Carbon Dioxide Reduction Using Whole House Fans

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Abstract

Whole house fans have been used for residential cooling for many years. However with the advent of sealed, insulated doors, and use of acoustical damping this technology has become more convenient, efficient, and can provide a very low cost way to reduce an individual's or community's carbon footprint.

1. Purpose

The purpose of this paper is to advance the concept that whole house fans are an extremely cost effective way to reduce greenhouse emissions. The manner of operation, calculation techniques, and their limitations will be discussed. Motivators, incentives and potential barriers to implementation will also be addressed. This paper will only address residential applications.

2. Operation and Applications

Whole house fans either eliminate or reduce the need for mechanical cooling (air conditioning) by exhausting hot air, and allowing fresh air to enter the house. The fan is used at times when outside air is cooler than inside air. Our data leads us to conclude that whole house fans are effective throughout most of North America. Arid climates provide the best conditions, because of the hot days, high solar insolation, and lower nighttime temperatures.

Homeowners in humid climates are best advised to use whole house fans in the later Spring and early Fall for the best results. (shoulder periods).

Modern whole house fans are designed to be quiet, efficient, and incorporate motorized doors that are insulated and sealed. This is in contrast to the vast majority of installed whole house fans that are comprised of a belt (or direct) drive axial fan with steel or plastic backdraft dampers.

Older whole house cooling strategies were generally based upon a quick purge of air from the house. This technique delivered quick relief from heat, but provided no long lasting benefit. Pre-cooling the structure is a great energy saving strategy, however the time to remove heat from the structure is more limited by the building materials themselves rather than amount of airflow. Larger, modern whole house fans that have extra low energy use at low speed or multiple smaller fans fit this strategy very well.

3. Energy Calculations

In order to compare the efficiency of whole house fans with the alternative of air conditioning, we calculated the cooling capacity and power usage of whole house fans and compared that cooling capacity to an equivalent sized air conditioner. The assumptions are that the whole house fan is used in a western U.S. Location, and that all whole house fan cooling is usable and is replacing electrically driven air conditioning. Our calculations indicate that whole house fans can deliver cooling for 5-20% of the energy use of a typical AC unit. These favorable results lead us to conclude that further research and analysis into the subject should be done.

4. Carbon Calculations

Per the U.S. Department of Energy, the blended rate for utility production of carbon dioxide is 1.35 pounds of carbon dioxide per kilowatt hour of electricity.

Households in ideal climates can typically reduce their air conditioning electrical use completely. Since an average US household consumes2,835 kWh for AC use (EIA 2005 Residential Energy Consumption Study), this would equate to 1.7 metric tons of CO_2 per year.

Our calculations show that over the whole house fan life, whole house fans can avoid carbon dioxide for a cost of $25 to $35 per metric ton. To illustrate the cost effectiveness of this solution, the European

Union carbon trading market currently sells carbon offsets for approximately $20 per metric ton.

4.1. Assumptions

Energy and carbon calculations were based on scenarios that included the following assumptions:
•Arid climate with an average of 10 degrees between outside night temperatures and inside temperature.
•4 month cooling season
•20 year product lifetime

5. Consumer Motivations

Our customer surveys and anecdotal evidence lead us to conclude that the primary motivation for using whole house fans is to reduce the cost of electrical energy. A close second in motivation is to avoid the closed in feel of a sealed house and feel fresh air at night. Significantly down the popularity scale, customers report that they do like to minimize their environmental impact and are looking for ways to “do the right thing”.

6. Barriers

There are a few barriers to wide acceptance and use of whole house fans. The most important issue to overcome is the unfamiliarity with newer, quieter whole house fans. There are two groups of potential users, those who are familiar with traditional whole house fans, but object to their noise level and those that have no knowledge of the product or its intended function.

Other less important barriers include first cost, as well as concerns regarding convenience, noise, and air leakage that are actually associated with older technology whole house fans.

7. Incentives

Incentives play a valuable role by helping to validate the concept of whole house fans.

Several utilities have whole house fan rebate programs. Incentive amounts range from $50 to $250 and typically only require the recipient to be a current utility customer and have purchased and installed a whole house fan.

Utilities typically only require a minimum airflow level, but offer no base line levels for efficiency nor do they require automatic sealed doors. Establishing set benchmarks for all products would help customers maximize energy savings and return on investment.

As well, public utility education and Incentive programs play a crucial role by validating the concept of whole house fans, and their importance in the current energy debate.

8. Opportunity

The Western states, especially California with its high electrical rates, and range of incentive programs offer the best opportunity for implementation and energy savings. Currently the DOE reports that residential AC use is approximately 17% of electrical consumption. The Western States, with a focus on California is a primary target for adoption of whole house fans. With high electrical rates and a wide range of incentive programs, there is a community willingness to explore the whole house fan as a common sense solution to cooling.

Targeted research and development to advance operating efficiencies, expand applications, and provide ease of use will further erode market resistance.

9. Conclusion

Modern whole house fans offer instant reduction of residential utility costs and carbon emissions, with minimal lifestyle changes.

Barriers to implementation continue to be broken down through public education and policy changes, at the local, state and national levels.

With a high cost to net benefit ratio, ease and speed of implementation, this is a timely solution that

provides effective cooling to the marketplace while reducing our combined carbon footprint..

This is an opportunity to provide low energy cooling that appeals to customers and those tasked with reducing our carbon footprint. The cost to benefit ratio is high and the speed of implementation can be very rapid.