What is an ERV?

An Energy Recovery Ventilator (ERV) is a mechanical ventilation system that supplies fresh outdoor air to a home while exhausting an equal volume of stale indoor air. It recovers both sensible heat (temperature) and latent heat (moisture) from the exhaust air, preconditioning the incoming fresh air with minimal energy loss.

ERVs are closely related to Heat Recovery Ventilators (HRVs). Both provide balanced ventilation for energy-efficient, airtight ("tight") homes. The key difference:

- HRVs transfer only sensible heat.
- ERVs transfer both heat *and* moisture via a specialized permeable enthalpy core.

Why are ERVs and HRVs needed? Modern tight homes achieve excellent energy efficiency but have very low natural air leakage. This traps indoor pollutants, CO_2, VOCs, and moisture, making mechanical ventilation essential for healthy indoor air quality (IAQ). Without energy recovery, ventilation wastes significant heating or cooling energy. Recovery ventilators capture 70–95% of that energy, reducing HVAC load while maintaining fresh air.

Key Benefits of ERVs (Especially for Tight/Airtight Homes)

- Improved Indoor Air Quality: Continuously dilutes and removes pollutants, allergens, and CO_2 with a slow airflow while potentially filtering incoming air (often with MERV 8–13 filters).
- Energy Efficiency: Recovers up to 80–95% of heating/cooling energy, dramatically lowering the "ventilation penalty" in tight envelopes and helping meet Passive House, IECC, and ASHRAE 62.2 standards.
- Humidity Control (Year-Round, Including Winter):
    - In summer, ERVs transfer moisture from humid incoming air to the exhaust stream, reducing the latent load on air conditioning and helping prevent high indoor humidity and mold risk.
    - In winter, ERVs help conserve indoor humidity. Cold outdoor air is very dry. An ERV moves water vapor from the warmer, more humid exhaust air to the incoming dry air. This retains more indoor moisture than an HRV or no recovery at all, helping maintain healthier relative humidity levels (winter, ideally 40–50% RH). Benefits include improved comfort, easier breathing, healthier skin, and less stress on wood floors/furniture.
- Comfort & Pressure Balance: Prevents negative pressure issues (backdrafting of chimneys/fireplaces) and reduces drafts or infiltration of unconditioned air.

- Additional Features/Benefits:
    - Very quiet operation (many models < 0.5–1.0 sones).
    - Variable or ECM motors with boost modes.
    - Frost protection and automatic defrost in cold climates.
    - Low maintenance (washable cores, easy filter access).
    - Smart controls and integration with whole-house systems.

ERVs vs. HRVs by Climate

- ERVs are generally preferred in mixed or humid climates (where both heating and cooling occur) because of their superior year-round humidity management — including winter humidity retention and summer dehumidification assistance.
- HRVs may be preferred in very cold, heating-only climates if the goal is to aggressively remove excess indoor moisture (e.g., to reduce condensation risk on windows).

How ERVs Work (Technical Overview)

Fresh and exhaust air streams pass through a counterflow or crossflow enthalpy core. A permeable membrane that allows heat and water vapor to transfer without mixing the airstreams.

Key performance metrics (HVI/AHRI rated):

- Sensible Recovery Efficiency (SRE): 70–95%.
- Total Recovery Efficiency (TRE) / Latent Effectiveness: 50–80%+ for moisture transfer.
- Fan efficacy (CFM/Watt) and low pressure drop for efficiency.

This moisture transfer is what enables ERVs to conserve indoor humidity in winter while still providing fresh air.

Ventilator Selection, Sizing & Location

Volume-Based Method (quick estimate): Floor area (ft^2) × ceiling height (ft) × 0.85 (furniture adjustment) × ACH (e.g., 0.2–0.3) ÷ 60 = CFM needed. ACH= Air Changes / Hour

Example (1,000 ft^2 home, 9 ft ceilings, 0.30 ACH): 1,000 × 9 × 0.85 × 0.30 ÷ 60 ≈ 38 CFM.

Recommended Method: ASHRAE 62.2 Q_total (CFM) = 0.03 × floor area (ft^2) + 7.5 × (bedrooms + 1). Size for continuous low-speed operation with boost capability.

Ducted/central ERVs use or may integrate with existing with ductwork to supply fresh air to multiple rooms and exhaust stale air from key areas (bathrooms, kitchen, laundry). They provide uniform whole-house ventilation and are excellent at maintaining even distribution, but they require more installation cost, space for ducts, and can have higher fan energy use due to duct pressure losses.

Spot ERVs (smaller units such as the Panasonic FV-04VE1) are compact, localized ERVs that are typically installed in in a distributed manner, using one or several, and spaced intelligently to cover an entire home. They are simpler, cheaper, quieter, and easier to retrofit into tight homes with minimal or no ductwork and can result in better overall indoor air quality due to lower air velocity.

Pollutant Control and Fick's Law In a reasonably open floor plan, VOCs, CO_2, humidity, and pollutants naturally diffuse toward lower concentration areas (Fick's Law of diffusion). A few well-placed spot ERVs can often achieve good equilibrium across the home without constant high-volume forced circulation. In closed-off rooms like bedrooms, a spot ERV connected inlet or outlet grille is beneficial. Spot ERVs are often sufficient for most tight homes, while central ducted systems are preferred when maximum uniformity or code compliance demands fully balanced multi-room distribution.

Conclusion

In today's tight, energy-efficient homes, an ERV is an excellent choice for delivering fresh outdoor air while recovering both heat and moisture. It provides major energy savings, superior year-round humidity control (retaining indoor moisture in winter and rejecting excess humidity in summer), and improved indoor air quality. Whether using a central ducted system or multiple low-CFM spot ERVs, natural diffusion of VOCs, CO_2, humidity, and other pollutants quickly creates equilibrium across open floor plans, so aggressive whole-house circulation is rarely needed. Chiltrix recommends pairing their high-efficiency air to water heat pumps with properly sized ERVs to create a healthy, comfortable, and ultra-efficient indoor environment.