playbook

Better Ventilation

Solutions for multifamily buildings

Improve indoor air quality, enhance resident health and comfort, and save energy by balancing and maintaining your ventilation system.

be ex
building energy exchange

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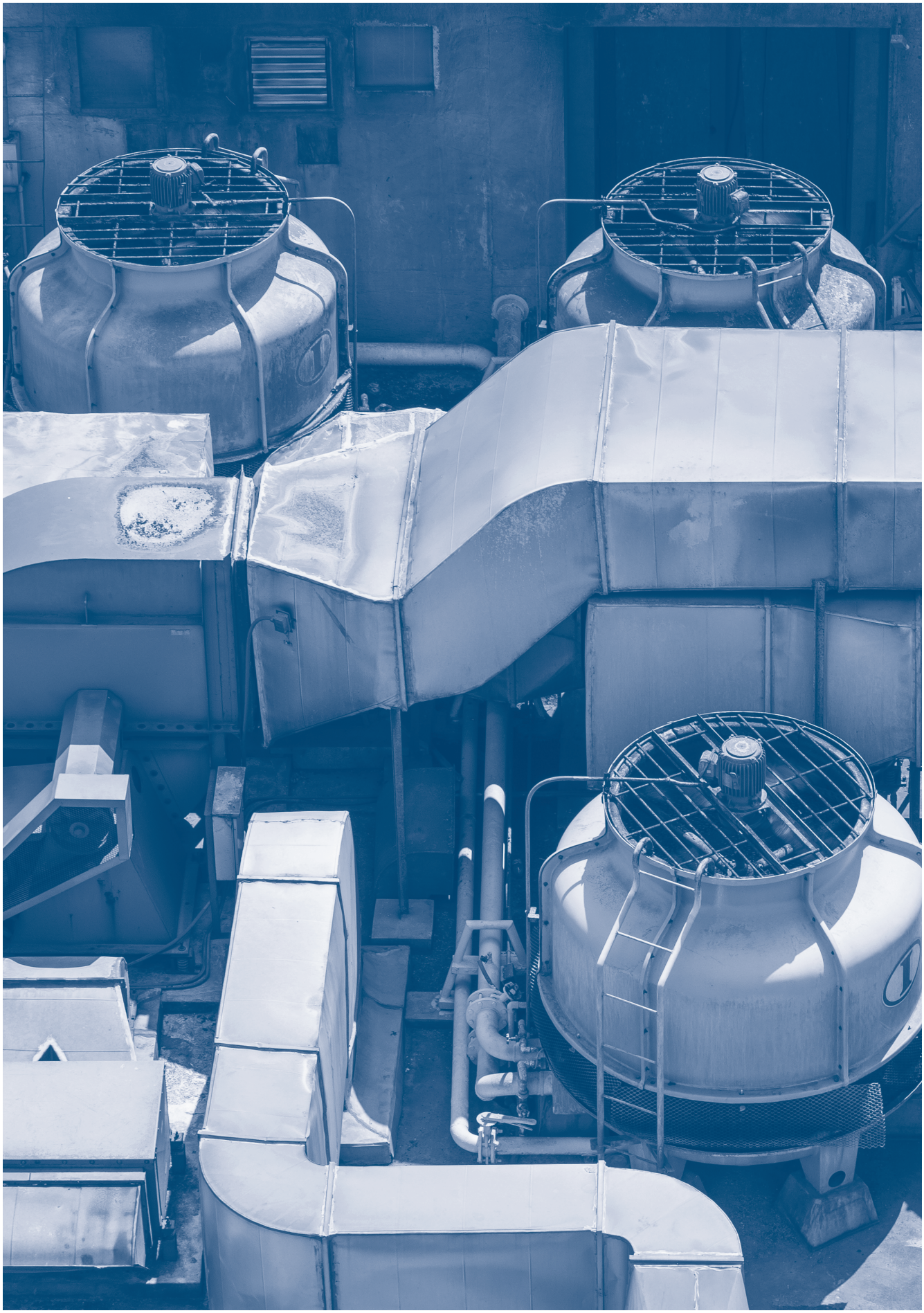
NOV 2020



breathe easier with better ventilation

A well-maintained ventilation system ensures that pollutants, odors, and moisture are removed from your building and replaced with a steady supply of fresh, outdoor air. Although many NYC buildings lack adequate ventilation, simple solutions are available.

Why Ventilation Matters

To keep our living spaces safe and healthy, the City of New York sets minimum ventilation requirements for all buildings.[1] Ventilation is needed to remove pollutants and moisture from apartments — especially from kitchens and bathrooms — and to provide occupants with fresh, clean air.[1] Proper ventilation improves indoor air quality, enhances comfort, and helps prevent mold growth, which improves the durability of building components and reduces the risk of respiratory illnesses, like asthma.

Unfortunately, many NYC buildings fall short of delivering these benefits. Inspections find ventilation problems in well over 50% of inspected buildings.[2] Many of these buildings are under-ventilated and suffer from stale, stuffy, or humid air. Others are drastically imbalanced, with some parts of the building receiving little to no airflow, while other parts experience over-ventilation, uncomfortable drafts, and whistling winds.

Ventilation is a holistic, whole-building system, which means that failure of one component — such as a broken fan or clogged bathroom vent — can affect proper functioning across the entire system.

Common Ventilation System Problems

Inspections often uncover the following issues:

- **Fans** are broken, switched off, or not tuned to the proper speed settings.
- **Ducts** are dirty, clogged, damaged, or leak air. Gaps along ductwork cause air to be pulled from random parts of the building, rather than from kitchens, baths, and cooridors as needed. Air leakage leads to energy loss, airflow imbalances, and can cause odors and contaminants to be pulled into apartments, raising air quality concerns.
- **Vents (registers)** are leaky, clogged, poorly tuned, or blocked by furnishings (often done intentionally by occupants to keep out drafts).
- **Air pressure** fluctuates with changes in wind, weather, and season. These fluctuations exacerbate existing system imbalances, particularly in leaky buildings and high-rises.

Fortunately, there are proven solutions to resolve these problems, improve air quality, and reduce tenant complaints of drafts, humidity, and odors. Over-ventilated buildings may also be able to save energy and money by decreasing fan use and reducing leakage of heated and cooled air.

Seal it Tight, Vent it Right

Ventilation is a holistic system that interacts with all parts of your building. Many New York City buildings have gaps and cracks in the building exterior that allow air to creep in and out. These air leaks not only cause uncomfortable drafts and waste money on heating and cooling, but also make it difficult to control ventilation system performance.

By air-sealing leaks in exterior walls, you can keep out drafts and reduce the impact that changing winds and weather have on ventilation system balance. Sealing leaks between apartments, also known as *compartmentalization*, will further improve ventilation system reliability and prevent the transfer of smoke, odors, and other contaminants between units.

To get the most out of any ventilation system upgrade, be sure to air-seal leaks in these common locations:

- **Apartments:** Remove window air conditioning units when not in use, or cover and seal around each unit. Weather-strip and seal around exterior windows and doors.
- **Common Areas:** Weather-strip and seal around doors, windows, and walls. Pay attention to penetrations made by pipes, vents, and wires, and to areas like maintenance rooms, trash chutes, basements, and roof cavities.
- **Going Farther:** Address vents at the top of stair and elevator shafts, which cause major air leakage. Changes to NYC code now allow these vents to be partially or fully covered.[3]

These air-sealing measures will improve ventilation system performance and can save up to 15% a year on heating costs.[4] Visit nyc.gov/accelerator to learn more.

getting to know your ventilation system

Most buildings have mechanical ventilation systems that use fans to pull stale air out or blow fresh air in via ductwork and vents located in apartments and common areas. Some buildings rely on windows and other natural ventilation strategies instead.

Common Ventilation System Types

Most large multifamily buildings in New York City have centralized, exhaust-based ventilation systems. Old, pre-war buildings often have no mechanical systems at all. Some newer buildings have balanced systems that pair exhaust with an equal amount of fresh, filtered supply air.

1 **No Mechanical Ventilation**: Many NYC buildings built prior to the 1940s have no mechanical ventilation systems at all. Instead, they rely on air to filter in and out through windows and cracks in the building's exterior.

This is not an effective ventilation strategy and is not permitted for new construction or major renovations under current code. It also has negative impacts on indoor air quality and health, as the uncontrolled flow of air pulls in outdoor allergens, pollutants, and dust, as well as smoke, odors, and moisture from neighboring units.

2 **Exhaust-Only Ventilation:** The majority of NYC apartments have *central exhaust systems*, which are typically found in mid- to high-rise buildings built after 1950.[5] Central exhaust systems work by pulling stale air out through exhaust registers in each apartment, up common ductwork, and out through one or more large fans on the roof. Exhaust registers are typically located in kitchens and bathrooms, and sometimes in common areas and corridors. Some rooms with operable windows may not have any registers.

Exhaust-only ventilation is not ideal and is prone to problems with pressure imbalance, as well as indoor air quality issues related to the uncontrolled infilatration of outdoor air.

3 **Balanced Ventilation:** Some newer buildings have balanced systems that provide both exhaust- and supply-side ventilation. This is the best option for introducing fresh outdoor air to spaces while maintaining controlled and consistent airflow across the building. Balanced systems can be *centralized* or *unitized* in design.

3a **Balanced — Centralized Systems**: Fresh outdoor air is blown in by a central fan, *dedicated outdoor air system (DOAS),* or *energy recovery ventilator (ERV)*, typically located on the roof, and supplied to registers in common areas, corridors, and living spaces. DOAS and ERVs filter incoming air to remove allergens and pollutants.

3b **Balanced — Unitized Systems:** Each apartment has its own exhaust and supply air unit connected to the outside directly or via a dedicated duct run. These systems are most common in low-rise and recently constructed high-rise buildings. Unitized systems perform best when each apartment is airtight or *compartmentalized* from its neighbors.

Some buildings take a *semi-decentralized* approach, in which supply and exhaust are delivered on a floor-by-floor or zone-by-zone basis, rather than by individual apartment.

Natural Ventilation

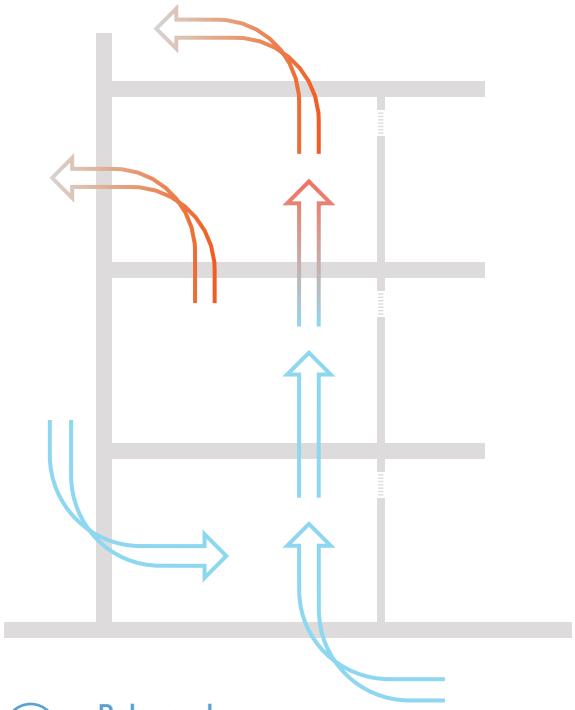
This playbook focuses on strategies for improving mechanical ventilation systems. However, some buildings use natural or ***passive*** ventilation strategies, which rely on deliberate openings in walls and the roof—such as windows, low-volume trickle vents, louvers, and wind towers—to introduce outdoor air and circulate it through the building. Others employ a ***hybrid or mixed-mode*** approach that combines natural and mechancial ventilation methods. Hybrid systems often incorporate building management system (BMS) controls to automate and monitor ventilation equipment.

Natural and hybrid ventilation use less energy and have smaller carbon footprints than fully mechanical systems. However, if these systems are not carefully designed and commissioned, they may provide less control over airflow, making it difficult to meet code-required ventilation rates. For this reason, 100% natural ventilation is no longer permitted for new residential construction projects.

Natural ventilation strategies should be carefully considered within the context of each specific building and its environs. Consult a qualified service professional to determine which style of ventilation is appropriate for your building type, use, occupancy class, and project goals.

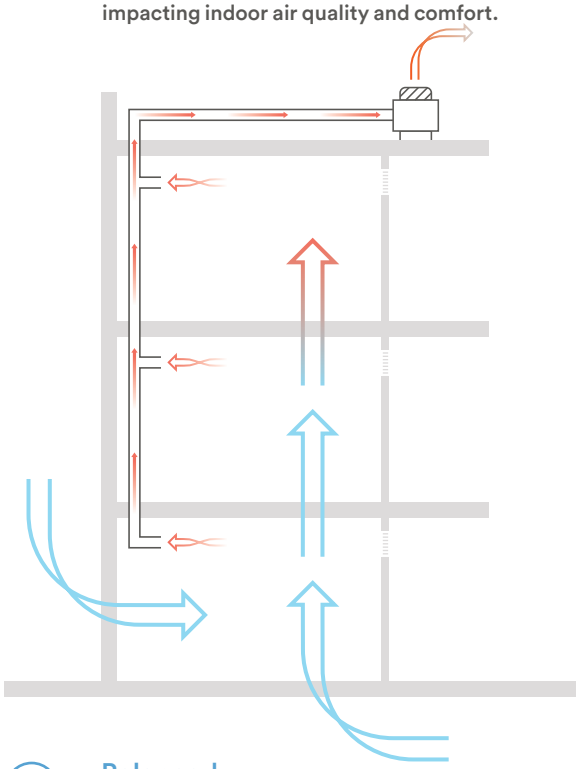
1 No Mechanical Ventilation

Supply and exhaust air are completely uncontrolled, infiltrating and exfiltrating the building through cracks in the roof and walls. Air is also pulled through neighboring units and floors as it heats and rises, carrying odors, moisture, and dust along with it.



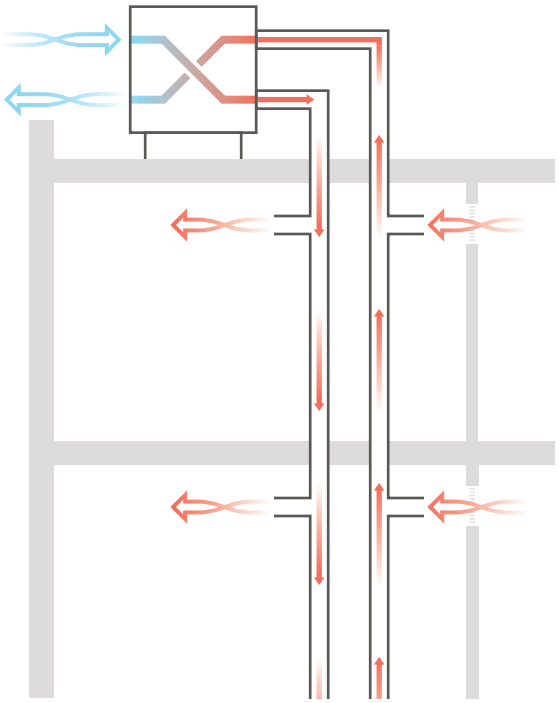
2 Exhaust-Only Ventilation

Exhaust air is controlled by kitchen and bathroom exhaust registers and pulled out via one or more roof fans. Supply air remains uncontrolled and is driven by infiltration through cracks in the building exterior, negatively impacting indoor air quality and comfort.



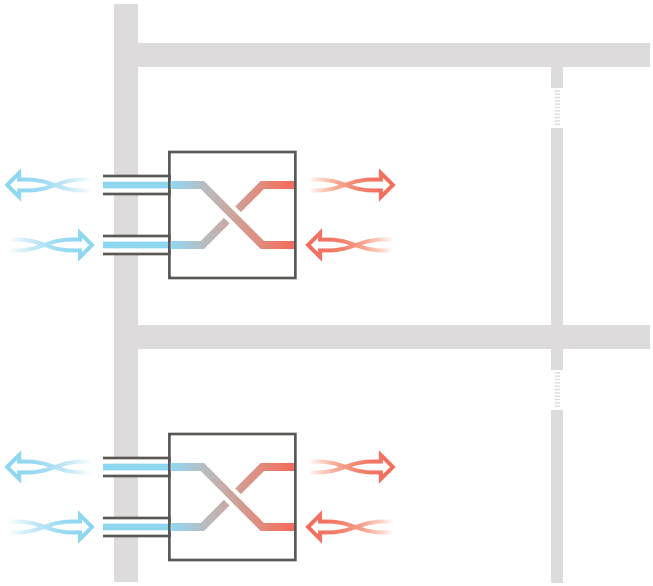
3a Balanced: Centralized Ventilation

Incoming and outgoing airstreams are carefully controlled, keeping pressure balanced across the building and ensuring excellent indoor air quality. Centralized systems serve the entire building, with mechanical units typically located on the roof.



3b Balanced: Unitized Ventilation

Decentralized or unitized systems serve specific areas of the building, typically on a floor-by-floor or unit-by-unit basis. Unitized systems offer occupants more direct control over ventilation than centralized systems do, but require the servicing of more mechanical units.



solutions for better ventilation

There are a number of proven practices that can enhance the performance of your ventilation system. These range from basic maintenance measures to comprehensive system upgrades.

Below are three recommended scopes of work to increasingly improve ventilation system performance:

A Perform Basic Maintenance (Good)
B Improve Exhaust (Better)
C Provide Balanced Ventilation (Better Yet)

Before undertaking any work, consult a qualified service provider to determine the appropriate measures for your building.The NYC Accelerator, a free program provided by the City of New York, can provide assistance. (See *Resources* for more.)

A Perform Basic Maintenance (Good)

At a minimum, perform the following:

1. **Clean:** Clean ductwork and exhaust registers, which can become clogged with dirt and grease over time. Registers should be checked for blockages once a year and cleaned as necessary. Ducts should be cleaned every three to five years.[6]

Clean or replace air filters as often as recommended by the manufacturer, which can range from monthly to a few times each year.

2. **Tune:** Check airflow rates at kitchen and bath exhaust registers and adjust as needed to meet ventilation requirements.[7] Inspect fans, tighten or replace loose and broken fan belts, and calibrate speed and pressure settings. NYC law requires fan retrocommisioning once every ten years.[8]

B Improve Exhaust (Better)

For more substantial improvements, complete a comprehensive scope of work that addresses all parts of your ventilation system. Many of the measures under this scope can be scheduled for completion on the same day, thereby reducing labor costs and disruption to occupants:

1. **Clean & Seal:** Clean ducts and registers as described in Scope A. While cleaning, inspect equipment for damage and sources of air leakage.

Air leaks commonly occur at joints along ductwork and at connections between ducts and other building materials, such as sheetrock and plaster. Pay close attention to connections at roof curbs — where ducts meet roof fans — and at exhaust registers. Gaps at these key locations can account for as much as 50% of system leakage.[9]

Gaps can be sealed using a variety of methods, which may be combined to achieve optimal airtightness:

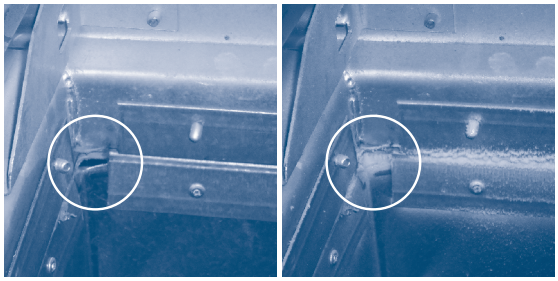
Manual Sealing: Use mineral wool to fill large gaps and use fireblocking foam for holes over 1 inch. Install custom gaskets around registers and roof curbs to ensure airtight connections.

Remote Spray Sealing: Use spray mastic to fill holes smaller than 1 inch. Mastic can be applied remotely by lowering a spray nozzle and video camera assemby down each ventilation shaft.

Ducts become clogged with dirt over time.

Build-up also reduces the efficacy of exhaust fans.

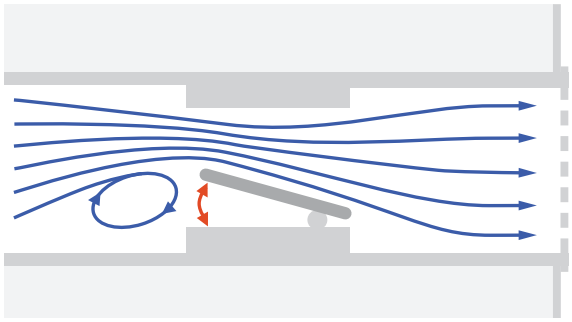
Advanced Spray Sealing: Use a finer spray mastic, such as Aeroseal, to seal holes 1/2 inch and smaller. This step is best implemented after manual and traditional spray sealing. To apply the mastic, a technician will need to temporarily close off all registers, which can be done at the time of cleaning and inspection. During the sealing process, the technician will use monitoring software to verify that target airtightness and ventilation rates are met.



Aeroseal can be used to seal very fine gaps in ductwork.

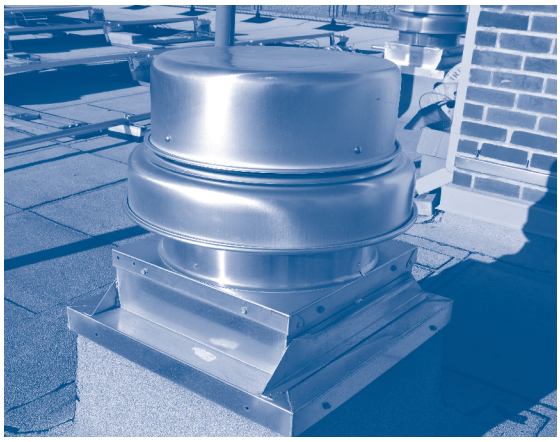
2. Upgrade & Calibrate Equipment:

Install Self-Balancing Registers: Upgrade to new airtight registers that include Constant Airflow Regulators (CARs). CARs are self-balancing dampers that automatically adjust to changing pressure, thereby maintaining consistent ventilation rates across the building. CARs require a minimum system operating pressure to function and work best when implemented with the other measures listed in this scope. Ventilation ducts should be well-sealed and roof fans properly calibrated.[10]



As pressure changes, a Constant Airflow Regulator (CAR) automatically adjusts the airflow to maintain consistent ventilation rates.

Install High-Efficiency Fans: Fans with belt drives are difficult to adjust and maintain. Upgrade to direct-drive fans with adjustable speed controllers or electronically commutated motors (ECMs). These types of fans automatically sense and maintain the proper system operating pressure in each duct. Upgrading fans after completing air-sealing work may also enable you to reduce the size or speed settings of fans to save energy and money.



Direct-drive fans with adjustable speed controllers or ECMs maintain proper system operating pressure.

3. Verify Ventilation Rates: Ensure that your system meets code-required ventilation rates. Remember that ventilation is a holistic system, so adjusting one component can affect all others. It is essential to test and re-balance airflow rates after any work has been completed. Measure the airflow rate at each exhaust fan and at a representative number of registers on top, middle, and bottom floors (approx. 20% of units). Contractors should provide building owners with a final balancing report.

Common Indoor Air Pollutants

Proper ventilation keeps these pollutants in check:

- **Allergens:** Dust, pollen, and other irritants can cause respiratory health problems with extended exposure.
- **Carbon Dioxide (CO2):** An odorless gas produced naturally and by human activity, CO2 is typically not found at harmful levels indoors. However, at high concentrations, CO2 can cause headaches, dizziness, and cognitive impairment.
- **Carbon Monoxide (CO):** An odorless, toxic gas and byproduct of combustion (e.g. from stoves, furnaces, fireplaces, and lighters), CO can cause headaches and fatigue at low levels and prove fatal at high concentrations.
- **Excess Moisture:** Moisture is often overlooked as a pollutant. When moisture accumulates, so too do mold, mildew, and dust mites. High moisture levels can also accelerate off-gasing of VOCs (see below).
- **Radon:** A radioactive gas that occurs naturally in soil, radon becomes a leading cause of lung cancer at high concentrations. It is typically controlled with a ground-level radon barrier and exhaust system.
- **Volatile Organic Compounds (VOCs):** A variety of natural and artificial chemicals found in paint, cleaning products, home furnishings, and even plants and animals. Many VOCs are harmless but some can pose health threats, particularly with long-term exposure.

C Provide Balanced Ventilation (Better Yet)

For building owners interested in achieving even better performance and excellent indoor air quality, upgrade to a balanced, fresh air ventilation system that includes both exhaust- and supply-side ventilation. Adding energy recovery can greatly reduce operating costs and improve thermal comfort. Integrating controls and sensors can further reduce system waste.

1. Introduce Conditioned Supply Air:

Install Ductwork: Install ductwork and registers to introduce outdoor supply air. Supply air should be conditioned to reduce the risk of introducing moisture into the building or freezing pipes.

Some buildings may be able to convert one or more exhaust lines to supply, or repurpose existing service cavities to run ductwork. Be sure to provide supply air to common areas, such as corridors and lobbies, and to all living spaces. To reduce ductwork and the number of supply registers needed, design teams can specify transfer grilles and door undercuts that allow air to pass from one room to another. Consult your design team to determine the best layout for ductwork.

Install Fans: Balanced ventilation systems require the addition of supply fans to blow in fresh outdoor air. This can be done with direct-drive fans, a dedicated outdoor air system (DOAS), or Energy Recovery Ventilation (ERV), which is the most efficient option.

Calibrate Equipment: To maintain balanced ventilation and consistent air pressure throughout the building, the supply airflow should be roughly equal to that of exhaust. Add a 10–15% buffer to the design flowrate to account for some remaining air leakage after sealing and static pressure in the system.

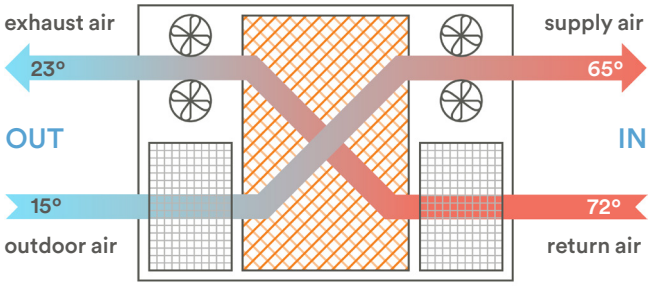
Coordinate Upgrades for Maximum Savings

Adding supply ventilation to existing buildings can be disruptive and costly, but it provides major health and comfort benefits. Consider implementing this scope of work at the time of a major renovation or when refinancing.

As noted, implementing a ventilation retrofit in conjunction with upgrades that reduce air leaks and infiltration can improve the performance of the ventilation system. In addition to air-sealing, consider establishing an even tighter building exterior through window upgrades, insulation improvements, and re-roofing measures.

2. Install Energy Recovery Ventilation (ERV): ERVs are an ultra-efficient option for balanced, fresh air ventilation. ERVs use a heat exchanger to extract heat from outgoing, stale air and pre-temper incoming cool fresh air, or vice versa, depending on the season. This technique conserves energy that is lost with traditional ventilation methods and dramatically reduces heating and cooling loads. ERVs also filter supply air and help regulate humidity, enhancing indoor air quality and comfort.

ERVs are available for both centralized and unitized ventilation systems. Note that any building supplying 100% outdoor air is required to use an ERV by current energy code.[11]



Energy Recovery Ventilator

During winter, heat from exhaust air is transferred to supply air in the ERV's heat recovery core. The system reverses in summer, where heat from the outdoor air is transferred to the exhaust, helping to cool the supply air.

3. Use Demand Controlled Ventilation (DCV): DCV uses occupancy or carbon dioxide sensors, along with motorized dampers and controls, to deliver the right amount of ventilation to a space at the right time. Rather than running the system at full power during times of low to no occupancy, DCV saves energy by modulating fan power down to an appropriate level. DCV is best suited for spaces that require high ventilation rates but have unpredictable occupancy patterns, such as excercise rooms and other amenity spaces.

For a more cost-effective but slightly less efficient alternative to DCV, use scheduling controls to set back ventilation rates during times of known vacancy.

4. Conduct Routine Maintenance: Whatever equipment you install, your ventilation system will require regular maintenance to ensure its efficient operation. This includes regular cleaning and inspection of ductwork and registers, as well as fans and ERV systems. ERVs should typically be inspected every 3 months and air filters replaced regularly to maintain optimal performance. Routinely test and retrocommission flow rates to ensure that the system continues to meet code requirements and perform as designed.

ventilation for healthy buildings

Under typical operating conditions, the high-performance, balanced ventilation measures described under Scope C will yield excellent indoor air quality while maximizing energy savings. During epidemic scenarios, there are additional measures that can help to keep air clean and reduce the risk of virus transmission. While the health and safety of occupants must always come first, bear in mind that these measures typically have a steep penalty in terms of increased energy use and carbon emissions, as well as increased strain on equipment. Consult a qualified service provider to determine the right solutions for your building type and occupancy patterns.

1. Increase Ventilation

Maxmize Outdoor Air: Ventilation is measured by air change rate, or how frequently indoor air is completely replaced by fresh outdoor air. By increasing outdoor air supply to as close to 100% as possible, buildings can dilute and disperse any pathogens present in the air, thereby minimizing the risk of infection.

Run Systems Longer: Ideally, ventilation systems should operate at this high rate continuously, so long as comfortable thermal conditions can be maintained for occupants. However, this may not be possible or appropriate for all buildings. A less energy-intensive alternative is to schedule pre- and post-occupancy flush periods, during which the air change rate is maximized for a just few hours or a few days.

Eliminate Recirculation: Recirculation of indoor air should be eliminated as much as possible to prevent contamination of fresh supply air. This may entail disabling some energy-saving systems, like DCV. Certain types of ERVs may also need to be disabled if they allow leakage between exhaust and supply air. Consult manufacturer specifications and have a service technician check the operation and condition of your ERV system to determine if this is the case. ASHRAE (the American Society of Heating, Refrigerating, and Air-Conditioning Engineers), which sets national standards for ventilation, advises that many ERVs can and should continue operating under pandemic conditions:

"Well-designed and well-maintained air-to-air energy recovery systems should remain operating in residences, commercial buildings and medical facilities... This is because maintaining at least normal outside air ventilation rates, with proper temperature and humidity conditioning of the inside space, is important for maintaining health and combatting infectious aerosols."[12]

2. Increase Filtration

Upgrade Filters: Filters are rated by their ability to block airborne particles, known as their minimum efficiency reporting value (MERV). The higher the MERV rating, the more effectively a filter can remove particles from the air. Most buildings typically use MERV 6 to 8 filters. To help reduce airborne transmission of viruses, upgrade to MERV 13 or 14 filters. Note that these thicker filters will need to be replaced more frequently than standard filters . They may also strain the motors on some fans, so be sure to check fan capacity first.

Evaluate Emerging Technologies: With the spread of COVID-19, new ventilation technologies have emerged in the market. For example, ultraviolet germicidal irradiation (UVGI) has received attention for its potential to disinfect air and reduce virus transmission. However, the use of UVGI in ventilation applications is still relatively new and uncommon. Be sure to carefully research and evaluate any new technologies before moving forward with implementation.

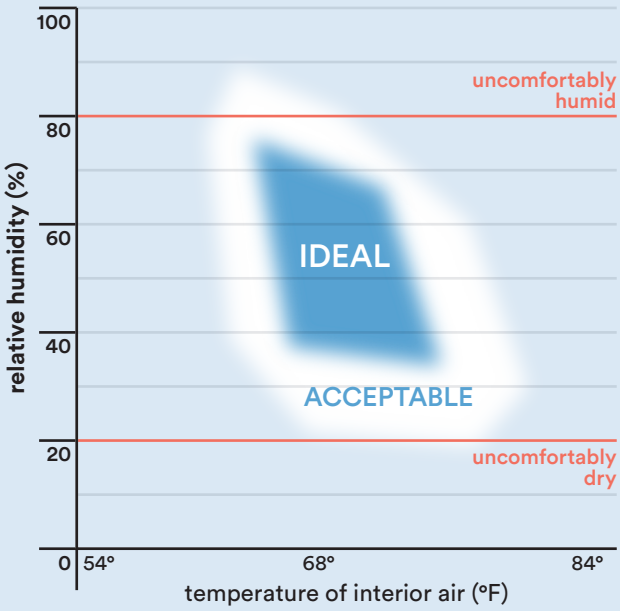
3. Control Humidity

The ideal range for relative humidity in indoor spaces is approximately 40 – 60% This is the range at which human health and comfort are optimized and pathogens are naturally disadvantaged.

When indoor air becomes too dry, however, it can lead to respiratory irritation, exacerbation of skin conditions like eczema, and also increase the risk of virus transmission. Similarly, when the air becomes too humid, it creates conditions for bacteria and viruses to thrive and for mold and dust mites to form, which can trigger allergies and negatively impact respiratory health.

ERV systems help to moderate humidity levels as a normal part of their operation. Some buildings may want to explore other system options, such as installing steam or direct expansion (Dx) coils, however, these measures do carry significant financial costs and increase carbon intensity.

Occupant Comfort and Relative Humidity



resources

Assistance is available to help guide you through the entire process of tuning and upgrading your building's ventilation system. You may also qualify for financing and incentives to help reduce the cost of improvements. NYC Accelerator, a program of the NYC Mayor's Office of Sustainability, is a great resource to help you get started.

NYC Accelerator

NYC Accelerator offers free advisory services to streamline the process of making your building energy efficient. NYC Accelerator works with thousands of buildings across the five boroughs to build a cleaner future by lowering pollution and carbon emissions. Their team can help you:

- Plan, finance, and complete efficiency projects
- Connect with qualified contractors
- Access incentives to help pay for the cost of work
- Navigate local law requirements
- Find trainings to improve skills for you and your team

To get help call (212) 656-9202 or visit nyc.gov/accelerator.

Education & Training

In addition to the **Building Energy Exchange**, the following organizations provide education and training on a variety of building efficiency topics, including ventilation and air-sealing measures. Courses are available for for building owners, mangers, operators, and staff in New York City:

32BJ Training Fund
The 32BJ Training Fund is a joint labor-management partnership that offers training to eligible participants at no cost. 32BJ provides training on a range of topics.

- training.32bjfunds.com

Association for Energy Affordability (AEA)
AEA is dedicated to achieving energy efficiency in new and existing buildings in order to foster and maintain affordable and healthy housing and communities, especially those of low income. AEA offers training on a range of topics.

- aea.us.org/education

CUNY Building Performance Lab (BPL)
CUNY BPL promotes high-performance building operations for existing commercial and public real estate. BPL offers energy efficiency and building O&M trainings.

- cunybpl.org/training

Solar One
Solar One, New York City's Green Energy Education Center, offers trainings through its Green Workforce Training Program.

- solar1.org

Additional Resources
Relevant trainings may also be available through: Building Performance Institute (BPI); the Green Jobs Training Center; the New York State Energy Research and Development Authority (NYSERDA); the North American Passive House Network (NAPHN); and Urban Green Council (UGC).

Financing & Incentives

Financing and incentives may be available to help cover the costs of ventilation and air sealing improvements:

Community Preservation Corportation (CPC)
CPC is a leading nonprofit affordable housing and community revitalization finance company. CPC offers options for financing energy efficiency upgrades.

- communityp.com

NYC Energy Efficiency Corporation (NYCEEC)
NYCEEC provides loans for energy efficiency and clean energy projects across the Northeast and Mid-Atlantic. NYCEEC also administers NYC's Property Assessed Clean Energy (PACE) program, which offers up to 100% financing with lower interest rates and longer loan terms that standard financing tools.

- nyceec.com

NYS Energy Research & Development Authority (NYSERDA)
NYSERDA has many programs that support energy efficiency in buildings. In addition to rebates, incentives, and technical assistance for efficiency projects, NYSERDA also provides support for a variety of energy efficiency and clean energy training programs.

- nyserda.ny.gov

Utilities
In New York, Con Edison and National Grid provide incentives and rebates for a wide variety of energy efficiency and renewable energy projects. Visit their websites to learn about current offerings.

- coned.com/energyefficiency
- nationalgridus.com/services-rebates

Further Reading

To learn more about the topics covered in this brief, please consult the following publications:

- *Improving Ventilation in Existing or New Buildings with Central Roof Exhaust*. National Center for Healthy Housing. Fall 2009.
- *Improving Ventilation in Existing or New Buildings with Individual Ventilation Systems*. National Center for Healthy Housing. Winter 2009.
- *Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation*. National Center for Healthy Housing. Fall 2009.
- *Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems.* ASHRAE TC 5.5. June 2020.
- *Spending Through the Roof.* Urban Green Council, prepared for NYSERDA. March 2017
- *There are Holes in Our Walls.* Urban Green Council and Steven Winter Associates. April 2011

endnotes

1 In residential spaces, the New York City Mechanical Code requires mechanical ventilation systems to provide an airflow of at least 0.35 ach (based on the total floor area), or 15 cfm per person. Kitchens must meet ventilation rates of 100 cfm (intermittent) or 25 cfm (continuous), and bathrooms must meet 50 cfm (intermittent) or 20 cfm (continuous). Spaces that are unheated or not continually occupied or are exempt. Refer to ASHRAE Standards 62.1 & 62.2-2019 for additional guidance on determining ventilation flow rates.

2 Source: NYC Local Law 87 energy audit data

3 Per 2014 updates to the NYC Building Code

4 Source: *NYC Accelerator, Keep Out the Cold campaign*, NYC Mayor's Office of Sustainability

5 While precise numbers are not available, the engineering firm Bright Power estimates that roughly 90% of NYC multifamily buildings in NYC have central exhaust ventilation.

6 Source: National Duct Cleaners Association

7 See endnote 1 for guidance on ventilation requirements.

8 Buildings over 25,000 square feet are subject to NYC Local Law 87, which requires an energy audit and retro-commissioning of major equipment, including ventilation fans, once every ten years.

9 Source: *Improving Ventilation in Existing or New Buildings with Central Roof Exhaust*. National Center for Healthy Housing. Fall 2009, p 3.

10 CAR dampers need a minimum duct operating pressure of 0.2 inches water gauge to operate properly. This requires tight ducts and roof fans capable of providing sufficiently high pressure.

11 Per ASHRAE Standard 90.1-2016

12 Source: *Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems.* ASHRAE TC 5.5. June 2020.

about this report

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Building Energy Exchange

The NYC Accelerator offers free, personalized advisory services to streamline the process of making energy efficiency improvements to your building that will reduce operating costs, enhance tenant comfort, and improve our environment.

web: nyc.gov/accelerator

The **Building Energy Exchange** connects the New York real estate communities to **energy** and lighting **efficiency** solutions through exhibitions, **education**, technology demonstrations, and research. We identify opportunities, navigate barriers to adoption, broker relationships, and showcase best practices at our resource center in the Surrogate's Courthouse.

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