

tech overview

- applicable building types
 - commercial
- implementation
 - anytime, at mid-cycle or refinance
- fast facts
 - reduces GHG emissions
 - improves air quality
 - reduces heating and cooling loads
 - reduces maintenance costs
 - reduces utility costs

tech primer

Dedicated Outdoor Air Systems (DOAS) and Energy Recovery Ventilators (ERV)

Controlled ventilation for enhanced comfort and savings.



New York Botanical Garden, Marlon Co., Photography

cost & benefits

- GHG savings**
 - 🌿 🌿 🌿 🌿
- Tenant Experience Improvements**
 - ★ ★ ★ ★
- Utility Savings**
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- Capital Costs**
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- Maintenance Requirements**
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*ratings are based on system end use, see back cover for details.

Getting to know DOAS and ERV systems

Dedicated Outdoor Air Systems (DOAS) and Energy Recovery Ventilators (ERVs) provide controlled and conditioned ventilation that improves indoor air quality and occupant health, while reducing greenhouse gas emissions and saving energy.

How do DOAS and ERVs work?

All commercial buildings in the US are required to supply fresh air to occupied spaces. Fresh, clean air supports human health and is critical to indoor air quality and comfort. Although ventilation methods may differ, tempering fresh air can be an energy demanding process.

A Dedicated Outdoor Air System (DOAS) with a high efficiency Energy Recovery Ventilator (ERV) is an alternative ventilation system design that can significantly reduce a building's heating and cooling loads. Pairing DOAS and ERV with a ductless heating and cooling system, such as Variable Refrigerant Flow or Mini-Split heat pumps, can further reduce heating and cooling loads while enhancing comfort.

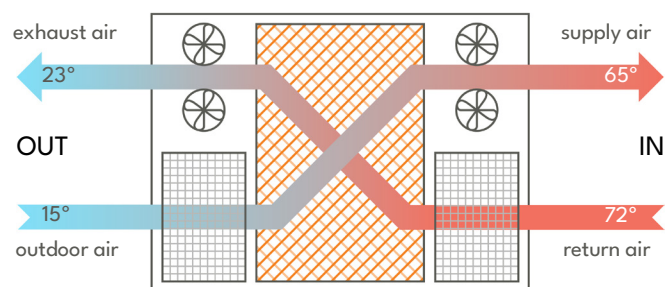
Conventional Heating, Ventilation and Air-Conditioning (HVAC) systems must fully temper fresh air before distributing it throughout the building. This contributes to high heating and cooling loads, and means that fresh air is only provided simultaneously with heating or cooling. A DOAS, on the other hand, brings fresh air into interior spaces independently from heating or cooling, greatly increasing efficiency and allowing the downsizing of heating and cooling equipment.

An ERV tempers incoming outdoor air with heat from the exhaust air, significantly reducing the demand on heating and cooling equipment. ERVs work by transferring heat contained in exhausted (indoor) air

to incoming (outdoor) air or vice versa, depending on the season (see Fig 1). The two air streams do not mix, keeping odor and pollutants in exhausted air separate from fresh supply air. This technique, called preconditioning, conserves a significant amount of energy that would otherwise be lost with traditional exhaust ventilation methods.

This tech primer outlines a high performance ventilation upgrade option for commercial buildings using a DOAS with ERV and recommends the installation of an efficient, ductless heating and cooling system (VRF or Mini-Split) to fully realize savings.

Fig 1. During winter, heat from the return air is transferred to the supply air in the heat recovery core (orange hatch) of an ERV. The system reverses in summer, where heat from the outdoor air is transferred to the exhaust air, helping to cool the supply air.



Assess

Always consult a qualified service provider before undertaking any building upgrades.

Coordinate Upgrades for Maximum Savings

Implementing a DOAS retrofit in conjunction with building envelope improvements that reduce heat loss and infiltration can enhance the ventilation system performance.

Establish a tight building envelope through general air sealing. Updating windows and adding insulation can further reduce heating and cooling loads.

Plan Ahead for Success

A DOAS retrofit is most easily applied to buildings with existing ventilation systems that are either floor by floor or have both supply and return air ductwork.

Buildings that are currently supply or exhaust-only ventilated will require additional duct work.

Costs and benefits of DOAS and ERV*

Greenhouse Gas (GHG) Savings



In a DOAS with ERV system, almost all of the energy in exhausted air can be recovered by the incoming fresh air (or vice versa), dramatically lowering heating and cooling loads and related GHG emissions. Further GHG reductions occur when the DOAS and ERV are paired with a ductless heating and cooling system and upgraded HVAC controls, depending on the existing ventilation strategy and heating and cooling fuel type.

Tenant Experience Improvements



A DOAS installation dramatically improves tenant satisfaction by delivering fresh air where it's needed, resulting in a controlled indoor environment with reduced temperature extremes and improved indoor air quality.

Utility Savings



Although DOAS with ERV significantly reduces heating and cooling loads, electricity is a significantly more expensive form of energy than natural gas, fuel oil, or district steam. Future changes in utility costs should be considered when evaluating project feasibility.

Capital Costs



A DOAS installation requires a very high capital investment, although actual installation costs will depend on the building's existing conditions. Buildings with a decentralized ventilation system will generally be simpler and cheaper to convert, while buildings with central ventilation systems, particularly where the total supply and exhaust rates are not already balanced, may be more difficult and expensive. Further due diligence is recommended for determining site specific costs, benefits and retrofit considerations.

Maintenance Requirements



A DOAS with ERV system requires a low level of maintenance. ERVs and DOAS terminal units have air filters that require regular cleaning. ERV controls detect dirty filters and automatically alert operators, however it is recommended to visually inspect ERV units every 3 months and fully clean the unit every 6 months.

Take Action

This document is one of more than a dozen High Performance Technology Primers prepared by the Building Performance Partnership (BPP) to introduce decision-makers to solutions that can help them save energy and improve comfort in their buildings.

For more information, contact Built Environment Plus.

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The Building Performance Partnership (BPP), created by Building Energy Exchange (BE-Ex) and the Institute for Market Transformation (IMT), supports the creation and operation of local high-performance building hubs that accelerate measurable, equitable, and sustainable action to improve the health, comfort, and performance of buildings. With support from both BE-Ex and IMT, partner hubs serve their respective regions with customized resources that cater to the needs of their communities while benefiting from the existing resources and expertise of our network.

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*The Costs & Benefits rating system is based on a qualitative 1 to 4 scale where 1 (🍃🍃🍃🍃) is lowest and 4 (🍃🍃🍃🍃) is highest. Green correlates to savings and improvements, dark blue correlates to costs and requirements. Ratings are determined by industry experts and calculated relative to the system end use, not the whole building.

Note: Existing ventilation assumed to supplied floor by floor. Existing heating and cooling system to be replaced with VRF or Mini-Split system.