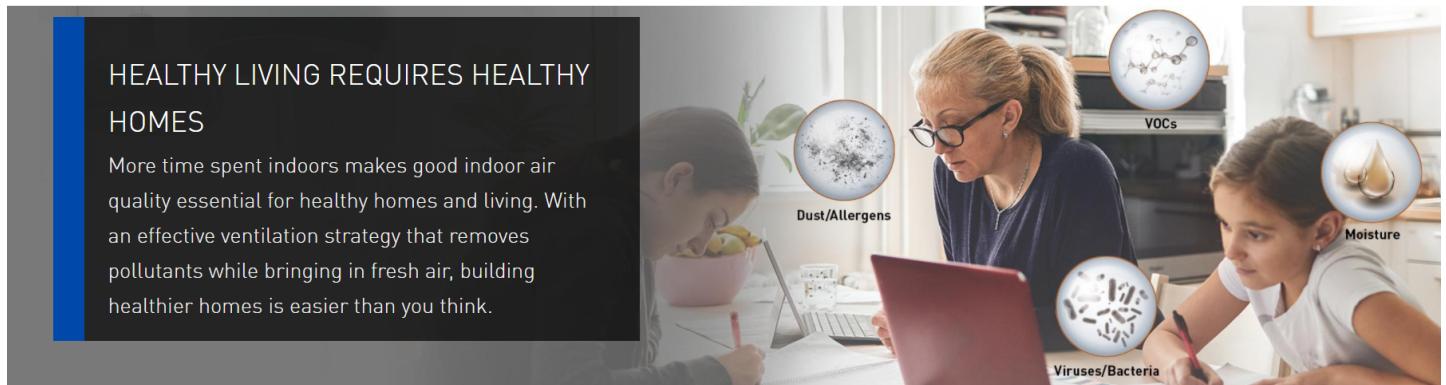


# Panasonic

Research new market & sales opportunities (like healthcare, nursing homes, dentist office, etc)

**As the World is identifying the Health risks associated with viruses like COVID, there is a big opportunity to bring existing Panasonic products to the North America Market. The NanoX and Ziano technologies have substantial market opportunities in the following markets - Elderly Care Facilities, Doctors Offices, Dentist Offices, Individual Hospital Rooms, College Dormitories, School Classrooms, etc. These are areas outside our current range of expertise and we need to gather a lot of information to assess the market opportunities. The goal of the project is to better understand these markets.**



## Website overview

**Project Report:** Contains a detailed report for market analysis led by IAQ .

1. Potential Markets (report\_1.html)
2. Market Applications (report\_2.html)
  - o 2.a ASHRAE Standards (report\_2.html#What\_is\_ASHRAE)
  - o 2.b Panasonic Solutions (report\_2.html#Panasonic\_Solutions)
3. Market Competitors (report\_3.html)
4. Conclusion (final\_report.html)

## Motivations

Our primary focus for ventilation solutions has been in residential and multifamily / hotel construction. In this project, we have set out to better understand additional sub segments of the construction industry. Our aim is to help our business to know what the market opportunities are for each sub-segments.

## Main findings and discussions

The global pandemic has focused the attention of Engineers, Architects, Builders and occupants on IAQ. This topic had been gaining traction over the year but this has moved the needle more than ever. Guidelines continue to pour out from the CDC on ventilation recommendations which will inevitably add to more business in the years to come. Ventilation strategies had been relatively stagnant, now top of mind for change

# Potential Markets

Bingkun Luo

In this project, we are going to explore some potential markets in United States and intend to discover some critical opportunities for Panasonic ventilation production

## Motivation

According to EPA (<https://www.epa.gov/coronavirus/ventilation-and-coronavirus-covid-19>), an important approach to lowering the concentrations of indoor air pollutants or contaminants including any viruses that may be in the air is to increase ventilation – the amount of outdoor air coming indoors. Ensuring proper ventilation with outside air can help reduce the concentration of airborne contaminants, including viruses, indoors.

The ventilation rate should be based on the number of people that occupy an indoor space (and a few other factors), people should give special consideration to increased ventilation when occupancy increases and for areas with high-traffic. Improving ventilation also benefits indoor air quality by reducing exposure to products used for cleaning and disinfecting potentially contaminated surfaces.

When used along with other best practices recommended by CDC and others, increasing ventilation can be part of a plan to protect people indoors.

## Initial Research for Potential Markets

- Elderly Care Facilities, Day Care Centers
- Hotel Rooms
- College Dormitories, School Classrooms
- Multifamily Housing
- Doctor Office, Dentist Clinic
- Hospital Rooms

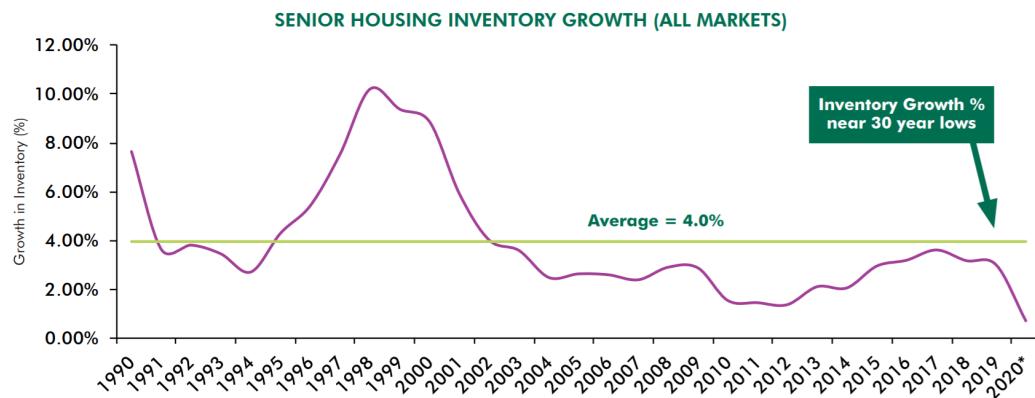
### Elderly Care Facilities, Day Care Centers

#### Elderly Care Facilities

This market has had steady growth while year over year varies. While the segment may not have significant growth trajectory, one key component to note is the attention ventilation will receive due to virus transmission.

**With a year-over-year growth rate of 2.9% in 2020 (annualizing Q1 data), inventory growth has contracted below the 30-year average annual growth rate of 4.0%.<sup>5</sup>**

The Senior Housing pipeline (rolling four quarters construction versus inventory) was 2.48% in Q1 2020, dipping 73 basis points from the 2019 average of 3.21%. In Q1 2020 there were approximately 3,481 units/beds of new construction starts for Primary and Secondary Market areas.<sup>5</sup> The COVID-19 pandemic has caused a construction debt to fund new construction. Q2 2020 new construction is expected to be at low levels not seen



Source: NIC MAP Data & Analysis Service, Q1 2020 Supply Report; All Markets. \*2020 is YTD through Q1.

(<https://www.cbre.us/-/media/cbre/countryunitedstates/media/files/services/senior-housing/senior-housing-market-insight-q1-2020.pdf>)

## Opportunity

### 1. Pragmatic steps for long-term care facilities

According to the recent publication ([https://www.jamda.com/article/S1525-8610\(20\)30320-0/pdf](https://www.jamda.com/article/S1525-8610(20)30320-0/pdf)) by The Society for Post-Acute and Long-Term Care Medicine(AMDA), the Ventilation should follow these standards,

- Control of airflow essential, for instance, A 2400 cubic feet room should receiving approximately 80 cubic feet per minute (cfm) of outdoor air.
- Install supplemental exhaust ventilation through dedicated exhaust portals, for example, a 250-cfm booster fan would increase the air exchange rate by approximately 6.5 ACH.
- Increase efficiency of filtration, All rooms are typically equipped with MERV (minimum efficiency reporting value) 7 prefilters and MERV 14 final filters, which remove up to 98% of airborne particles as small as 0.3 to 1.0 mm in diameter (typical diameter of respiratory droplets)
- Keep doors to hallways closed and follow infectious disease prevention guidelines(CDC)

### 2. ANI/ASHRAE/ASHE Standard 170-2017

Following is the most up to date standard for senior-caring facilities and has a strong focus on the filtration requirements, which could be utilized under pandemic scenario.

**Table 6-1 Minimum Filter Efficiencies**

Space Designation (According to Function)	Filter Bank Number 1 (MERV) <sup>a</sup>	Filter Bank Number 2 (MERV) <sup>a</sup>
<u>Resident care, treatment and support areas in Inpatient Hospice Facilities</u>	<u>13</u>	<u>N/R</u>
<u>Resident care, treatment and support areas in Assisted Living Facilities</u>	<u>7</u>	<u>N/R</u>

(<https://www.nafahq.org/wp-content/uploads/Moeller.pdf>)

### 3. Researchers alarm the outbreak

There are multiple independent researchers (<https://www.ahcancal.org/News-and-Communications/Fact-Sheets/FactSheets/Analysis-COVID-Outbreaks-in-Nursing-Homes.pdf>) indicates that community spread is linked to outbreaks in nursing homes. In early March, the alarming outbreak in senior living complex, Seattle, shows the vulnerability of long-term care facilities.

## Day Care Centers

In year 2020, there are 643,538 existing Day Care centers in US with a total of 1,519,664 industry employment. Through year 2015-2020 the industry has a stable growth of 2.4% in revenue annually.

Although some day care centers are required to stay open,these facilities are expected to experience increased purchase costs as they must increase spending on sanitizing facilities(Toys) and personal protective equipment for employees, thus leading to an expected 8.1% decline in 2020 alone.

US Day Care (<https://www.ibisworld.com/united-states/market-research-reports/day-care-industry/>) has four major divsions and includes following:

- In-home day care
- Center-based day care
- Pre-primary grade instructional programs
- Other services and programs

## Opportunity

### 1. Provide support for essential workers

On the child care market report of Federal Reserve Bank of Minneapolis (<https://www.minneapolisfed.org/article/2020/covid-19-challenges-the-child-care-market>), majority of the healthcare workers strived with a huge burden, about a quarter of the health care and first responder workforce would require child care.

Nevertheless, the potential child day care market may increase as in the later period of reopening, 34 to 43 percent of the total U.S. workforce hold jobs in industries that the Department of Homeland Security designates as critical infrastructure.

### 2. Designed ventalation for children

National resouce center has published Caring for Our Children(CFOC) (<https://nrckids.org/CFOC/Database/5.2.1>) suggested that day care center for kids would keep a draft-free temperature of 68°F to 75°F with 30%-50% relative humidity during the winter months.

The study focus on building an asthma friendly environment ([http://www.nhlbi.nih.gov/health/public/lung/asthma/chc\\_chk.pdf](http://www.nhlbi.nih.gov/health/public/lung/asthma/chc_chk.pdf)) because of the high prevalence rates of allergic and respiratory symptoms among young children, whose immune system is still under-developed. CFOC suggests that filters in forced-air heating and cooling system equipment should be checked and cleaned or replaced according to the manufacturer's instructions on a regular basis, at least every three months and more often if necessary.

- 5.2.1.2 (<https://nrckids.org/CFOC/Database/5.2.1.2>) Indoor Temperature and Humidity
- 5.2.1.3 (<https://nrckids.org/CFOC/Database/5.2.1.3>) Heating and Ventilation Equipment Inspection and Maintenance
- 5.2.1.4 (<https://nrckids.org/CFOC/Database/5.2.1.4>) Ventilation When Using Art Materials
- 5.2.1.5 (<https://nrckids.org/CFOC/Database/5.2.1.5>) Ventilation of Recently Carpeted or Panelled Areas
- 5.2.1.6 (<https://nrckids.org/CFOC/Database/5.2.1.6>) Ventilation to Control Odors

### 3. Special-designed ventilation implementation

In Oregon, such implementation has already taken in place according to **Goddard Childcare**, a nationwide childcare provider. The Organization released "Operational Blueprint for School Rentry saftey guidelines (<https://www.oregon.gov/ode/students-and-family/healthsafety/Documents/thegoddardschoolbethany.pdf>)

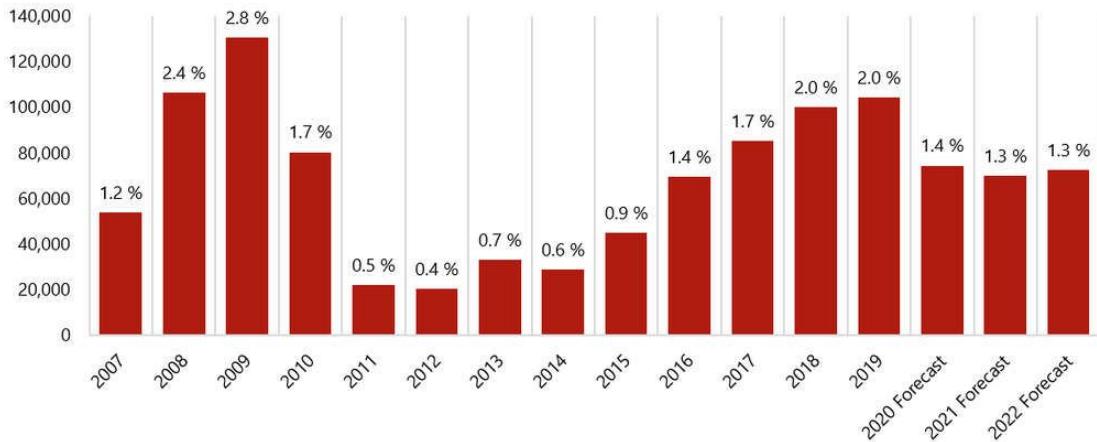
U.S. General Services Administration (<https://sftool.gov/learn/about/502/child-care-centers#classroom>) also recommend to implement a whole-system approach to the design of new or replacement building systems in a child care center will maximize energy conservation while balancing the necessities of child safety and health. **A child care center's HVAC system is generally independent from the rest of the building, including separate controls.** Include careful balancing and commissioning to accommodate the need for fresh air with specific ventilation requirements, especially in restrooms and food preparation areas. Supply air systems include automation controls that pull the system back to pre-determined set points when the spaces are not in regular use. Energy loads can be further reduced by using glass for windows and doors that has a high insulative value while maintaining a high visible light transmittance (VLT). Proper lighting design, including occupancy sensors, will limit the heat generated by electric lights, often left on in child care centers through the entire day, other than nap times.

## Hotel Rooms

### Hotel Rooms

According to the American Hotel & Lodging Association (AHLA), there is a 2.0% increase in supply in 2019 representing approximately 104,000 new hotel rooms; new supply growth resulting from new hotels is projected to increase by 1.4% by year-end 2020, and then to moderate to 1.3% in 2021 and 2022, per STR. Prior to the onset of COVID-19, STR had initially projected new supply to grow by 2.0% in 2020; the revised forecast for 2020 suggests that a number of hotel developments will not reach completion this year.

As of July 2020, 217,000 new hotel rooms were under construction across the country, reflecting hotels likely to open in the next 18 months. Additionally, at the same time, 260,000 rooms were in the final planning stages and expected to begin construction within the next twelve months. Similar to the last recession of 2008/09, lower revenue, NOI, and estimated values may result in some projects being placed on hold until revenues levels once again support the feasibility of development.



(<https://www.ahla.com/dreams>)

## Opportunity

### 1. Improve air quality in the public space for high risk worker

WHO (<https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-ventilation-and-air-conditioning-in-public-spaces-and-buildings>) would recommend enhance the current ventilation standards for tourist accommodation and hotel workers who are considered as individuals at a medium or high risk of exposure to COVID-19. It is important to keep the air recirculation according to HVAC professional's standards.

- Generate clean-to-less-clean air movements by re-evaluating the positioning of supply and exhaust air diffusers and/or dampers and adjusting zone supply and exhaust flow rates to establish measurable pressure differentials.
- Increase central air filtration to as high as possible without diminishing design airflow. Regular inspection for filters is required for housing and racks to ensure appropriate filter fit and check for ways to minimize filter bypass
- Ensure exhaust fans in restroom facilities are functional and operating at full capacity when the building is occupied.

### 2. Consider separated ventilation between hotel rooms

For hotels, improved ventilation has become a feature to promote to bring customers back. Major chains, including MGM Resorts International and the Four Seasons, have advertised that they are enhancing ventilation systems, and smaller companies have gotten in on the movement as well.

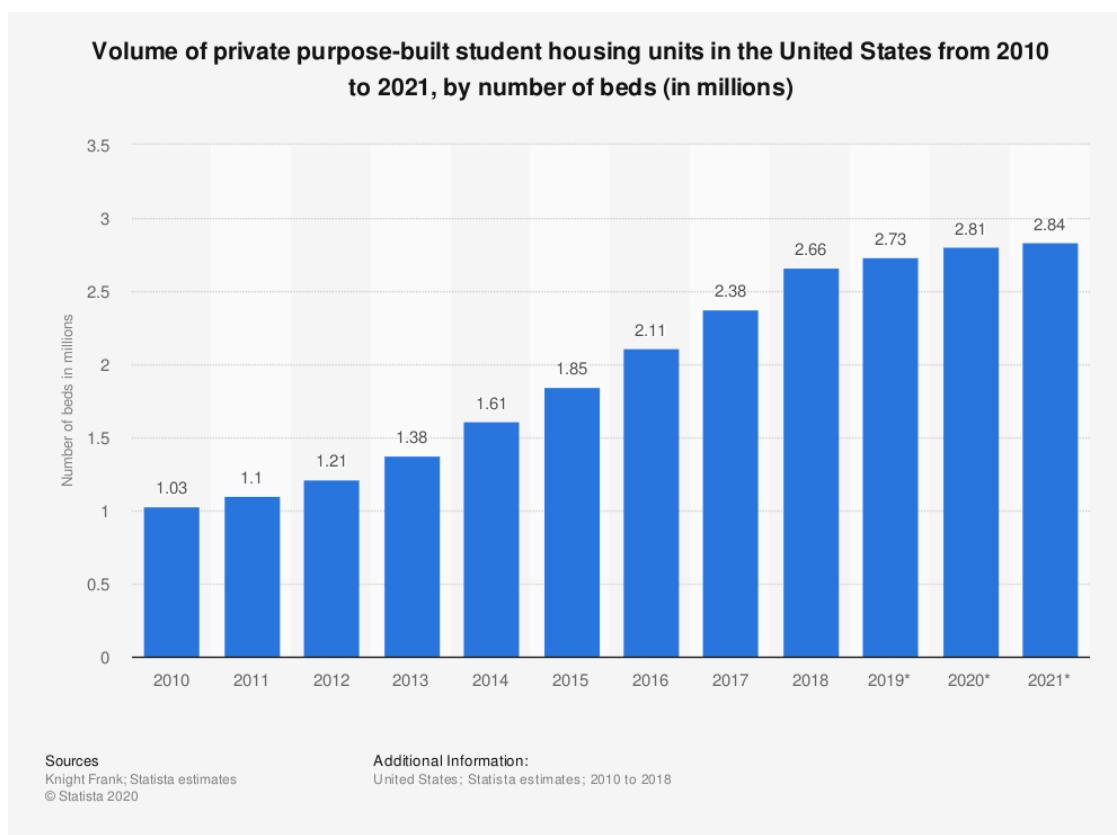
Washington Post (<https://www.washingtonpost.com/travel/tips/hotel-ac-ventilation-covid/>) interviewed with several epidemiologists and listed their suggestions,

- Opening the window to increasing the exchanging airflow
- Holding a room vacant between guests and spacing out for air circulating
- Bringing a personal air filter could help mitigate the risk.

## College Dormitories, School Classrooms

### College Dormitories

This statistic shows the volume of student housing units in the United States from 2010 to 2021. In 2018, there were 2.66 million student beds in the United States, which is set to increase to 2.84 million by 2021 with the annual growth approximately 45,000 bed per year.



\*Forecast: beds under construction and planned.

### Opportunity

#### 1. Dilute potential contaminants in campus buildings

CDC (<https://www.cdc.gov/coronavirus/2019-ncov/community/colleges-universities/considerations.html>) has certified an detail guidelines for the operation of univeristy buildings from ASHRAE.

- Increase total airflow supply to occupied spaces, when possible.
- Disable demand-controlled ventilation controls that reduce air supply based on occupancy or temperature during occupied hours.
- Further open minimum outdoor air dampers to reduce or eliminate HVAC air recirculation.
- Use portable high-efficiency particulate air fan/filtration systems

#### 2. Guidance for building operations during the COVID-19

Additional notes by ASHRAE ([https://www.ashrae.org/file%20library/technical%20resources/ashrae%20journal/2020journal/documents/72-74\\_ieq\\_schoen.pdf](https://www.ashrae.org/file%20library/technical%20resources/ashrae%20journal/2020journal/documents/72-74_ieq_schoen.pdf)) showed that During covid-19, HVAC is essential for improving the indoor air quality and even more significant are social distancing, hygiene and the influence we can have on personal behavior

- Increase outdoor air ventilation (use caution in highly polluted areas); with a lower population in the building, this increases the effective dilution ventilation per person.
- Disable demand-controlled ventilation (DCV).
- Further open minimum outdoor air dampers, as high as 100%, thus eliminating recirculation (in the mild weather season, this need not affect thermal comfort or humidity, but clearly becomes more difficult in extreme weather).
- Improve central air filtration to the MERV-13 or the highest compatible with the filter rack, and seal edges of the filter to limit bypass.
- Keep systems running longer hours, if possible 24/7, to enhance the two actions above.
- Consider portable room air cleaners with HEPA filters.
- Consider UVGI (ultraviolet germicidal irradiation).

### Classrooms for PK–12 Education

One perspective would be projection on the number of educational institutions ([https://nces.ed.gov/fastfacts/display.asp?id=372#PK12\\_enrollment](https://nces.ed.gov/fastfacts/display.asp?id=372#PK12_enrollment)) including special education, alternative, and other schools not classified by grade span.

## Opportunity

### 1. Poor ventilation inside schools, especially in older buildings

In fact, the U.S. Government Accountability Office said in a report (<https://www.nea.org/advocating-for-change/new-from-nea/school-ventilation-must-be-addressed-reopening-plans>) in June that to prevent the spread of the coronavirus among schooling students, more than 41% of school districts need to update or replace their heating, ventilation, and air conditioning systems in at least half of their buildings.

Some major problem would be fresh air vents were blocked with insulation, zone valves were removed or defective, and fresh air dampers that allow outside air in to circulate had been disconnected or were defective.

### 2. Prioritizes and renovate the system with existing standards

ASHRAE EPIDEMIC TASK FORCE (<https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-reopening-schools-and-universities-c19-guidance.pdf>) suggested following the instruction for renovation for K-12, Higher education institutions opened, with the extended implementation period and the ventilation system can be improved by

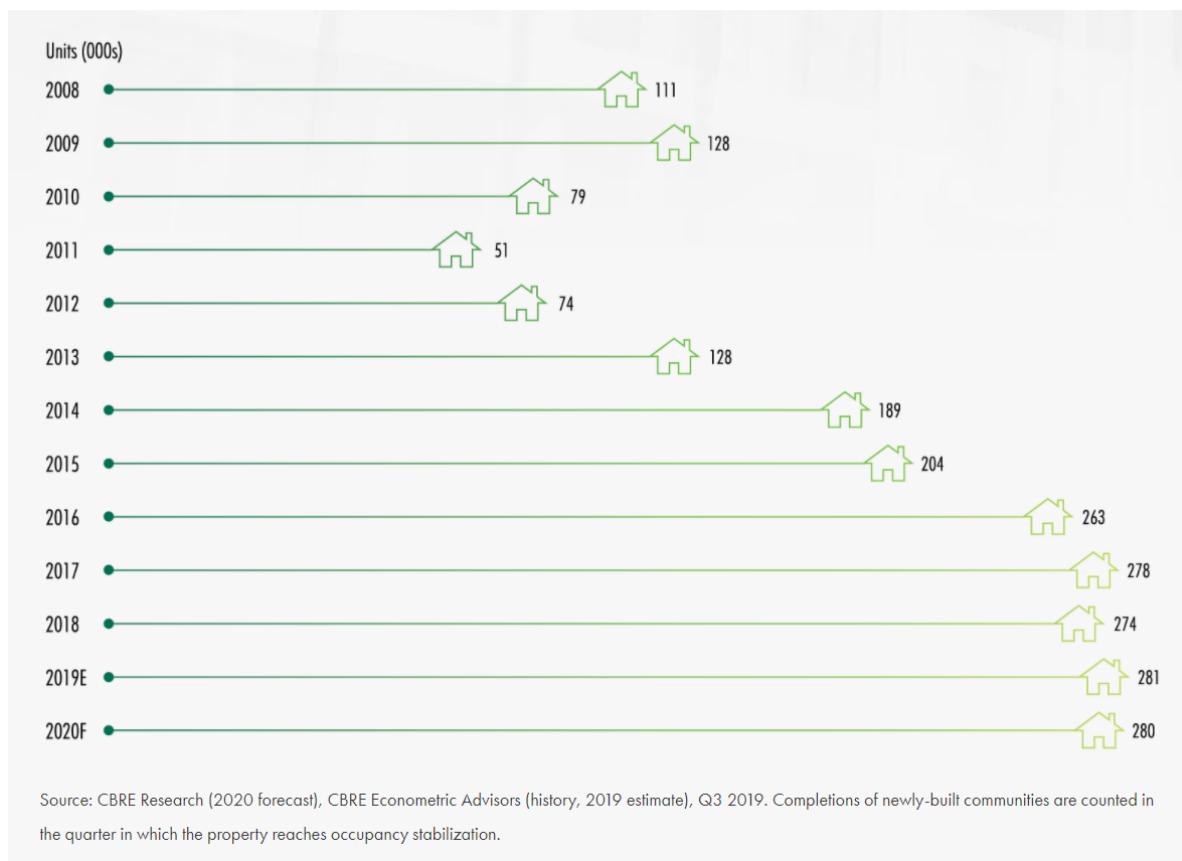
- Installing portable High Efficiency Particulate Air (HEPA) filters in rooms.
- Flushing air two hours before and after occupation.
- Upgrading MERV-8 to MERV-13 filters where appropriate.

## Multifamily Housing

### Multifamily Housing

For the multifamily housing market in 2020, CBRE Research predicted that permits and starts likely will fall, but not deliveries. Thus the completion amount still remain substantial. In 2020, multifamily completions will total 280,000 units, on par with 2019's estimated 281,000 units.

Permits, starts and completions were all at or near this cycle's highest levels in 2019. Development will continue in both urban and suburban locations next year and no doubt, multifamily developers will remain very active in 2020.



## Opportunity

### 1. Ensure adequate ventilation

According to CDC (<https://www.cdc.gov/coronavirus/2019-ncov/community/multifamily-housing.html#GuidingPrinciples>)'s latest guideline, multifamily housing need to be aware of following standards and more:

- Disable demand-controlled ventilation (DCV) controls that reduce air supply based on occupancy or temperature during occupied hours.
- Use portable high-efficiency particulate air (HEPA) fan/filtration systems to help enhance air cleaning, especially in higher risk areas such as common spaces.
- Generate clean-to-less-clean air movement by re-evaluating the positioning of supply and exhaust air diffusers or dampers, especially in higher-risk areas such as common spaces.
- Consider using ultraviolet germicidal irradiation icon (UVGI) as a supplement to help inactivate SARS-CoV-2, especially if options for increasing room ventilation are limited.
- Consider running the HVAC system at maximum outside airflow for 2 hours before and after the space is occupied.

## 2. Multihousing settings in common areas

ASHRAE Standard 62.2-2016 requires a continuous ventilation rate of 45 cfm for a onebedroom enclosure of 1,000 ft<sup>2</sup> floor area. ASHRAE Standard 62.2-2016 only allows credit for infiltration in horizontally attached (i.e., low-rise) multifamily units

However, the current standards may be improved with accommodation with corridors, elevator shafts, and trash chutes

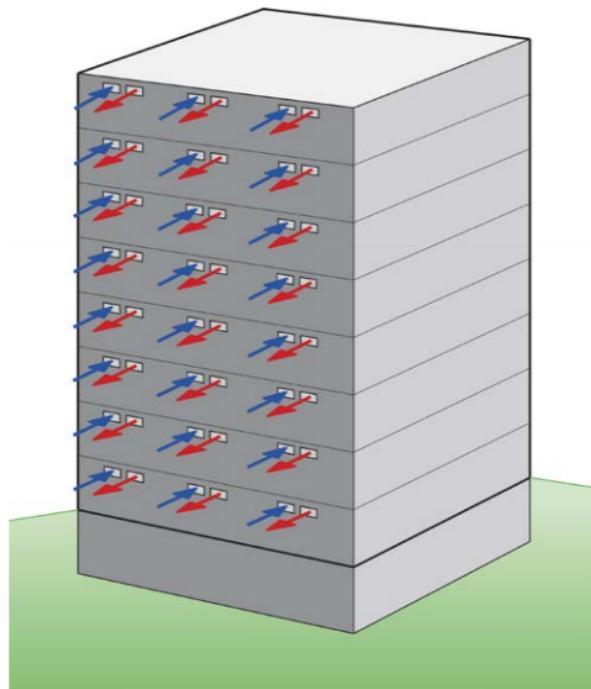
- Individual corridor supply fans should be replaced by a central rooftop system that supplies ventilation air to each corridor
- Elevator shafts should be equipped with an exhaust flow fan which is controlled by a constant airflow regulator to compensate for seasonal stack-effect variation.
- Trash chute should be maintained at a negative pressure

## 3. Dilution Ventilation vs. Displacement Ventilation

Displacement ventilation leads to cleaner air comparing to the mixing ventilation, as contaminants are removed from the occupied zone in a room towards the ceiling, as well as minimizing drafts.

With displacement ventilation, air is introduced at low velocity into a room at a low level and is exhausted at the ceiling. The flow of air is maintained by convective forces, which also have the effect of the concentration of pollutants rising from floor to ceiling.

For now, displacement ventilation is used mostly in Europe, and rarely in residential applications.



**Figure 1. Only balanced ventilation strategies are recommended for most multifamily construction**

([https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/67581.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/67581.pdf))

## Doctors' Office, Dentist Clinic

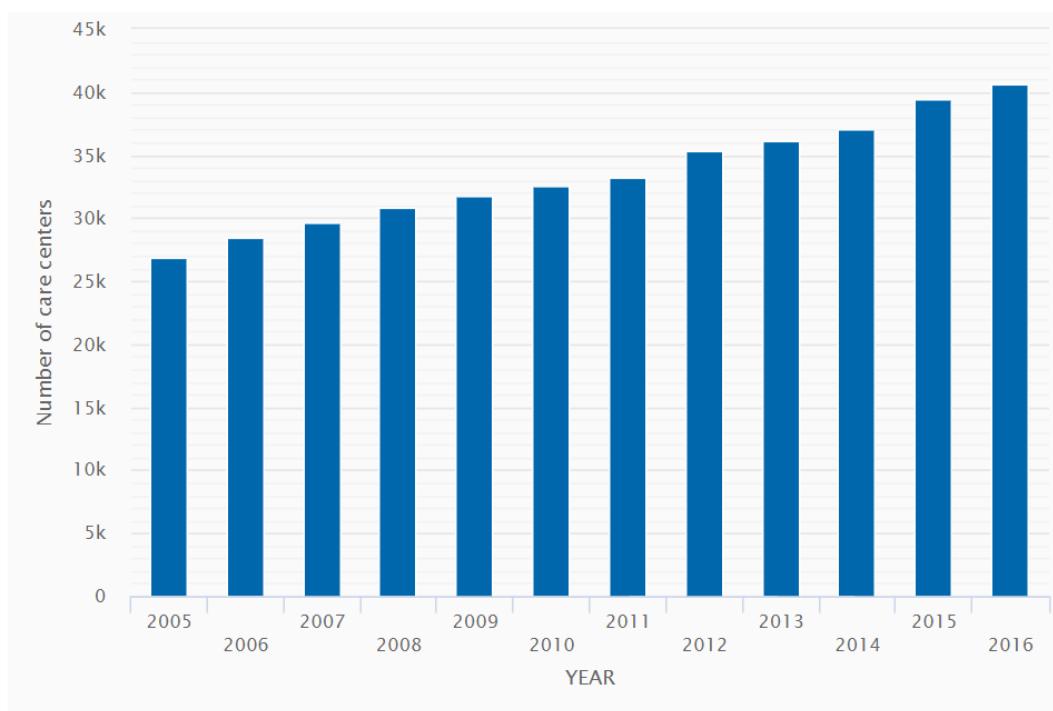
### Doctors' Office & Outpatient Clinic

Centers for Disease Control(CDC) has published statistics on the Office-based Physician Visits, 2016 (<https://www.cdc.gov/nchs/products/databriefs/db331.htm>), in 2016, there were an estimated 883.7 million office-based physician visits in the United States and there were an estimated 278 office-based physician visits per 100 persons.

## Number of outpatient centers in the U.S.

The number grew 51% from 26,900 in 2005 to 40,600 in 2016.

The chart below is interactive: **click or touch** to see more.



Source: CBRE analysis of U.S. Census data

Modern Healthcare

(<https://www.modernhealthcare.com/article/20181220/NEWS/181229992/number-of-outpatient-facilities-surges-as-industry-values-more-convenient-affordable-care#:~:text=Number%20of%20outpatient%20centers%20in,2005%20to%2040%2C600%20in%202016>)

As one doctor would treat approximately 4 patients who would visit 3 times annually, the doctor offices in United States would be at least 73,641,666 in 2016.

However, the prediction for doctor offices would also be affected by the numbers of hospital, the budget and growth of full time equivalent for doctors.

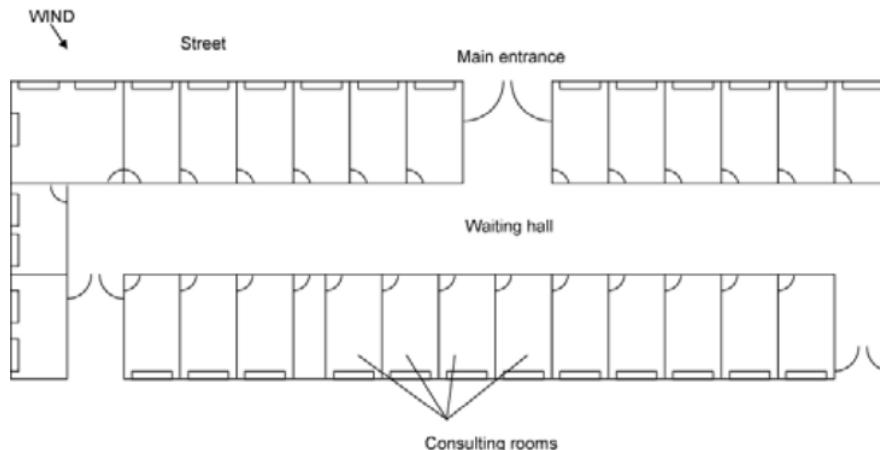
### Opportunity

#### 1. Sepcial designs to tackle patient flow issues

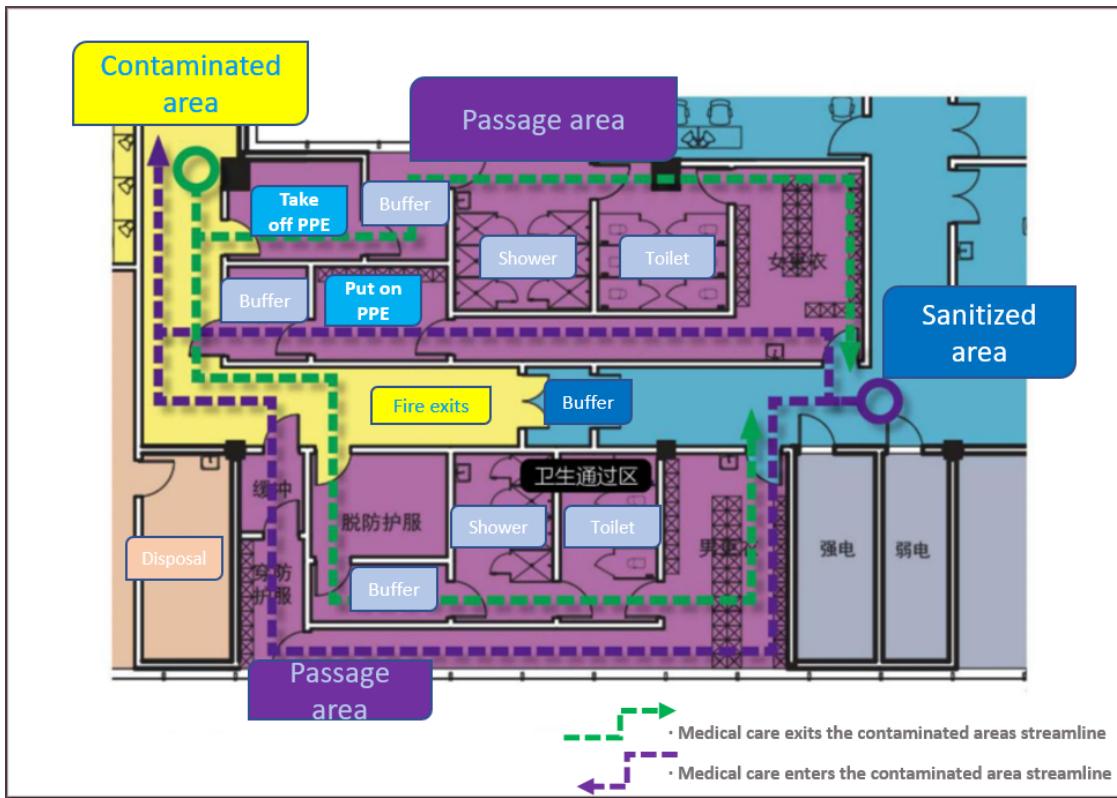
According to WHO ([https://www.who.int/water\\_sanitation\\_health/publications/natural\\_ventilation.pdf](https://www.who.int/water_sanitation_health/publications/natural_ventilation.pdf))'s Natural Ventilation for Infection Control in Health-Care Settings

Usually, there will be up to 300 patients share this room during consulting hours in the mornings and afternoons. The current outbreak of Covid-19 has already burden the medical system, which remarks the importance of a frequently ventilated and disinfected public areas. The ventilation rate should increase from a mean of 6.5 ACH to 15 ACH with the new design in the general outpatient waiting room.

- The waiting area for general outpatients (including most medical specialties, surgery and psychiatry) is located in the large hall shown in the photograph.
- The consulting rooms lead off from both sides of this waiting hall.



## 2. Prevent cross-infection between doctors and patients



(<http://www.zjkcsj.cn/newsshow.php?cid=5&id=295>)

- Hospitals should set up mechanical ventilation systems in different zones. (clean areas, contaminated areas, buffer rooms)
- Admission inspection in contaminated areas (negative pressure) and the mechanical ventilation system of the discharge disinfection treatment area (positive pressure) should be set up independently, and should not be used in combination with the ward.
- Adopt positive pressure buffer isolation method, that is, set the air supply not less than 30 times/h in **passage area**. The compartment is equipped with a short D300 ventilation pipe, and the airflow flows from the clean area to the isolation area.

### Dentist Clinic

The guidelines from US Oral Health Workforce Projections, 2017-2030 (<https://bhw.hrsa.gov/sites/default/files/bhw/health-workforce-analysis/research/projections/oral-health-2017-2030.pdf>) showed that the national demand for dentists is projected to increase by 9 percent across the industry to 206,850 FTEs in 2030, while the demand for pediatric dentists (2 percent) and orthodontists (-1 percent) is expected to grow slowly or not at all (Exhibit 1).

#### **The projection of the overall dentists' office in 2030 in the US would be 1,344,525**

Adjusting for the number of office in practical, Current standards (<https://blog.hjtdesign.com/how-many-dental-operatories>) suggest that five to eight operatories may be the perfect and the number for any office with a single dentist and the working environment should include following features:

- 3 operation room per dentist at least
- 2 full-time hygienists' operating room
- 1 optional common office managing the flow of traffic

### Opportunity

#### 1. Guidance for Dental Settings, adding HEPA filtration

CDC and American Dental Association (<https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html>) have updated some of the dental setting in the recent article,

- Air movement must move in from adjacent areas.
- Minimum air changes of outdoor air per hour is two.
- Air may not be recirculated by means of room units.

Rather than just relying on the building's HVAC system capacity, use a HEPA air filtration unit to reduce aerosol concentrations in the room and increase the effectiveness of the turnover time.

Place the HEPA unit near the patient's chair, but not behind the DHCP. Ensure the DHCP are not positioned between the unit and the patient's mouth. Position the unit to ensure that it does not pull air into or past the breathing zone of the DHCP.

Moreover, considering dental offices have patients with different health histories and they may be more susceptible to infections from bioaerosols, it would be better to avoid aerosol generating procedures

## Hospital Rooms

### Hospital Rooms

US hospital system has four major divisions and includes following

- U.S. Community hospital —— 84.60%
- Federal Government Hospitals —— 3.40%
- Nonfederal Psychiatric Hospitals —— 10.00%
- Other Hospitals for nonfederal long term care hospitals and hospital units within an institution such as a prison hospital or school infirmary —— 2.00%

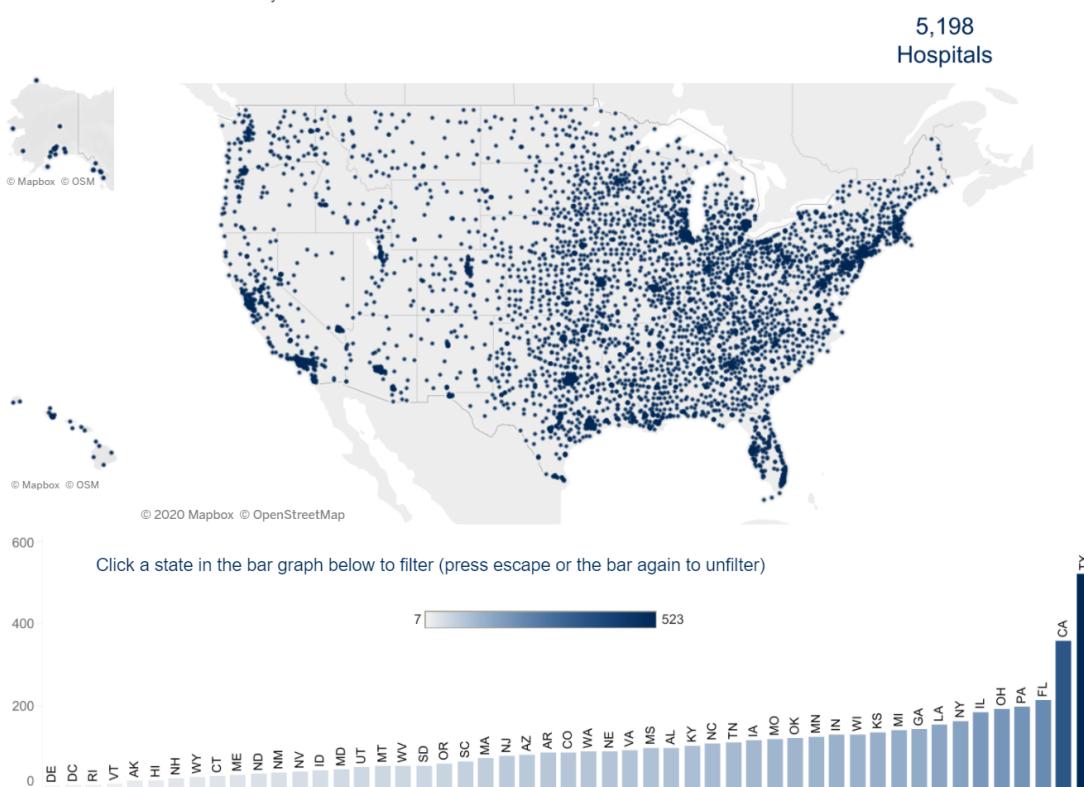
There are of total 6,146 US hospital from the AHA hospital statistic published 2018 statistics, where staffed beds could count up to 924,107.

Comparing to the total of 5,534 US hospital in 2016, the CAGR accounts for 5.376%

### Map of Community Hospitals in the United States

Data source: 2018 AHA Annual Survey Database

[Learn more about hospital data from AHA](#)



(<https://www.aha.org/statistics/2020-01-07-archived-fast-facts-us-hospitals-2019>)

## Opportunity

### 1. Airborne Infections Isolation (AI) Room

All room, also known as Negative pressure ward, has a restrictive setting

([https://www.cdc.gov/tb/webcourses/course/chapter7/7\\_infection\\_control\\_7\\_infection\\_control\\_program\\_airborne\\_infection\\_isolation\\_aai\\_room.html](https://www.cdc.gov/tb/webcourses/course/chapter7/7_infection_control_7_infection_control_program_airborne_infection_isolation_aai_room.html)) guide by CDC.

A special high efficiency air (HEPA) filter that removes most (99.97%) of the droplet nuclei before it is returned to the general circulation has to be implemented.

### 2. The Increment for Single Patient Rooms

"The Use of Single Patient Rooms versus Multiple Occupancy Rooms in Acute Care Environments"

([https://www.healthdesign.org/sites/default/files/use\\_of\\_single\\_patient\\_rooms\\_v\\_multiple\\_occ\\_rooms-acute\\_care.pdf](https://www.healthdesign.org/sites/default/files/use_of_single_patient_rooms_v_multiple_occ_rooms-acute_care.pdf)) strongly suggested that it is critical that infected patients or patients highly susceptible to infections need to be isolated in private rooms with proper ventilation.

What's more, preliminary findings at Bronson Methodist Hospital in Michigan demonstrate that private rooms, with well-designed air-flow have resulted in a 10 to 11 percent decline in overall nosocomial infections rates

# Market Applications

Bingkun Luo

2/11/2021

## Ventilation and Coronavirus (COVID-19)

An important approach to lowering the concentrations of indoor air pollutants or contaminants including any viruses that may be in the air is to increase ventilation – the amount of outdoor air coming indoors. Ensuring proper ventilation with outside air can help reduce the concentration of airborne contaminants, including viruses, indoors.

The ventilation rate should be based on the number of people that occupy an indoor space (and a few other factors), people should give special consideration to increased ventilation when occupancy increases and for areas with high-traffic.

Improving ventilation also benefits indoor air quality by reducing exposure to products used for cleaning and disinfecting potentially contaminated surfaces.

When used along with other best practices recommended by CDC and others, increasing ventilation can be part of a plan to protect people indoors.

- Elderly Care Facilities, Day Care Centers
- Hotel Rooms
- College Dormitories, School Classrooms
- Multifamily Housing
- Doctor Office, Dentist Clinic
- Hospital Rooms

## What is ASHRAE?

ASHRAE (<https://www.ashrae.org/>) stands for the American Society of Heating, Refrigerating and Air-Conditioning Engineers, which is the technical body that develops and maintains ventilation standards for the United States. Ventilation codes and energy efficiency programs throughout the U.S. are based on ASHRAE standards.

Since most of our discussion would be based on the ASHRAE standards, here is a brief overview of the most popular subsegment principles in ASHRAE.

## What is ASHRAE Standard 62.2?

Formed in 1996, the ASHRAE 62.2 committee developed and maintains a residential ventilation standard for buildings three stories and less which is titled Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. It is reviewed and revised every three years. The first version of Standard 62.2 was published in 2003, the second in 2007, and the most current version is ANSI/ASHRAE Standard 62.2-2010. (ANSI stands for the American National Standards Institute. ANSI certification of a standard means that a specific consensus process was used to develop and maintain the standard and is required for adoption of a standard into codes.)

ASHRAE Standard 62.2 is the ventilation standard that applies to low-rise residential buildings of three stories or less in the U.S. ASHRAE Standard 62.1 applies to all other buildings.

## What is ASHRAE Standard 170?

Developed in partnership with Facility Guidelines Institute (FGI) and American Society of Health Care Engineering (ASHE), ASHRAE Standard-170 has been providing key guidance for ventilation requirements for health care industry facilities since 2008. Use Standard 170-2017 alongside HVAC Design Manual for Hospitals and Clinics for comprehensive design guidance on hospitals, nursing and outpatient facilities.

## When ASHRAE Standard is Not Enough

Is ASHRAE Standard 62.2/170 current best practice for ventilation?

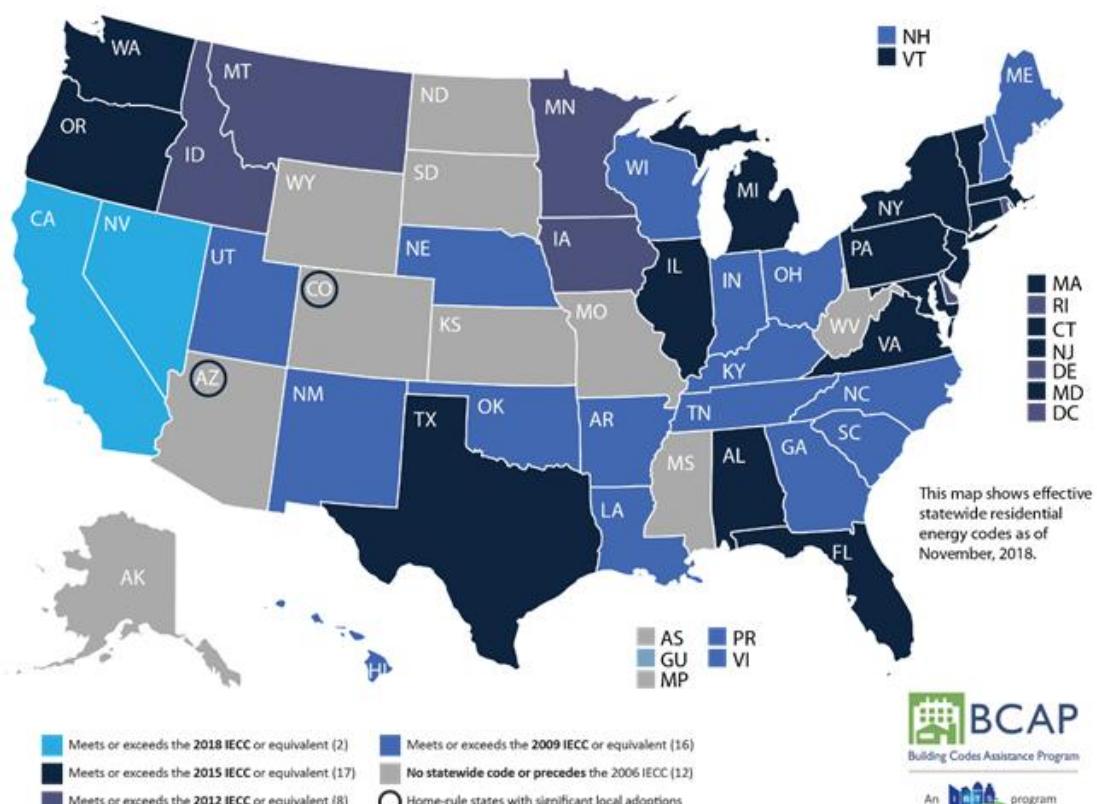
In a word, no. The standard that national experts could agree upon that sets a minimum standard for ventilation — not best practice, which would further customize ventilation rates based on factors such as number of occupants in a dwelling and strength of pollutant sources.

Meeting the ventilation requirements for ASHRAE Standard 62.2 will not always provide enough ventilation for a home. In these circumstances, ventilation rates need to be increased beyond the Standard.

- The Standard does not address high-polluting events such as painting, cleaning, smoking, or construction projects.
- The Standard does not address the use of unvented combustion space heaters such as unvented decorative gas appliances and kerosene heaters, which are not allowed in California.
- The Standard assumes one person per bedroom, with two people in the master bedroom. Higher numbers of occupants will increase ventilation needs.
- Occupants with health issues such as asthma and allergies may benefit from increased ventilation and/or filtration.

## Residential Energy Code

### RESIDENTIAL ENERGY CODE ADOPTION



(<https://www.wbdg.org/resources/energy-codes-and-standards>)

- Meets or Exceeds 2018 (2 states)
- Meets or Exceeds 2015 (17 states)
- Meets or Exceeds 2012 (8 states)
- Meets or Exceeds 2009 (16 states)
- No states code or Precedes 2006 (12 states)
- AZ/CO:Home rule states with significant adoption (2 out of 12 states)

## Current Ventilation Principles

### Ventilation Principles

Function of Space	Min total ach	Min outdoor ach	Temp control F/C	Moisture control(k),%	Min Filter Efficiency(ab)
Elderly Care Facilities	NR	NR	NR	NR	7/NR
Nursing Unit	12	2	70-75/21-24	MAX 60/NR	13/NR
Day Care Centers	4	2	—	—	—
Hotel Rooms	—	1-2	—	—	—
College Dormitories	—	1-2	—	—	—
School Classrooms	—	5-6	—	—	—
Multifamily Housing	—	0.35-1	—	—	—
Doctor Office	12	2	—	—	—
Dentist Clinic	6	2	70-75/21-24	MAX 60	7/14
<b>Hospital Rooms</b>	—————	—————	—————	—————	—————
Patient room	4	2	70-75/21-24	—	8/14
Patient toilet room	10	NR	NR	—	8/NR
Newborn nursery	6	2	72-78/22-26	—	8/14
Continued care nursery	6	2	NA	—	8/14

[https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/170-2017/170\\_2017\\_p\\_20200302.pdf](https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/170-2017/170_2017_p_20200302.pdf)

([https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/170-2017/170\\_2017\\_p\\_20200302.pdf](https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/170-2017/170_2017_p_20200302.pdf))

[http://sspc170.ashraepcs.org/pdf/170-2008\(with\\_a,b,d,e,f,g\)\\_ edits.2.pdf](http://sspc170.ashraepcs.org/pdf/170-2008(with_a,b,d,e,f,g)_ edits.2.pdf) ([http://sspc170.ashraepcs.org/pdf/170-2008\(with\\_a,b,d,e,f,g\)\\_ edits.2.pdf](http://sspc170.ashraepcs.org/pdf/170-2008(with_a,b,d,e,f,g)_ edits.2.pdf))

<https://smartairfilters.com/en/blog/ventilation-rates-office-home-school-virus/> (<https://smartairfilters.com/en/blog/ventilation-rates-office-home-school-virus/>)

*Note: NR = no requirement*

## Elderly Care Facilities

The nursing home (<https://app.leg.wa.gov/wac/default.aspx?cite=388-97-4040&pdf=true>) must ensure following:

- Ventilation of all rooms is designed to prevent objectionable odors, condensation, and direct drafts on the residents;
- All habitable space is mechanically ventilated including:
  - Air supply and air exhaust systems;
  - Installation of air-handling duct systems according to the requirements of the International Mechanical Code and chapter 51-52 WAC;
  - Installation of supply registers and return air grilles at least three inches above the floor;

- Installation of exhaust grilles on or near the ceiling
- Outdoor air intakes located a minimum of twenty-five feet from the exhaust from any ventilating system

The nursing home must locate the bottom of outdoor air intakes serving central systems a minimum of three feet above adjoining grade level or, if installed through the roof, three feet above the highest adjoining roof level.

(3) Minimum ventilation requirements meet the pressure relationship and ventilation rates per ASHRAE 2007 HVAC Applications Chapter 7.11 Table 6, Pressure Relationships and Ventilation of Certain Areas of Nursing Homes.

**TABLE 6  
PRESSURE RELATIONSHIPS AND VENTILATION OF CERTAIN AREAS OF NURSING HOMES**

Function Area	Pressure Relationship To Adjacent Areas <sup>1,2</sup>	Minimum Air Changes of Outdoor Air Per Hour Supplied To Room	Minimum Total Air Changes Per Hour Supplied To Room	All Air Exhausted Directly To Outdoors	Air Recirculated Within Room Units
<b>RESIDENT CARE</b>					
Resident room (holding room)	±	2	4	Optional	Optional
Resident corridor	±	Optional	2	Optional	Optional
Toilet room	N	Optional	10	Yes	No

## Day Care Centers

According to U.S. General Services Administration (<https://www.wbdg.org/FFC/GSA/chilcare.pdf>), the day care center's ventilation design should follow following instructions:

Design ventilation systems to allow zero exposure of non-smokers to environmental tobacco smoke (ETS) even if smoking is limited to outdoor areas, as described in LEED Version 2.0. Design ventilation systems to achieve an air-change effectiveness of minimum 0.9 per ASHRAE 129- 1997 and as described in LEED Version 2.0. Locate air return over diaper and toilet areas

**TABLE 6.2.2.1 Minimum Ventilation Rates in Breathing Zone**  
(Table 6.2.2.1 shall be used in conjunction with the accompanying notes.)

Occupancy Category	People Outdoor Air Rate <i>R<sub>p</sub></i>		Area Outdoor Air Rate <i>R<sub>a</sub></i>		Notes	Default Values				
	cfm/ person	L/s· person	cfm/ft <sup>2</sup>	L/s·m <sup>2</sup>		#/1000 ft <sup>2</sup> or #/100 m <sup>2</sup>	Combined Outdoor Air Rate (see Note 5)			
							cfm/ person	L/s· person	Air Class	
Daycare (through age 4)	10	5	0.18	0.9		25	17	8.6	2	
Daycare sickroom	10	5	0.18	0.9		25	17	8.6	3	
Classrooms (ages 5–8)	10	5	0.12	0.6		25	15	7.4	1	
Classrooms (age 9 plus)	10	5	0.12	0.6		35	13	6.7	1	

([https://www.ashrae.org/File%20Library/Technical%20Resources/Standards%20and%20Guidelines/Standards%20Addenda/62.1-2016/62\\_1\\_2016\\_s\\_20190726.pdf](https://www.ashrae.org/File%20Library/Technical%20Resources/Standards%20and%20Guidelines/Standards%20Addenda/62.1-2016/62_1_2016_s_20190726.pdf))

## Hotel Rooms

For hotel/motel guestrooms and high-rise residential spaces. The sum of the operable open areas must total at least 5 percent of the floor area of each space that is naturally ventilated. The openings must also be readily accessible to the occupants of the space at all times.

Airflow through the openings must come directly from the outdoors; air may not flow through any intermediate spaces such as other occupied spaces, unconditioned spaces, corridors, or atriums. High windows or operable skylights need to have a control mechanism accessible from the floor.

**Table 4-12 – (Standards Table 120.1-A) Minimum Ventilation Rates**

Type of Use	CFM per ft <sup>2</sup> of Conditioned Floor Area
Hotel guest rooms (less than 500 ft <sup>2</sup> )	30 cfm/guest room
Hotel guest rooms (500 ft <sup>2</sup> or greater)	0.15

(<https://energycodeace.com/site/custom/public/reference-ace-2013/index.html#!Documents/43ventilationrequirements.htm>)

## College Dormitories

One thing that College dorms differ from hotel would be that during summer vacations schools are intermittently occupied. It is important to consider hot or humid climates and mechanically cooled the college dormitories and military barracks that are unoccupied for long periods.

Occupancy Category	People Outdoor Air Rate <i>R<sub>p</sub></i>		Area Outdoor Air Rate <i>R<sub>a</sub></i>	
	cfm/ person	L/s· person	cfm/ft <sup>2</sup>	L/s·m <sup>2</sup>
<b>Hotels, Motels, Resorts, Dormitories</b>				
Bedroom/living room	5	2.5	0.06	0.3
Barracks sleeping areas	5	2.5	0.06	0.3
Laundry rooms, central	5	2.5	0.12	0.6
Laundry rooms within dwelling units	5	2.5	0.12	0.6
Lobbies/prefunction	7.5	3.8	0.06	0.3
Multipurpose assembly	5	2.5	0.06	0.3

([https://www.ashrae.org/File%20Library/Technical%20Resources/Standards%20and%20Guidelines/Standards%20Addenda/62.1-2016/62\\_1\\_2016\\_s\\_20190726.pdf](https://www.ashrae.org/File%20Library/Technical%20Resources/Standards%20and%20Guidelines/Standards%20Addenda/62.1-2016/62_1_2016_s_20190726.pdf))

## School Classrooms

The ventilation system in classrooms such that air from the science rooms are not recirculated into non-science areas.

In chemical storage rooms, the ventilation system shall exhaust the air to the outside, and shall not be recirculated back into space. There is no minimum ventilation rate called out.

An exhaust fan controlled by the Instructor shall be provided in all rooms where hazardous or vaporous chemicals are to be used or stored. The exhaust fan shall be of sufficient size to exhaust the total volume of the room within 15 minutes.

Referring back to the minimum ventilation rate given by ANSI/ASHRAE 62.1.

**TABLE 6.2.2.1 Minimum Ventilation Rates in Breathing Zone**

(Table 6.2.2.1 shall be used in conjunction with the accompanying notes.)

Occupancy Category	People Outdoor		Area Outdoor		Default Values				
	Air Rate $R_p$		Air Rate $R_a$		#/1000 ft <sup>2</sup> or #/100 m <sup>2</sup>	Notes	Occupant Density (see Note 4)	Combined Outdoor Air Rate (see Note 5)	
	cfm/ person	L/s· person	cfm/ft <sup>2</sup>	L/s·m <sup>2</sup>			cfm/ person	L/s· person	
<b>Correctional Facilities</b>									
Cell	5	2.5	0.12	0.6	25		10	4.9	2
Dayroom	5	2.5	0.06	0.3	30		7	3.5	1
Guard stations	5	2.5	0.06	0.3	15		9	4.5	1
Booking/waiting	7.5	3.8	0.06	0.3	50		9	4.4	2
<b>Educational Facilities</b>									
Daycare (through age 4)	10	5	0.18	0.9	25		17	8.6	2
Daycare sickroom	10	5	0.18	0.9	25		17	8.6	3
Classrooms (ages 5–8)	10	5	0.12	0.6	25		15	7.4	1
Classrooms (age 9 plus)	10	5	0.12	0.6	35		13	6.7	1
Lecture classroom	7.5	3.8	0.06	0.3	H	65	8	4.3	1
Lecture hall (fixed seats)	7.5	3.8	0.06	0.3	H	150	8	4.0	1
Art classroom	10	5	0.18	0.9		20	19	9.5	2
Science laboratories	10	5	0.18	0.9		25	17	8.6	2
University/college laboratories	10	5	0.18	0.9		25	17	8.6	2
Wood/metal shop	10	5	0.18	0.9		20	19	9.5	2
Computer lab	10	5	0.12	0.6		25	15	7.4	1
Media center	10	5	0.12	0.6	A	25	15	7.4	1
Music/theater/dance	10	5	0.06	0.3	H	35	12	5.9	1
Multiuse assembly	7.5	3.8	0.06	0.3	H	100	8	4.1	1

([https://www.ashrae.org/File%20Library/Technical%20Resources/Standards%20and%20Guidelines/Standards%20Addenda/62.1-2016/62\\_1\\_2016\\_s\\_20190726.pdf](https://www.ashrae.org/File%20Library/Technical%20Resources/Standards%20and%20Guidelines/Standards%20Addenda/62.1-2016/62_1_2016_s_20190726.pdf))

## Multifamily Housing

Research has shown that multifamily units (<https://homes.lbl.gov/ventilate-right/upgrading-multifamily-buildings>) have less infiltration of outside air but mostly the air leakage through common walls and ceilings brings in air from the neighbors. Thus to provide adequate whole-building ventilation, multifamily units often need higher levels of mechanical ventilation to compensate for less infiltration.

Section 8 in Addendum j to ASHRAE 62.2-2010 covers multifamily units, which includes higher required airflows for whole-building ventilation, plus air-sealing requirements between units in multifamily buildings.

**ASHRAE Standard 62.2 Table 8.2.1a**  
**Multifamily Ventilation Air Requirements in cfm**

Floor Area (sq ft)	Number of Bedrooms				
	0 - 1	2	3	4	5
< 500	30	38	45	53	60
501 - 1000	45	53	60	68	75
1001 - 1500	60	68	75	83	90
1501 - 2000	75	83	90	98	105
1001 - 2500	90	98	105	113	120
2501 - 3000	105	113	120	128	135
3001 - 3500	120	128	135	143	150
3501 - 4000	135	143	150	158	165
4001 - 4500	150	158	165	173	180
4501 - 5000	165	173	180	188	195

Additionally, in recent ASHRAE Standard 62.2-2016 requires a vented kitchen range hood with a minimum intermittent exhaust flow of 100 cfm or local kitchen area intermittent ventilation of 5 ach. Bathroom exhaust is also required at a minimum intermittent rate of 50 cfm or a continuous rate of 20 cfm.

What's more the choice of supplemental dehumidification is made by climate location according to US department of energy ([https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/67581.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/67581.pdf)). It is the only viable option in hot-humid and mixed-humid climates. No air conditioning systems currently exist that have sufficient dehumidification capability for multifamily units ventilated at ASHRAE Standard 62.2-2016 rates. Separate systems are required.

## Doctor Office

There yet not clear ventilation standards listed out for doctor's office but it could be referred from most of the hospital settings

Function of Space	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k) (%)	Design Temperature (l) (°F/C)
Airborne infection isolation room (u)	Negative	2	12	Yes	No	max 60	70-75/21-24
Combination AII/PE room	Positive	2	12	Yes	No	max 60	70-75/21-24
AII anteroom (u)	(e)	N/R	10	Yes	No	N/R	N/R
PE anteroom (t)	(e)	N/R	10	N/R	No	N/R	N/R
Combination AII/PE anteroom	(e)	N/R	10	Yes	No	N/R	N/R
Labor/delivery/recovery/postpartum (LDRP) (s)	N/R	2	6	N/R	N/R	max 60	70-75/21-24
Labor/delivery/recovery (LDR) (s)	N/R	2	6	N/R	N/R	max 60	70-75/21-24
Patient Corridor	N/R	N/R	2	N/R	N/R	N/R	N/R
<b>SKILLED NURSING FACILITY</b>							
Resident Room	N/R	2	2	N/R	N/R	N/R	70-75/21-24
Resident Gathering/Activity/Dining	N/R	4	4	N/R	N/R	N/R	70-75/21-24
Physical Therapy	Negative	2	6	N/R	N/R	N/R	70-75/21-24
Occupational Therapy	N/R	2	6	N/R	N/R	N/R	70-75/21-24
Bathing Room	Negative	N/R	10	Yes	N/R	N/R	70-75/21-24

## Dentist Clinic

Ventilation in the dental office can include placing a high-speed extraoral evacuation system close to the source of contaminants (patient's mouth) and additionally increasing air flows in mechanical ventilation systems (e.g. hoods, HVAC systems).

Air conditioning of a building or a room controls the purity, humidity and temperature of the indoor air, and it is essential in those buildings with clean zones and clean rooms.

REQUIRED ELEMENTS FOR DENTAL FACILITIES					
Guidelines for Design and Construction of Hospitals and Outpatient Facilities (FGI 2014) ANSI/ASHRAE/ASHE Standard 170-2013, Ventilation of Health Care Facilities (ASHRAE)					
Code Reference Category					
Phase	Code Section	Component/Requirements	Complies	Comments	
Schematic	Design Development				
<b>3.14-3 Dental Treatment Areas</b>					
•	ASHRAE 7.1	Pressure Relationship to Adjacent Areas	N/R		
•	ASHRAE 7.1	Min. Outdoor Air Changes / Hour	2		
•	ASHRAE 7.1	Min. Total Air Changes / Hour	6		
•	ASHRAE 7.1	All Room Air Exhausted Directly to Outdoors	N/R		
•	ASHRAE 7.1	Air Recirculated by Means of Room Units	N/R		
•	ASHRAE 7.1	Relative Humidity (%)	60 max		
•	ASHRAE 7.1	Design Temperature(°F)	70-75		
<b>3.14-8 Building Systems</b>					
<b>3.1-8.2 Ventilation and space-conditioning requirements</b>					
•	Room	Filter Bank	Min. Filter Efficiencies		
•	ASHRAE 6.4	Filter Bank No. 1 (MERV)	7		
•	ASHRAE 6.4	Filter Bank No. 2 (MERV)	NR		
•	ASHRAE 6.4	Filter Bank No. 1 (MERV)	7		
•	ASHRAE 6.4	Filter Bank No. 2 (MERV)	NR		

(<https://www.health.ny.gov/facilities/cons/docs/3-14-0.pdf>)

## Hospital Rooms

**Negative pressure rooms**: Diagnostic or therapeutic endoscopic procedures involving the airway (i.e., bronchoscopies) increase the risk for air contamination with M. tuberculosis in patients with known or undiagnosed tuberculosis, a disease spread by the airborne route. No change was made in the new AIA Guidelines. Bronchoscopy rooms must be maintained at negative air pressure to protect the worker and the environment.

After all, consistency with the medical program requirements, e.g., pharmacy, anesthesia gas storage, etc., established on evidence-based clinical research and principles of asepsis.

Function of Space	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k) (%)	Design Temperature (l) (°F/°C)
Airborne infection isolation room (u)	Negative	2	12	Yes	No	max 60	70-75/21-24
Combination AII/PE room	Positive	2	12	Yes	No	max 60	70-75/21-24
AII anteroom (u)	(e)	N/R	10	Yes	No	N/R	N/R
PE anteroom (t)	(e)	N/R	10	N/R	No	N/R	N/R
Combination AII/PE anteroom	(e)	N/R	10	Yes	No	N/R	N/R
Labor/delivery/recovery/postpartum (LDRP) (s)	N/R	2	6	N/R	N/R	max 60	70-75/21-24
Labor/delivery/recovery (LDR) (s)	N/R	2	6	N/R	N/R	max 60	70-75/21-24
Patient Corridor	N/R	N/R	2	N/R	N/R	N/R	N/R
<b>SKILLED NURSING FACILITY</b>							
Resident Room	N/R	2	2	N/R	N/R	N/R	70-75/21-24
Resident Gathering/Activity/Dining	N/R	4	4	N/R	N/R	N/R	70-75/21-24
Physical Therapy	Negative	2	6	N/R	N/R	N/R	70-75/21-24
Occupational Therapy	N/R	2	6	N/R	N/R	N/R	70-75/21-24
Bathing Room	Negative	N/R	10	Yes	N/R	N/R	70-75/21-24

## Panasonic Solutions

### Heating, Ventilation and Air Conditioning (HVAC)

#### Asia

Including products from Great China, Japan, Malaysia

#### Dehumidification

1.FV-50NCD1C / FV-50NC1C (<https://iaq.panasonic.cn/productdetail/75>)



#### Product Label:

Intelligent control, IAQ visual, Nano X Sterilization, DC motor

- $500m^3/h$  Clean Air Delivery Rate(CADR)
- Smart control is simpler
- Rapid dehumidification and large air volume



2.F-YHC12X (<https://www.plshk.panasonic.hk/product/f-yhc12x>)



#### Product Label:

Hybrid type, Dehumidifying capacity = 12L/day

- Hybrid technology provides efficient dehumidification year-round
- Intelligent humidity control maintains a pleasant humidity
- 2-way air outlet at front and back to suit different purposes of dehumidification
- 3D louver enhances clothes drying efficiency
- Anti-bacteria and super allergen-buster filter inhibit bacteria and allergens effectively

#### Supply Air

- Most of the devices are direct current motor, with high performance 'Twin Flow Fan' employed for powerful Airflow and high static pressure
- Slim and compact design allow installation at narrow ceiling space

- Newly designed casing with taper scroll minimizes turbulence inside the casing
- Noise absorption material adopted for low noise operation
- Able to install upside down for different location of inspection opening

**FV-01NAP1**

- DC Motor
- Supply Fan
- Low noise
- Pre filter & PM2.5 filter equipped

**FV-01NJP1**

- DC motor
- Constant airflow output
- Low noise
- Pre filter & PM2.5 filter equipped

**FV-02NJP1**

- DC motor
- Constant airflow output
- Low noise
- Pre filter & PM2.5 filter equipped

**FV-02NU1H**

- Compact design
- Low noise level
- Two speed selection
- Easy installation

**FV-04NU1H**

- Compact design
- Low noise level
- Two speed selection
- Easy installation

**FV-05NU1H**

- Compact design
- Low noise level
- Two speed selection
- Easy installation

(<https://www.plshk.panasonic.hk/category/Cabinet-Fan>)

**FV-18NF3H**

- Low noise series
- Single phase
- Exhaust type
- Ceiling mounting

**FV-18NS3**

- Low noise series
- Single phase
- Exhaust type
- Ceiling mounting

**FV-18NS3H**

- Low noise series
- Single phase
- Exhaust type
- Ceiling mounting

(<https://www.plshk.panasonic.hk/category/Cabinet-Fan>)



### FV-25SW3

- Low noise series
- Three phase
- Exhaust type
- Ceiling mounting

### FV-28NX3

- Low noise series
- Three phase
- Exhaust type
- Ceiling mounting

### FV-28NX3H

- Low noise series
- Three phase
- Exhaust type
- Ceiling mounting

(<https://www.plshk.panasonic.hk/category/Cabinet-Fan>)

## Middle East

> Consumer > Air Solutions

## Residential Air Conditioners

Choose the one that's right for you

**nanoe-G**  
Advance Air Purification System

**Learn more**

**nanoe-G**  
Purifies your living space down to the smallest detail

**RELIABILITY FACTS**

**INVERTER**  
Advanced Air Conditioning

**ECONAVI**  
Intelligent Eco Sensors

Unique Air Purifying System: nanoe-G

Reliability Facts of Quality

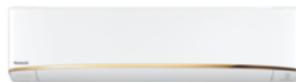
INVERTER

ECONAVI with intelligent eco sensors

(<https://www.panasonic.com/middleeast/en/consumer/air-solutions/residential-air-conditioners-learn/features-explanation/unique-air-purifying-system--nanoe-g.html>)

## Air Condition(air curtains)

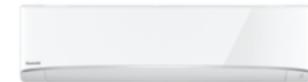
nanoe-G will even deactivate bacteria and viruses that are trapped in the filter and remove up to 99% of PM2.5. It automatically operates as an air supply when the air conditioner is turned off.

**CS-V24VKF**

Better air quality for your living space

**SHOP NOW****CS-V18VKF**

Better air quality for your living space

**SHOP NOW****CS-PV30VKF**

25M Long Reach Airflow. Powerful Cooling.

**SHOP NOW****CS-PV24VKF**

25M Long Reach Airflow. Powerful Cooling.

**SHOP NOW****CS-PV18VKF**

25M Long Reach Airflow. Powerful Cooling.

**SHOP NOW****CS-RV30VKF**

Powerful Cooling with Big Compressor

**SHOP NOW**

(<https://www.panasonic.com/middleeast/en/consumer/air-solutions/residential-air-conditioners.html>)

## High Efficiency Particulate Air (HEPA)

### Asia

Including products from Great China, Japan, Malaysia

### Air Purifiers

1. F-PDS90C (<https://consumer.panasonic.cn/product/home-living/air-purifier-dehumidifier/air-purifier/f-pds90c.specs.html>)

- 4-fold gradient purification, multi-directional filtration of air
- AUK professional certification to reduce 7 major allergens
- Equipped with dust sensor and air pollution indicator display

2. F-VJL55C2 (<https://consumer.panasonic.cn/product/home-living/air-purifier-dehumidifier/empty-disinfecting-machine/f-vjl55c2.specs.html>)

- ASEPTIC FEELING-clean bacteria technology

- High-efficiency composite filter, filter out 10 kinds of bacteria, reduce 7 major allergens
- Fog-free humidification technology to prevent bacterial growth



3.F-PDS130C (<https://consumer.panasonic.cn/product/home-living/air-purifier-dehumidifier/air-purifier/f-pds130c.specs.html>)

- $710m^3/h$  Clean Air Delivery Rate(CADR)
- 3 airflow modes, precise purification
- 99.99% space sterilization rate, nearly 100% peace of mind

#### Nanoe™ Technology-Air Purifiers

1. F-VXT90 ([https://panasonic.jp/airrich/products/f\\_vxt90.html](https://panasonic.jp/airrich/products/f_vxt90.html))

- Using the “Mill Air” phone app to check the level of dust (pollen, house dust, PM2.5, peculiar smell)
- Function as humidifier as well
- Unique air flow and ion technology”

2. F-VJL75C (<https://consumer.panasonic.cn/product/home-living/air-purifier-dehumidifier/empty-disinfecting-machine/f-vjl75c.specs.html>)

- High efficiency nanofiber HEPA filter can filter  $0.02\mu m$  particles
- Air disinfection technology

3. F-PXP155C (<https://consumer.panasonic.cn/product/home-living/air-purifier-dehumidifier/air-purifier/f-pxp155c.specs.html>)

- The particulate matter is as high as CADR  $800m^3/h$
- Equipped with 3 sets of filters, all-round three-dimensional purification
- Certified by the British Allergy Association to effectively reduce 7 allergens



#### Nanoe™ Technology- Portable Air Purifier

F-GMK01 ([https://panasonic.jp/nanoe\\_h/products/f\\_gmk01.html](https://panasonic.jp/nanoe_h/products/f_gmk01.html))

- Equipped with “8 hours automatic shutdown timer”
- Record the air volume when the car engine is stopped, and when the engine is restarted, the same air volume is generated again with “nanoe”.

[https://www.youtube.com/watch?v=RJ59o3YLxBg&ab\\_channel=NancyTonAI](https://www.youtube.com/watch?v=RJ59o3YLxBg&ab_channel=NancyTonAI) ([https://www.youtube.com/watch?v=RJ59o3YLxBg&ab\\_channel=NancyTonAI](https://www.youtube.com/watch?v=RJ59o3YLxBg&ab_channel=NancyTonAI))

F-GPT01AKM (<https://www.panasonic.com/my/consumer/air-solutions/air-purifier/f-gpt01akm.html>)

- Panasonic Unique nanoe™X Technology
- Inhibit Virus and Bacteria
- Deodorize Environment
- Hydrate Skin and Hair
- Portable & Lightweight



#### HEPA Composite Filter

##### 1.F-ZXSL40C

- Recommended renewal frequency: 2 years
- Compatible with F-VXL40C

##### 2.F-ZXJP90C

- Recommended renewal frequency: 10 years
- Compatible with F-VXJ90C (<https://consumer.panasonic.cn/product/home-living/air-purifier-dehumidifier/air-purifier/f-vxj90c.html>)

**F-ZXSL40C**

[HEPA dust collection and deodorization integrated filter](#)

**F-ZXJP90C**

HEPA dust filter

### 3.F-ZXKP55C

- Recommended renewal frequency: 5 years
- Compatible with F-655FCV, F-5F5FCV, F-VK655C, F-VK5F5C

### 4.F-ZXKP40C

- Recommended renewal frequency: 5 years
- Compatible with F-41C4VX, F-VXK40C

**F-ZXKP55C**

HEPA dust filter

**F-ZXKP40C**

HEPA dust filter

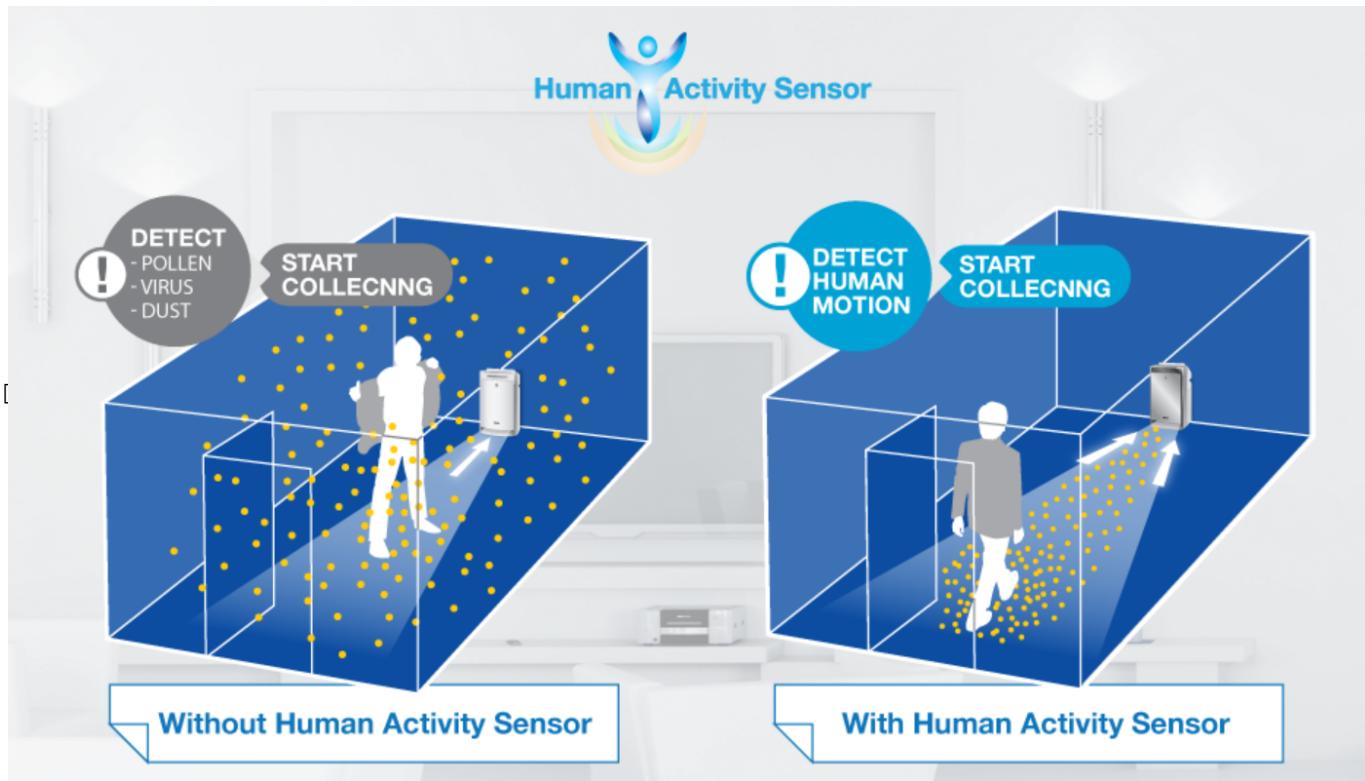
## Middle East

<https://www.panasonic.com/middleeast/en/consumer/air-solutions/air-purifiers.html> (<https://www.panasonic.com/middleeast/en/consumer/air-solutions/air-purifiers.html>)

### Air Purifiers

1. F-VXK90M (<https://www.panasonic.com/middleeast/en/consumer/air-solutions/air-purifiers/f-vxk90m.specs.html>)

- Extra filter Protects against sandstorms
- Applicable Area 66m<sup>2</sup>(710 ft<sup>2</sup>)
- Humidifying Capacity 830mL/h



2. F-PXL45M (<https://www.panasonic.com/middleeast/en/consumer/air-solutions/air-purifiers/f-pxl45m.specs.html>)

- Allows multi-installation to save space
  - Can be mounted on wall
  - Can be placed on the table or floor
- House Dust Catcher: Purifies with powerful suction near the floor where children play around
- Applicable Area 33m<sup>2</sup>(355ft<sup>2</sup>)

3. F-VXL95M (<https://www.panasonic.com/middleeast/en/consumer/air-solutions/air-purifiers/f-vxl95m.specs.html>)

- Applicable Area: 71m<sup>2</sup>
- Sandstorm Mode
- Anti-virus/Bacteria 99.9% H1N1,H5N1,MRSA



## Nanoe™ Technology

Please see a brief overview of the most recent Nanoe™ Technology

[https://www.youtube.com/watch?v=MO7arSRgvuI&ab\\_channel=PanasonicAsia](https://www.youtube.com/watch?v=MO7arSRgvuI&ab_channel=PanasonicAsia) ([https://www.youtube.com/watch?v=MO7arSRgvuI&ab\\_channel=PanasonicAsia](https://www.youtube.com/watch?v=MO7arSRgvuI&ab_channel=PanasonicAsia))

# Market Competitors

Bingkun Luo

2/11/2021

## Regional/Commercial Market Competitors

### Broan Nutone



(<https://www.broan-nutone.com/en-us>)

Here is an overview of the product lines Broan actively promoted.

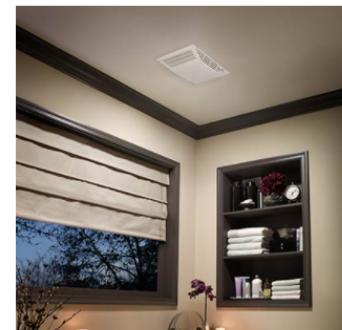
- Bath & Exhaust Ventilation Fans
  - **Bluetooth Fans**
  - Decorative & Recessed Fans
  - Fans w/ Lights
  - Fans w/ Heaters
  - Humidity & Motion Sensing Fans
  - High Capacity & Commercial Fans
  - Controls
- Range Hoods
  - Under-Cabinet
  - Wall-Mount Chimney
  - **Wall-Mount Canopy**
  - Island
  - **Built-In / Power Pack**
  - **Downdraft**
  - **Outdoor**
- Fresh Air Systems
- Specialty Ventilation & Heating
  - Heaters
  - **Attic Ventilation**
  - In-Line Fans
  - Utility Fans & Through-Wall Fans
  - **Central Vacuum Systems**
- **Mosquito Repellency**

### Heating, Ventilation and Air Conditioning (HVAC)

#### Exhaust Fan & Air Supply

Panasonic offers basically the same range of products in the bathroom ventilation, comparing with Broan. The only product gap highlights in the entertaining experience.

The bluetooth fans from Broan are featured in entertaining the bathing experience with the ChromaComfort™ fan (<https://www.broan-nutone.com/en-us/chromacomfort>) combines colorful LED lighting options and Broan® Sensonic™ (<https://www.broan-nutone.com/en-us/sensonic>) exhaust vent fan with a build-in speaker.



### Fans

Fans to eliminate odor, humidity and other air-borne pollutants that affect indoor air quality without calling attention to itself when it's working.

### Bluetooth Fans

Easily reinvigorate your space and your senses by playing music or control light settings, brightness, timers, and fan speed through your smartphone.

### Fans w/ Lights

Fan/light options also offer a quiet ventilation fan to remove excess humidity and a convenient light-all in one fixture.

### Fans w/ Heaters

Fans that add instant heat to quickly warm up the room, a quiet ventilation fan to remove excess humidity and a convenient light-all in one fixture.

(<https://www.broan-nutone.com/en-us/bath-exhaust-ventilation-fans>)



### Humidity & Motion Sensing Fans

Motion and humidity sensing fans are a hands-free solution to fighting excess humidity that employ unique sensing technology.

### Decorative Fans

Fan/light combination fixtures that unobtrusively blends into the ceiling or a statement fan/light with a stunning LED perimeter glow.

### High Capacity & Commercial Fans

Low-vibration and low-profile fans work quietly and powerfully behind the scenes to remove odor, humidity, and air-borne pollutants that affect indoor air quality in larger areas.

### Grille/Covers & Upgrade Kits

A dingy and discolored fan grille/cover can be an eye sore to your updated bathroom. And a loud or noisy fan can keep you from using it. Upgrades as fast as 5-minutes.

(<https://www.broan-nutone.com/en-us/bath-exhaust-ventilation-fans>)

## Range Hoods

Panasonic range hood products are not as diverse as Broan. They are more traditionally designed and focus on the indoor aspect.

Whereas Broan has advantages in diverse design in the build-in and island range hood,500-1500 CFM (<https://www.broan-nutone.com/en-us/product/rangehoods/rmip33>), it is one of the leading company in building downdraft range hoods,500 CFM (<https://www.broan-nutone.com/en-us/range-hoods/downdraft>) which compatible with both island and traditional cooktop.



### Under-Cabinet

Under-cabinet range hoods deliver best-in-class ventilation performance while preserving precious cabinet space.

### Wall-Mount Chimney

When a kitchen is designed to make the range hood the center of attention, the wall mounted hood is the perfect choice.

### Island

Island hoods provide you with a selection of the most popular designs available which come with classic, telescopic chimney flue to allow a perfect fit.

### Built-In

Built-in/power packs are a hidden ventilation alternatives for the kitchen. It's a simple, behind-the-scenes solution that eliminates smoke and odors without ever being noticed.

### Downdraft

Think about having a powerful range hood that's there when you need it and hidden when you don't.

### Outdoor

Range hoods suitable for outdoor installation when used in partially protected environments such as screened-in lanais or covered patios.

## Fresh Air Systems

### BROAN AI SERIES

#### Fresh Air Systems driven by Virtuo Air Technology

Broan turned our classic fresh air ventilation line into a single and versatile platform: the AI Series. A platform specifically designed and improved to make your life easier and more profitable, in addition to offering superior air quality.

- Superior air filtration: MERV 8-13
- Premium ECM motors with built-in smart technology
- Ultra-quiet operating environment and 60% energy savings
- Versatile Installation Options



(<https://www.broan-nutone.com/en-us/ai-series>)

## Heating Fans

Broan features spot heating as one of their specialty and it introduced Attic ventilation system (<https://www.broan-nutone.com/en-us/specialty-ventilation-heating>) to prevent heat and moisture build-up, which could extend roof life by preventing rot, premature aging and shingle distortion.

Worth noting that Panasonic has ventilation fan with similar function. Although WhisperValue® DC™ Fan, Condensation Sensor (<https://na.panasonic.com/us/home-and-building-solutions/ventilation-indoor-air-quality/ventilation-fans/whispervaluer-dctm-fan-condensation-sensor>) was advertised for bathroom, it could be a potential multi-purpose solution.

## HEPA filters

Panasonic's global HEPA filter has obvious advantages over Broan's listed catalog. Broan provided two series of whole-house solution ventilation fans (<https://www.broan-nutone.com/en-us/search?q=HEPA>) with CFM rate range in 100-250 CFM.

- Advanced Series Energy Recovery Ventilator (<https://www.broan-nutone.com/en-us/product/freshairsystems/ervh100s>), 100-104 CFM
- HE Series High Efficiency Heat Recovery Ventilator (<https://www.broan-nutone.com/en-us/product/freshairsystems/hrv200te>), 210-250 CFM

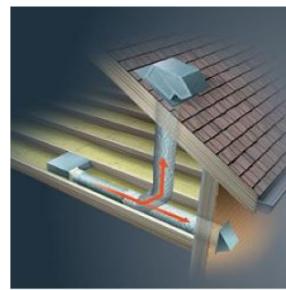
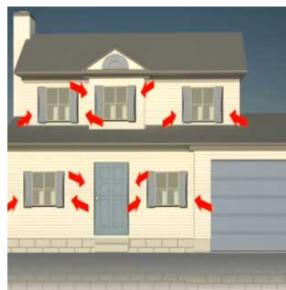
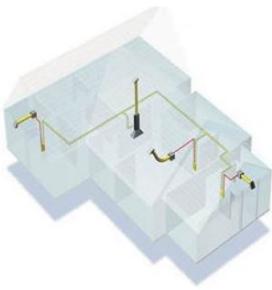
However, for Panasonic North America, the choice of high-efficiency ventilator (<https://na.panasonic.com/us/home-and-building-solutions/ventilation-indoor-air-quality/energy-recovery-ventilators/intelli-balancetm-100-balanced-air-50-100cfm>) is limited and with a relatively low CFM rate at 50 to 100.

[https://www.youtube.com/watch?v=Ra1yP\\_liXdg&feature=emb\\_title](https://www.youtube.com/watch?v=Ra1yP_liXdg&feature=emb_title) ([https://www.youtube.com/watch?v=Ra1yP\\_liXdg&feature=emb\\_title](https://www.youtube.com/watch?v=Ra1yP_liXdg&feature=emb_title))

## Special Designed tools for customer

Another interesting finding for the Broan is that they have provided some inspiring tools for customers to try out and learn more about their needs for ventilation.

- CodeKey Specifier Tool (<https://tools.broan-nutone.com/whms>)
- Range Hood Make-Up Air Damper Specifier (<http://tools.broan.com/muatemplate.aspx>)
- Allowable Duct Length Calculator (<https://tools.broan-nutone.com/duct-length/>)
- Attic Ventilation Estimating Tool (<https://tools.broan-nutone.com/attic-vents/>)



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#### CodeKey Specifier Tool

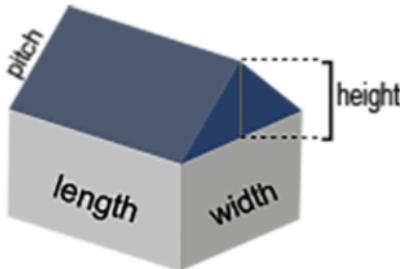
With our CodeKey Specifier you can select and specify products in accordance with the latest codes and regulations. Use this tool to make your specification job easier.

#### Range Hood Make-Up Air Damper Specifier

With our Make-Up Air Specifier tool you can specify equipment designed to provide for the home's Make-Up air needs and designed to be compliant with the latest codes and regulations. Use this tool to make your specification job easier. As a rule of thumb most codes require make-up air at 400 CFM of range hood exhaust (HVI rating at 0.1" static pressure).

#### Allowable Duct Length Calculator

This easy-to-use, flexible tool calculates maximum allowable duct length to hit a given delivered cfm airflow level based on basic inputs: CFM required, fan model, duct diameter, duct type (flex or rigid) and number of elbows.



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#### Attic Ventilation Estimating Tool

Use this tool to estimate the ventilation needs for your attic and get a list of Broan attic ventilation product that will meet your needs.

Reference:<https://www.broan-nutone.com/en-us> (<https://www.broan-nutone.com/en-us>)

## AirKing



Here is an overview of the product lines Airking actively promoted.

- Exhaust fans
  - ENERGY STAR® Exhaust Fans
  - ENERGY STAR® Exhaust Fans with Light
  - Exhaust Fans
  - Exhaust Fans with Light
  - Combination Heaters
  - Exhaust Fan Accessories
- Fresh air

- Range hoods
  - ENERGY STAR® Certified Range Hoods
  - Liners and Power Packs
  - Under Cabinet Range Hoods
  - Range Hood Accessories
- Air circulating fans
  - Industrial Grade Fans
  - Commercial Grade Fans
- Other product
  - **Furnace Mounted Humidifiers**



(<https://www.airkinglimited.com>)

## Heating, Ventilation and Air Conditioning (HVAC)

### Exhaust Fan

Most of the exhaust fans from Air king are equipped with 6" round duct and can be customized with motion humditiy sensor. Some of the products satisfied the ASHRAE 62.2 & CALGreen (<https://www.airkinglimited.com/product-category/ashrae-62-2-compliant-products/>).

What's more, Air king offers decorative lights that can be equipped somewhere other than the bathroom.



(<https://www.airkinglimited.com>)

### Range Hoods

Mainly, Airking has two major categories for range hoods

- Under cabinet range hood solutions
- Liners and power packs

The big selling point is that both types have been nominated by ENERGY STAR® Certified.

		
<a href="#">ENERGY STAR® Certified Essence™ Range Hoods</a>	<a href="#">ENERGY STAR® Certified ASHRAE 62.2 Variable Speed Deluxe Quiet Range Hoods</a>	<a href="#">ENERGY STAR® Certified Deluxe Quiet Range Hoods (including ADA compliant models)</a>
		
<a href="#">ENERGY STAR® Certified Quiet Range Hoods (including ADA compliant models)</a>	<a href="#">ENERGY STAR® Certified Power Packs</a>	<a href="#">ENERGY STAR® Certified ASHRAE 62.2 Power Packs</a>

(<https://www.airkinglimited.com/product-category/energy-star-range-hood/>)

## Fresh Air

The Air King AKEV160 Energy Recovery Ventilator (ERV) (<https://www.airkinglimited.com/product/energy-recovery-ventilator-copy/>)//Heat Recovery Ventilator (HRV) (<https://www.airkinglimited.com/product/heat-recovery-ventilator/>) are advertised as the lightest units in the Energy Recovery Ventilator market with only 30 pounds of weight.The following features are included:

- Durable white enamel finish
- Easy access to interior of unit through the latched door
- Includes removable and cleanable polyester air filters – option MERV filters can be purchased separately for additional air quality and air filtration
- Removable and cleanable fiber media core(ERV)/Removable and cleanable polypropylene cross-flow heat exchange core(HRV)
- Two energy efficient, permanently lubricated motors with a self resetting fuse
- Optional drain connection can be added for areas where condensation might be a consideration
- Safety switch shuts the unit off when the door is open
- Test ports on the front cover allow airflow verification without having to remove ducting

Note: The air exchanger can be installed as a fully ducted system, Extended exhaust system, or as a simplified system for continuous or intermittent ventilation.

Customer could choose the Supply air without the connection to HVAC system

- QFAM Fresh Air Machine (<https://www.airkinglimited.com/product/qfam-fresh-air-machine/>)
- FAS Fresh Air Supply (<https://www.airkinglimited.com/product/fas-fresh-air-supply/>)
- MQFAM Fresh Air Machine (<https://www.airkinglimited.com/product/mqfam-fresh-air-machine/>)

- MFAS Fresh Air Supply (<https://www.airkinglimited.com/product/mfas-fresh-air-supply/>)

## Heating Fans

Air King combination heater exhaust fans target for bathrooms needing supplemental heat and ventilation but with limited choices.



Bulb Heater with Exhaust



Ceramic Combination Heater



Deluxe Combination Heater

(<https://www.airkinglimited.com/product-category/combo-heater/>)

## HEPA filters

AirKing has listed several MERV air filters on their website. Those can be easily added to the QFAM, FAS, MQFAM or MFAS units to filter out unwanted pollutants from entering the dwelling and the model MERV16(QFAMD) is unique among those from other competitors.

Models	AF8102-2	AF13102-2	AF16102-2	AF882-2	AF1382-2
Specification Sheet Download	AF8102-2	AF13102-2	AF16102-2	AF882-2	AF1382-2
Filter Rating	MERV 8	MERV 13	MERV 16	MERV 8	MERV 13
Construction	Cardboard Frame				
Use With	QFAM, FAS	QFAM, FAS	QFAM, FAS	MQFAM, MFAS	MQFAM, MFAS
Mounting	Slides into holder in Fresh Air Unit				

(<https://www.airkinglimited.com/product/fresh-air-filters/>)

## Furnace Mounted Humidifiers

Air King's Furnace Mounted Humidifiers maximize the comfort level by maintaining the proper humidification and improving the Indoor Air Quality.

The products enable the whole house humidification but cannot be remotely controlled.

[https://www.youtube.com/watch?v=LUDwBlwP-i4&feature=emb\\_logo&ab\\_channel=AirKingVentilation](https://www.youtube.com/watch?v=LUDwBlwP-i4&feature=emb_logo&ab_channel=AirKingVentilation) ([https://www.youtube.com/watch?v=LUDwBlwP-i4&feature=emb\\_logo&ab\\_channel=AirKingVentilation](https://www.youtube.com/watch?v=LUDwBlwP-i4&feature=emb_logo&ab_channel=AirKingVentilation))

# Global/Multifamily Housing Market Competitors

## Delta Breeze



(<https://www.deltabreez.com/>)

Here is an overview of Delta's product lines.

- Bath & Exhaust Ventilation Fans

- Bluetooth Fans
- Fans w/ Lights
- Fans w/ Heaters
- Humidity & Motion Sensing Fans
- High Capacity Fans

Delta promotes mostly bathroom ventilation. Its lack of HEPA product choices and control panel is less attractive compared to Broan. However, their products highlight the demands for ASHRAE 62.2 & ENERGY STAR® Most Efficient 2021 (<https://www.deltabreez.com/energyefficient.php>) and focusing on the low-rise multifamily and single housing.

### Heating, Ventilation and Air Conditioning (HVAC)

<b>BreezSlim</b>	<b>BreezIntegrity</b>	<b>BreezGreenBuilder</b>	<b>BreezElite</b>
			
<b>BreezSignature</b>	<b>BreezSmart</b>	<b>BreezRecessed</b>	<b>BreezRadiance</b>
			
<b>BreezProfessional</b>	<b>BreezWall</b> (Disponibles Solo En México)		
			

(<https://www.deltabreez.com/>)

### High-Tier Solutions

High-Tier Solutions (<https://www.deltabreez.com/ASHRAEHightTier.php>) have targeted housing from less than 1500 up to 6000 square feet(140-560 square meter).

- Breez Smart: Engineered to run continuously for a minimum 70,000 hours. Motion-sensing, humidity-sensing, and dual-speed options available with user-adjustable continuous low speed.
- Breez Signature: Adding innovative brushless DC motor design to *Breeze Elite* with indicator light to show fan is on.

### BreezSmart Single Speed or Dual Speed Exhaust Fans

130 CFM Single Speed / **SMT130**150 CFM Single Speed / **SMT150**150 CFM Dual Speed / **SMT150D**

(<https://www.deltabreez.com/breezsmart.php>)

### Signature Bath Fans with Dual Speed

80 CFM Dual Speed  
**SIG80D**80-110 CFM Dual Speed (6" duct)  
**SIG80-110D**110 CFM Dual Speed /  
**SIG110D (Discontinued)**

(<https://www.deltabreez.com/signature.php>)

### Competitive Solutions

Competitive Solutions (<https://www.deltabreez.com/ASHRAECompetitive.php>)

- Breeze Slim: Super low profile & Super low energy consumption.
- Breez GreenBuilder: Built-in lighting with humidity sensor or motion sensor in a power efficient, quiet system
- Breez Signature: Adding innovative brushless DC motor design to *Breeze Elite* with indicator light to show fan is on.

50 CFM Single Speed / **SLM50**70 CFM Single Speed / **SLM70**70 CFM with Dual Speed  
**SLM70D**70 CFM w/Humidity Sensor  
**SLM70H**

(<https://www.deltabreez.com/slim.php>)

50 CFM Single Speed / GBR50  
(Discontinued)

80 CFM Single Speed / GBR80

80-110 CFM Single Speed (6" duct)  
SIG80-110110 CFM Single Speed  
SIG110

(<https://www.deltabreez.com/greenbuilder.php>)

(<https://www.deltabreez.com/signature.php>)

## Other Solutions

Other than the most popular lines such as Breez Slim/GreenBuilder, there are versatile alternative products could be compared at Delta (<https://www.deltabreez.com/ChooseAFan.php>).

## Which Fan Is Most Suitable To Your Needs?

### Bath Fan Buying Guide

[Hide Search Filters](#)

Mounting location	Housing Size	AIRFLOW	Sound Level (Sones)	Features
<input type="radio"/> Ceiling	<input type="radio"/> 7-1/2 x 7-1/4	<input type="radio"/> 50	<input type="radio"/> Virtually Silent (< 0.3 Sones)	<input type="checkbox"/> Single speed
<input type="radio"/> Wall	<input type="radio"/> 8-1/4 x 8	<input type="radio"/> 70	<input type="radio"/> Extremely Quiet (0.3~0.5 Sones)	<input type="checkbox"/> Dual speed
<b>Room size</b>	<input type="radio"/> 9-5/8 x 9-5/8	<input type="radio"/> 80	<input type="radio"/> Very Quiet (0.6~ 1.0 Sones)	<input type="checkbox"/> LED Light
<input type="radio"/> Small (up to 70 sq. ft.)	<input type="radio"/> 11-3/8 x 10-1/2	<input type="radio"/> 80-110	<input type="radio"/> Quiet (1~2 Sones)	<input type="checkbox"/> LED Dimmable Light
<input type="radio"/> Medium (80 sq. ft.)	<input type="radio"/> 11-1/4 x 10-1/2	<input type="radio"/> 100	<input type="radio"/> 2.5 Sones or more	<input type="checkbox"/> CFL Light
<input type="radio"/> Large (100-110 sq. ft.)	<input type="radio"/> 12-3/4 x 8-1/4	<input type="radio"/> 110		<input type="checkbox"/> Night Light
<input type="radio"/> Extra Large(over 110 sq. ft.)	<input type="radio"/> 12-1/4 x 12-1/4	<input type="radio"/> 120		<input type="checkbox"/> Humidity Sensing
<b>ENERGY STAR®</b>	<input type="radio"/> 14-3/8 x 8-1/4	<input type="radio"/> 130		<input type="checkbox"/> Motion Sensing
<input type="radio"/> ENERGY STAR®- Qualified	<input type="radio"/> 15-1/4 x 9-1/2	<input type="radio"/> 150		<input type="checkbox"/> Adjustable Color Temperature
<input type="radio"/> ENERGY STAR®- Most Efficient		<input type="radio"/> 200		<input type="checkbox"/> Decorative
		<input type="radio"/> 300		<input type="checkbox"/> Bluetooth Speaker
				<input type="checkbox"/> Heater

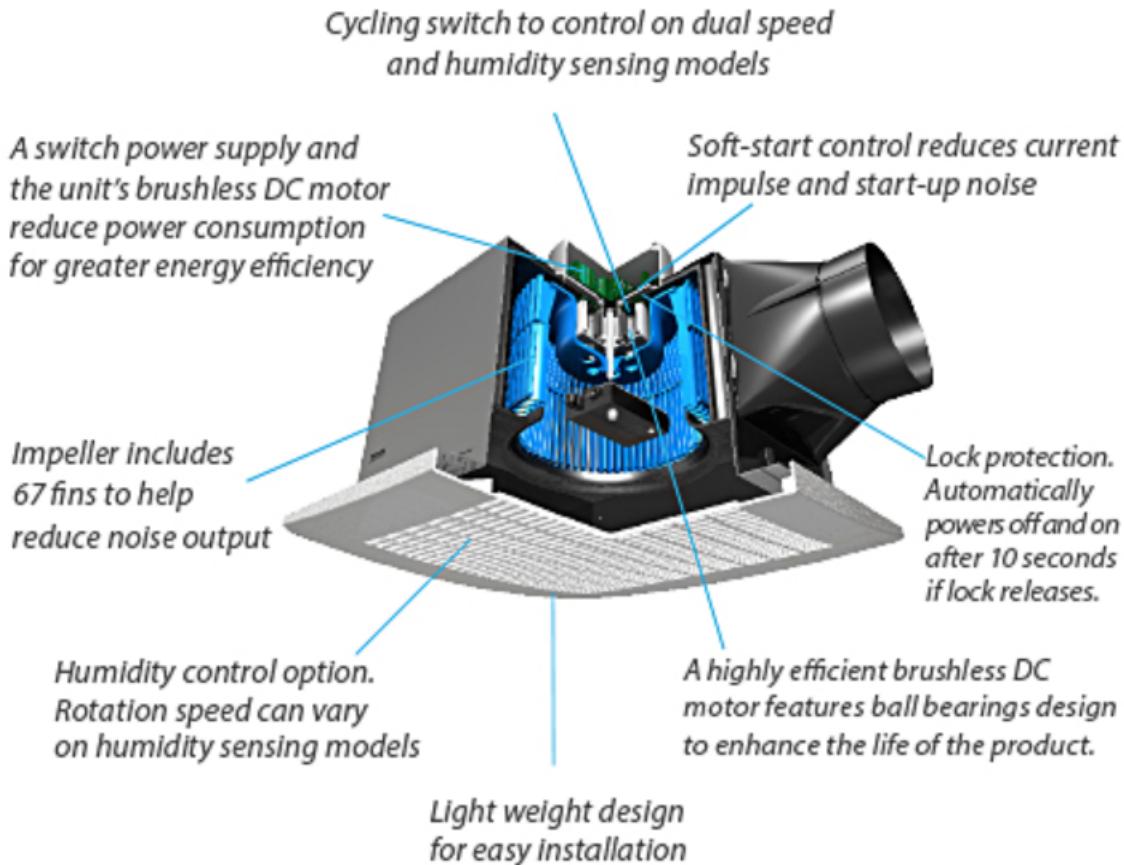
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There are considerable amount products have been implemented with humidity and motion modules and the product flexibility could be considered as an advantage.

- Breeze integrity: Enables to enjoy music or real-time news, compatible with LED light
- Breeze Elite: Bath fans with single/dual speed, humidity sensor or motion sensor
- Breez Recessed: Brushless DC motor lasts 70,000 hours for extended reliability.
- Breez Radiance: Energy saving heater module equipped with thermal cut off fuse with built-in thermostat for consistent temperature.
- Breez Professional: Powerful airflow extraction for heavier applications but with quiet operation, featuring 6" diameter metal duct adapter while normal one is 4".
- Breez Wall(Mexico only): Low noise, low power consumption with two models on market,CFM56/165

## DC Motor Technology

## High Efficiency Brushless DC Motor



(<https://www.deltabreez.com/dcmotor-tech.php>)

- Reliability
  - Delta's brushless DC motor fans are engineered to outlast popular AC motor models by as much as 70 percent, reducing the need for replacement.
- Less noise
  - Delta's brushless DC motor fans are precision engineered for low sound, down to less than 0.3 Sones, the lowest sound rating of any exhaust fan.
- Less power consumption
  - Delta's brushless DC motor fans use up to 74% less power than popular AC motor exhaust fans.
- Efficiency
  - Delta brushless DC motor fans are among the most efficient ventilation fans available, exceeding ENERGY STAR requirements for efficiency by as much as 367%.

**Note: All Delta Breez ventilation fans are precision engineered to run continuously for a minimum 70,000 hours.**

Reference:<https://www.deltabreez.com/index.php> (<https://www.deltabreez.com/index.php>)

# Final report

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**The global heating, ventilation, and air conditioning (HVAC) market is projected to reach about 367.5 billion U.S. dollars by 2030, based on a compound annual growth rate (CAGR) of 3.9 percent between 2020 and 2030 (<https://www.statista.com/statistics/414960/global-market-for-commercial-and-residential-hvac-systems/>)**

## 3 Panasonic ventilation system

- Positive pressure fresh air system with dehumidification: The filtered air (mainly to filter PM2.5) is sent into the room through a fan, and a positive pressure is formed in the room, and the turbid indoor air is discharged to the outside. This air supply method can ensure that the filtered air is sent into the room and ensure the cleanliness of the air. However, this air supply method cannot form a directional airflow, which takes a long time to completely replace it, and the direction of indoor air circulation is also more complicated, so this fresh air method has a poor replacement of indoor air. At the same time, water vapor is extracted preventing the formation of mold and harmful gases.
- Negative pressure fresh air system: The turbid air in the room is drawn out by a fan, and negative pressure is formed in the room. The feature of this system is that it can form a clear and clean directional airflow and effectively replace indoor and outdoor air. The disadvantage is that the negative pressure fresh air system has poor air filtration performance. Also, the indoor temperature will inevitably be lost.
- Balanced Ventilation is overall the best ventilation strategy any residential or commercial environment can have. The ideal process for this occurs with an ERV or HRV. This method allows for heat exchange without air exchange. The conclusion is that energy is saved by the transfer of heat or cooling; at the same time, providing fresh air while exhausting stale air. This method is becoming more popular as homes achieve air tightness.

## Main findings for ASHRAE Standard 62.2

### Positive pressure fresh air system

Classrooms/dormitories with uncomplicated structure and moderate size-choose the positive pressure type. The positive pressure type can fully filter the air and send it into the room, but on the one hand, it lacks heat exchange function, which is easy to cause temperature loss. On the other hand, it lacks pipe guidance. The air circulation efficiency and effect are reduced compared to the two-way heat exchange type. The advantage is that it is easy to install and has a low impact on the indoor space.

### Full heat exchanger

The Multifamily structure is relatively complex, with a medium or large area and a moderate floor height—choose the two-way flow heat exchange type. In fact, basically any building, except for the old houses with very low floors, I recommend the two-way flow heat exchange type. It balances many elements of filtration + heat retention + indoor purification efficiency, which can be described as the most scientific principle of fresh air system. The total heat exchange type performs temperature and humidity exchange without generating condensed water, and now there are antibacterial heat exchange cores available, so heat exchange is completely reliable. But the trouble is that laying pipes is more laborious, so newly decorated houses are more suitable for two-way flow heat exchange

### Stimulus for renovation

The renovated hotel is the target for the wall-mounted products. Although annual growth at 1.4% for hotels is hit hard by pandemic, the overall market should focus on the rebuild and upgrades. We acknowledge that the renovated hotel is not suitable nor easy to install pipes or install top-mounted machines. No matter the positive pressure type or the two-way flow heat exchange type, the installation is extremely difficult, and the wall-mounted type is built for this type of renovation.

## Main findings for ASHRAE Standard 170

### Functionality for condensed space

In the expanded market research, the absent commercial markets are identified including major recreational facilities., working offices, and study areas. Based on the research results, a negative pressure ventilation system is the most efficient and economical solution for the prevention of transmitting the air-borne virus in small and dense spaces. No matter the positive pressure type or the negative pressure type, either choice would be suitable depending on the expert's suggestion.

With the most concerned, Eldercare, daycare center and the hospital would the projects in urgent need of renovation with priorities, meanwhile those facilities need to be functioning continuously. Most of the facilities have complied with standard ASHRAE 170-2013/2017.

With average market growth rate for care centers around 2.4-2.9% CAGR and for hospital 5.376% CAGR. It would be critical to developing the outreach for care centers whose growth rates are below the global average.

In conclusion, I suggest the add-on unit would be a considerable solution to provide next-level clean air solution, such as **wall-mounted ventilators with HEPA**. In addition, customer should be aware that the air outlet should be designed upward otherwise may cause dust problem for sensitive patients

## Negative Pressure Ventilation and possible suggestion

