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MECHANICAL VENTILATION

This guide provides an explanation of mechanical ventilation requirement, including:

- A breakdown of all three code approved methods
- How to size a system properly
- Types of air in the code

This guide is based on the 2021 IECC and IRC.

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Modern homes are built with airtight envelopes that save energy and improve comfort. But the tighter we build, the less natural air exchange occurs. Pollutants, moisture, and odors can linger indoors unless we intentionally bring in fresh air and remove stale air.

The goal is simple: build tight, ventilate right.

That's where whole house mechanical ventilation comes in. It ensures a consistent, controlled supply of outdoor air, protecting both occupant health and building durability. Codes such as the IRC and IECC recognize this need, requiring all new homes to include whole house mechanical ventilation systems.

In cold climates, the codes go further, requiring balanced systems with heat or energy recovery to minimize losses.

Code Foundations

- R403.6: Mechanical ventilation is mandatory in all dwellings.
- R403.6.1: In Climate Zones 7 & 8 → HRV or ERV required with ≥65% sensible heat recovery at 32°F.
- M1505.4: Systems may be supply, exhaust, or balanced; outdoor air intakes and exhausts must have dampers.

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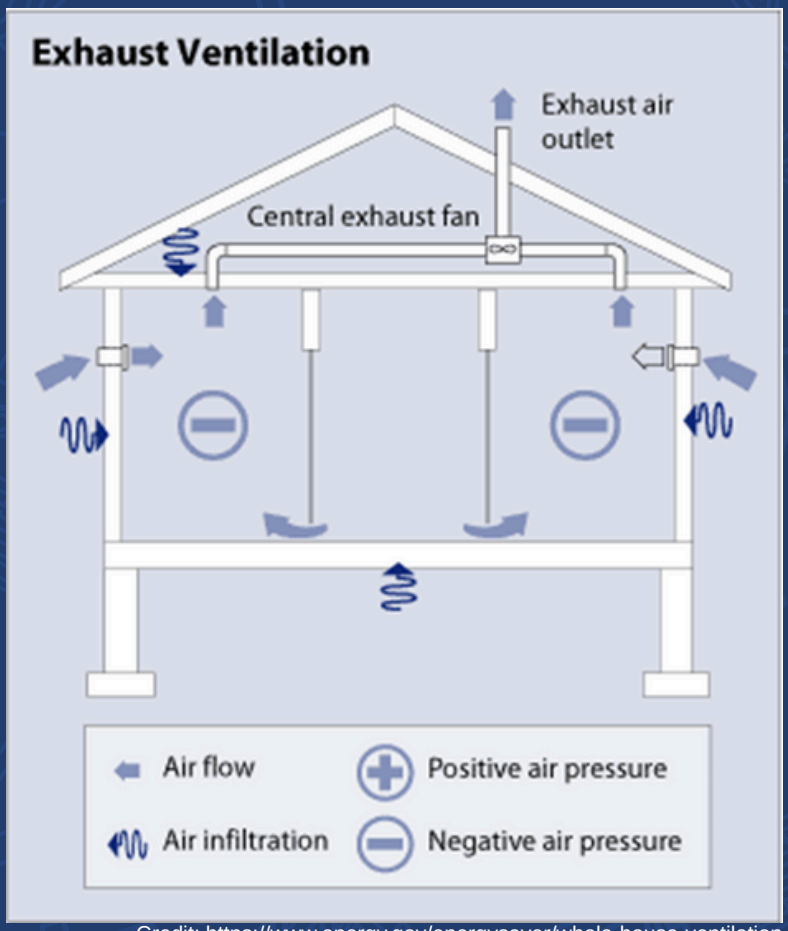
MECHANICAL VENTILATION

THE THREE BASIC TYPES OF MECHANICAL VENTILATION



Credit: https://www.energy.gov/energysaver/whole-house-ventilation

Exhaust-Only Systems

- Method: Uses fans (often in bathrooms or kitchens) to expel air.
- Pressure effect: **Creates negative pressure**, drawing outdoor air in through cracks or vents.
- Typical styles:
  - **Continuous bathroom fan.**
  - Centralized ducted exhaust tied to multiple rooms.
- Pros: Inexpensive, simple retrofit.
- Cons: Brings in unfiltered, unconditioned air; can cause back drafting.

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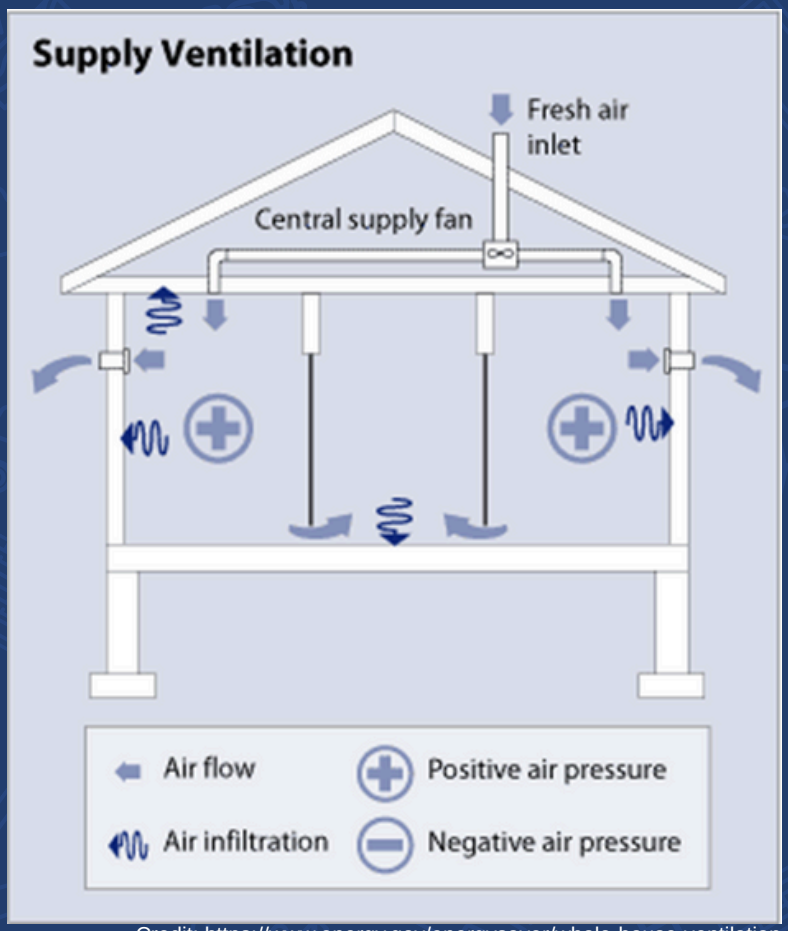

Credit: https://www.energy.gov/energysaver/whole-house-ventilation

Supply-Only Systems

- Method: Uses a fan to push fresh outdoor air into the house.
- Pressure effect: Creates positive pressure, forcing stale air out through leaks.
- Typical styles:
- Dedicated supply duct feeding an air handler.
- Standalone supply fan with filter.
- Pros: Cleaner entry point for outdoor air; helps block infiltration of pollutants.
- Cons: Can cause wall condensation in cold climates; exhaust pathways may be uneven.

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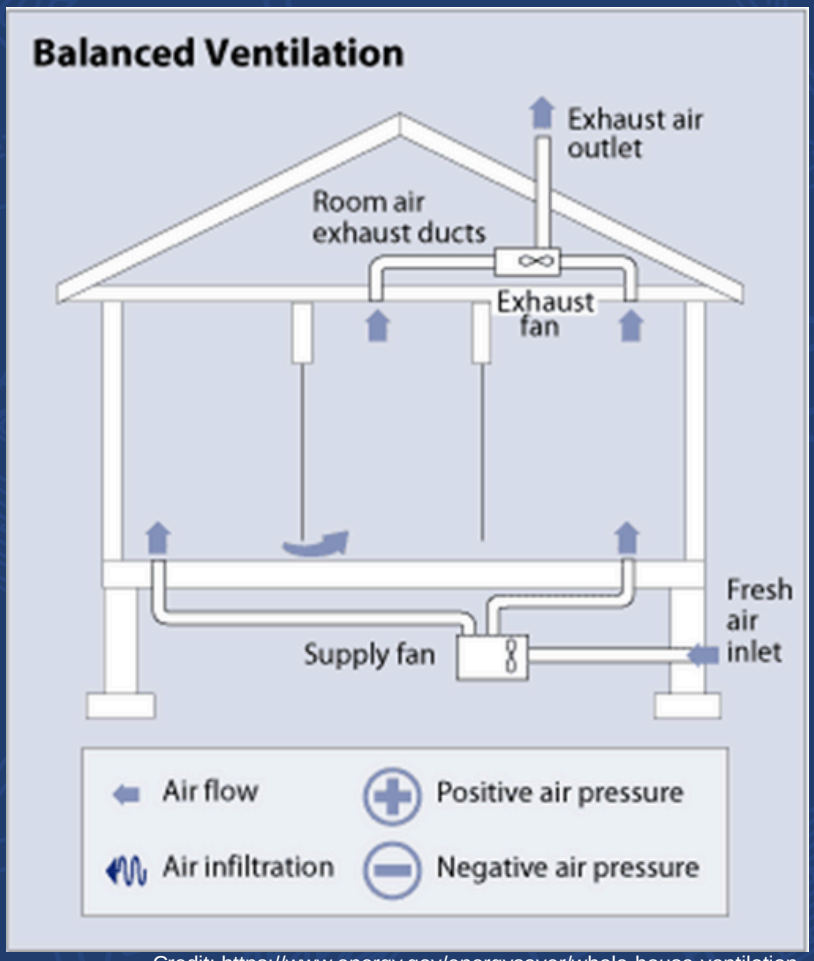
Balanced Systems (Often with HRV/ERV)



Credit: https://www.energy.gov/energysaver/whole-house-ventilation

- Method: Uses **both supply and exhaust fans to move equal amounts of air.**
- Pressure effect: Maintains neutral pressure, avoiding push-pull effects.
- Typical styles:
  - HRV: Transfers heat between air streams.
  - ERV: Transfers both heat and moisture.
- Pros: Best indoor air quality and energy performance.
- Cons: Higher cost, more complex to install and maintain.
- Required for Climate Zones 7 and 8 per code.

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Tight homes need a steady, predictable dose of outdoor air. The codes don't leave this to guesswork—they require you to size the whole-house mechanical ventilation to a minimum flow and then verify it with a measurement.

How do you size mechanical ventilation?

Sizing mechanical ventilation involves two components: Equation 15-1 and Table M1505.4.3(1). The Equation requires some basic information about the dwelling. To fulfill it you'll need to:

- Measure floor area (sq. ft.).
- Count bedrooms.

Equation 15-1

Ventilation rate in cubic feet per minute = (0.01 × total square foot area of house) + [7.5 × (number of bedrooms + 1)]

For example, let's say the calculation involves a 2200 square foot house with 3 bedrooms. Then plug in those values to find Ventilation Rate (*Vr*)...

$$Vr=(0.01 \times 2200)+7.5 * (3+1)$$
$$Vr=22+7.5 * 4$$
$$Vr=22+30$$
$$Vr=52$$

Great, now let's compare that to the Table's values

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How do you size mechanical ventilation?

TABLE M1505.4.3(1)
CONTINUOUS WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM AIRFLOW RATE REQUIREMENTS

DWELLING UNIT FLOOR AREA (square feet)	NUMBER OF BEDROOMS				
	0 – 1	2 – 3	4 – 5	6 – 7	> 7
	Airflow in CFM				
< 1,500	30	45	60	75	90
1,501 – 3,000	45	60	75	90	105
3,001 – 4,500	60	75	90	105	120
4,501 – 6,000	75	90	105	120	135
6,001 – 7,500	90	105	120	135	150
> 7,500	105	120	135	150	165

A 2200 square foot home would be right here, using 60 CFM from the table but 52 CFM when calculated from Equation 15-1. M1505.4.3 tells us we must use at minimum nothing less than the calculated values.

Factoring Intermittent Ventilation Rates

Code also requires us to address intermittent fan usage. If a fan is only running 25% of the time it has to push more air than one running 100% of the time. Factors are calculated by multiplying the required ventilation by the relevant factor in table M1505.4.3(2) for a total ventilation rate.

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Fan efficiencies

It wouldn't make sense to effectively design a ventilation system without making sure the fan is also efficiently sized to deliver the right amount of air without being too big or using too much power right? IECC Section R403.6.1 applies the required fan efficiency in CFM/Watt for the types of fans used to provide mechanical ventilation. For instance, an in-line exhaust fan must at least meet an efficiency value of 3.8 cfm per watt. Check this section after sizing to the ventilation system to align the required airflow rate with the right efficiency value.

Distinguishing Ventilation Air vs. Other Code-Required Air

Not all "air" in the codes is doing the same job. Whole-house mechanical ventilation is for health & indoor air quality—fresh outdoor air delivered intentionally. That's different from air used to replace strong exhausts, to feed combustion, or to carry heat/cool for comfort. Keeping these buckets straight avoids design conflicts and inspection misses. Remember there are also areas that need ventilation air specifically--bathrooms and kitchens (M1505.4.4).

The purpose and goal of each use of air helps determine how it's used and accounted for inside of the building thermal envelope (see next page for a helpful cheat sheet).

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Type of Air in Homes

Air Type	Purpose	Source / How It Moves	Key Point
Mechanical Ventilation Air	Brings in fresh **outdoor air** to improve indoor air quality, control odors, and manage moisture.	Dedicated fans/ducts (exhaust, supply, or balanced; often HRV/ERV).	Required by code; sized & tested for Indoor Air Quality (IAQ).
Makeup Air	Replaces air lost from **large exhaust appliances** (e.g., range hoods, dryers).	Outdoor duct tied to the appliance zone, sometimes interlocked with exhaust.	Prevents strong negative pressure; **not IAQ ventilation.**
Combustion Air	Provides oxygen for **fuel-burning appliances** to operate safely.	Outdoor (or allowed indoor) air ducted to the appliance combustion chamber.	Safety-critical; prevents backdrafting.
Heating & Cooling Air	Circulates conditioned air for **thermal comfort**.	Mostly recirculated indoor air through HVAC ducts; outdoor air only if system is designed for it.	Comfort ≠ ventilation; don't confuse with IAQ airflow.