



How efficient are whole-house fans compared to ceiling fans?

An Ask E Source answer

By Essie Snell

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Q: How do whole-house fans compare to ceiling fans in terms of energy savings, and what are the pros and cons of each?

A: Ceiling fans circulate air around an individual room, whereas whole-house fans (WHFs) vent air from the inside of the house to the outside, providing both air circulation and ventilation throughout the home.

When it's hot out, ceiling fans can create the impression that the ambient indoor air is cooler than it is and can yield energy savings if users increase their thermostat setpoint (for example, by changing it from 72° to 80° Fahrenheit). In contrast, WHFs are primarily intended to be used in the mornings or evenings when the outdoor temperature is cooler than the indoor temperature. By ventilating the home with cooler air, WHFs can save energy by offsetting the amount of air conditioning used each day (though they can also potentially increase energy consumption if a user forgets to turn off their air conditioner while the fan is running). As described in the US Department of Energy's (DOE's) [Cooling with a Whole House Fan](#) web page, WHFs can be used in conjunction with ceiling fans, so one isn't necessarily a replacement for the other.

By ventilating the home with cooler air, whole-house fans can save energy by offsetting the amount of air conditioning used each day.

Because ceiling fans and WHFs require users to adjust thermostat settings—and, in the case of WHFs, turn on the fan and open or close windows appropriately—the actual energy savings realized are highly variable, and not much robust research exists on typical savings. With that in mind, it's difficult to say with certainty which option is likely to be more energy efficient without much more information on the home in question. It would be most helpful to run a simulation model to compare the different options. Nonetheless, here are additional details and resources on ceiling fans and WHFs, with some regional estimates of potential savings for reference.

Ceiling fans

The Energy Star program is an excellent resource for information on ceiling fans. It offers [usage tips](#) (such as running the fan counterclockwise in the winter), suggestions on [choosing the appropriate fan size](#), and [ceiling fan efficiency requirements](#). Energy Star also offers [certification criteria for ceiling fans](#) to ensure that qualified fans are as efficient as possible. In particular, Energy Star fans use more-efficient motors and lighting to realize savings of 40% or more compared to standard ceiling fans. With that in mind, the California Municipal Utilities Association's (CMUA's) [Savings Estimation Technical Reference Manual 2017](#) (PDF) estimates average savings of about 151 kilowatt-hours (kWh) per year for an Energy Star-qualified ceiling fan, with an incremental measure cost of \$46 over a standard-efficiency ceiling fan. Note, however, that this is just for upgrading an existing fan, so it doesn't provide information on potential savings associated with installing a ceiling fan in a home that doesn't have one.

It's also worth mentioning the capabilities of Internet-connected fans. By moving air to make occupants feel more comfortable, and communicating with smart thermostats to dynamically adjust temperature setpoints and ensure that energy savings are realized, smart ceiling fans may have the potential to help reduce HVAC energy consumption while maintaining user comfort and avoiding the behavioral challenges that normal ceiling fans face in realizing energy savings. Big Ass Fans offers Haiku, a smart fan we highlighted in our [August 2017 Tech Roundup](#) web conference.

Whole-house fans

There are two main types of WHFs: ducted and nonducted (also called ceiling-mounted). Ceiling-mounted WHFs are the most common technology, and they work by pulling all the air in the house through a single hole in the ceiling and venting it through the attic. Ducted WHFs differ in that they pull air out of each room individually from existing or new ductwork before venting it. As a result, ducted WHFs don't require a large hole to be cut in the ceiling. They tend to be quieter, but installation costs are higher.

In either case, ducted or nonducted, if there isn't an available attic space, there are WHFs available that can be installed on a roof and vent directly outside. Roof-mounted fans are usually smaller in size and, as such, are usually limited to smaller homes.

According to the DOE's [Cooling with a Whole House Fan](#) web page and our existing research into the technology, installation considerations include:

- Installation should be done by a certified HVAC professional.
- A dedicated electrical circuit should be installed for the fan.
- If installed in an attic, the attic ventilation capacity will usually need to be increased. According to the DOE, "You'll need 2 to 4 times the normal area of attic vents, or about one square foot of net free area for every 750 cubic feet per minute of fan capacity. The net free area of a vent takes into account the resistance offered by its louvers and insect screens. More vent area is better for optimal whole house fan performance."
- It's important to size the fan correctly. According to the DOE, "Whole house fans are sized in cubic feet per minute (cfm) of cooling power. To determine the size you'll need, first calculate the volume of your house in cubic feet. To do that, multiply the square footage of the floor area you want to cool by the height from floor to ceiling. Take that volume and multiply by 30 to 60 air changes per hour (depending on the power you need). Then, divide by 60 minutes to get the cubic feet per minute of capacity your house requires."
- WHFs also need to be effectively sealed to prevent unwanted heat transfer into or out of the house when it's not in use. Occupants should be sure to install a tight-fitting insulated WHF cover in the winter to minimize heat loss.
- Install rubber or felt gaskets with WHFs to reduce noise.
- Some manufacturers provide misleading or inaccurate information about the sound levels of their fans. Users should look for certified laboratory test data to make sure that they're getting what they expect.

Additionally, do-it-yourself website This Old House offers the short video [How to Install a Whole House Fan](#).

The best times to run a WHF are at night and early morning, when the temperature outside is cooler than inside the home. Running the fan for a long duration can cool down the home's thermal mass (called precooling) and contribute to keeping the house cool during the day. The large amount of airflow drawn by the fan can also create a slight breeze, which can make occupants feel cooler, but this may or may not be desirable.

Interestingly, although Silicon Valley Power's 2014 technical reference manual (TRM) estimated savings of just 21 kWh per year for WHFs in single-family houses, the 2017 CMUA TRM cites higher modeled savings and installation costs for different California climate zones (**figure 1**).

Figure 1: Modeled WHF energy savings and installation costs in California

The 2017 CMUA TRM highlights the wide range of potential energy savings that WHFs offer in different climate zones.

	Energy savings (kilowatt-hours) ^a	Installation cost (\$) ^b
Climate zone 2	55	721
Climate zone 3	-142 ^c	861
Climate zone 4	161	821
Climate zone 5	-63 ^c	652
Climate zone 8	388	691
Climate zone 9	451	728
Climate zone 10	522	672
Climate zone 11	496	711
Climate zone 12	567	706
Climate zone 14	353	647
Climate zone 15	174	685
Climate zone 16	171	712

Notes: a. Per fan (2,000 cubic feet/minute). b. California Energy Commission case study; costs vary due to assumptions regarding regional labor rates. c. The negative savings for climate zones 3 and 5 represent the use of the whole-house fan for ventilation purposes in mild climates where little space cooling is replaced.

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Despite the benefits of WHFs, they have some potential drawbacks.

Unpleasant or unhealthy air and particles drawn into the living space. A WHF creates a negative pressure in the living space, drawing in air from outside. It's important to open as many windows as possible when using a WHF; otherwise it may pull air from places like chimneys, cracks in the floorboards, and other places, resulting in dirty, dusty air that can be unpleasant and unhealthy. Additionally, negative pressure

created by leaving windows closed can potentially cause dangerous back-drafting with gas appliances when the flue gases, replete with carbon monoxide, get pulled back into the home instead of being vented to the outside. WHFs also create a positive pressure in the attic, which can potentially force hot, unpleasant, unhealthy air back into the living space if there's insufficient venting to the outside. Caulk all penetrations between the attic and the living space, such as light fixtures, electrical boxes, attic hatches, and plumbing vents.

Whole-house fans create a positive pressure in the attic, which can potentially force hot, unpleasant, unhealthy air back into the living space if there's insufficient venting to the outside.

Noise. Small ceiling-mounted fans tend to be the noisiest, followed by large ceiling-mounted fans (which can rotate slower for a given flow rate because the blades cover a larger area), and ducted WHFs. One suggestion to minimize sound and energy consumption is to consider a dual-speed or variable-speed WHF that can allow users to ventilate the whole house quickly when needed (for example, when occupants first arrive home), or to slow down the fan speed for gentler air circulation with lower sound levels when less cooling is required.

Humidity. Unlike air conditioners that also provide dehumidification, WHFs won't dehumidify at all. A WHF may not be desirable in a humid climate.

Allergens. Because WHFs draw in significant amounts of outside air, occupants with allergies may not find them suitable.

Safety. WHFs require windows to be open while they're running, and they're most effective when run at night. However, some occupants may not want to leave their windows open at night if safety is a concern.