Massachusetts Farm Energy Program

Energy Saving Tip

Passive Ventilation for Greenhouses

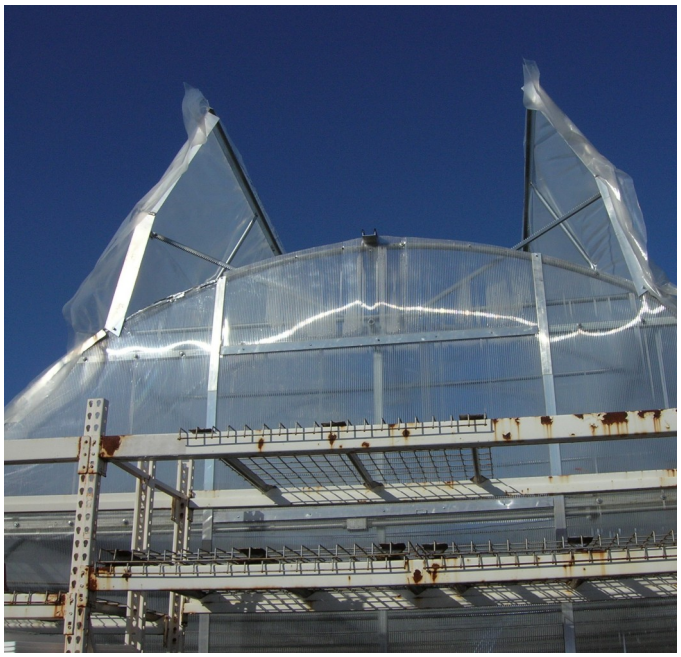

Photo credits: MFEP, GDS Associates, USDA-NRCS

Using passive ventilation and natural air movement rather than mechanically-powered fans can help farms reduce energy use and save on operating expenses.

Farmers operating greenhouses in the summertime - when ventilation is a constant need - can cut energy costs and power demand charges by replacing mechanical ventilation with natural air exchange. Wall fans and horizontal air flow can use 0.5-1 kWh/sf of greenhouse floor area per year[1].

Natural Ventilation

Natural ventilation uses wall and roof openings in both rigid and film-glazed greenhouses for air circulation and exchange rather than motorized fans. This set-up relies on pressure differences created by wind and temperature gradients. Side wall ventilation may be sufficient, or a combination of side wall and roof ventilation can be used to maximize air flow. It is not recommended to use roof ventilation alone.

Energy Savings and Payback

Payback periods - the amount of time it takes for the project to pay for itself through reduced electrical use and savings - depend on many factors, including: growing season and mechanical ventilation run-time, greenhouse size, cost of installation (retrofit vs. new construction), and electrical demand charges. For most greenhouse growers, **sidewall vents or roll-up sides tend to be a cost-effective retrofit opportunity**.

Natural ventilation may pay for itself in as little as four years. Energy and cost savings are maximized when:

1. little or no mechanical ventilation is used to supplement natural ventilation, and
2. designed into new greenhouses rather than installed as retrofits.

Side wall vents - Specs/Guidelines

Side wall ventilation may be installed as roll-up side wall for poly-film greenhouses and as a hinged vent for glass or polycarbonate houses. Side wall vents are typically two to three feet tall, installed at the ground level. Because natural ventilation relies on wind or pressure differences, side wall vents should be installed on the length walls of a greenhouse and on walls free from outside obstruction such as vegetation or other buildings. It is optimal to design new greenhouses to allow side wall vents to face normal summer wind so that wind naturally flows into the greenhouse.

Ridge Vents

Side wall vents paired with roof or ridge ventilation may increase air flow through a greenhouse. Ridge ventilation can be installed as a retractable, hinged rigid-glazed vent or as a framed-poly film hinged vent. Ridge ventilation can also be installed as a roll-up roof. An open ridge allows warm air to escape, creating a pressure difference within the greenhouse that draws air in from side wall vents. Ridge vents should open leeward to the wind, with ridge vents sized at 15-20% of the greenhouse floor area. In the pairing of side wall and roof vents, side wall vent openings should be sized larger than the area of the roof vent opening.[2]

Ridge vents are **most cost-effective when incorporated into new construction**. They can be installed through greenhouse retrofits, but tend to have extended paybacks (estimated at 15-20 years) depending on a number of variables. Costs vary according to the following considerations: manual vs. automated installations, solid vs. film-type glazing materials, ridge vent height, and installation complications related to irrigation systems, thermal currents, etc.

Controls & Operation

The roll-up or hinge operation of natural ventilation can be done with a manual crank or with a motorized control. Computer controls can be installed to anticipate high wind speeds and other weather events which help maintain the desired greenhouse environment. To maximize air flow of natural ventilation (and energy savings), it is not recommended to operate Horizontal Air Flow (HAF) fans at the same time vents are open. Vents should also close completely with seals to minimize heat loss during heating months.

Case Examples

These greenhouse natural ventilation cases illustrate the range of costs and savings for different projects. To find out the benefits of incorporating natural ventilation into your greenhouse, request a quote from your greenhouse vendor, and contact the Massachusetts Farm Energy Program to assist in estimating energy savings through a targeted audit.

Project Scope	**SF**	**Cost**	**Annual Savings**	**Payback** (years)	**Cost/lf**	Notes
sidewall venting (retrofit)	11,700	$7,000	$1,317	5.3	$26.92	Stopped using exhaust fans during summer months.
sidewall venting (retrofit)	3,840	$21,082	$3,480	6.1	$82.35	Installed on 30 x 128 house instead of 12 - 3/4 hp exhaust fans.
sidewall venting (retrofit)	25,000	$15,000	$972	15.4	$9.77	Installed on 8 houses, stopped using fans during summer months.
sidewall venting and ridge vents (retrofit)	1,854	$13,705	$1,591	8.6	$44.35	Installed side *and ridge venting to shut off fans during summer.*
roof vents (new construction)	2870	$2,000	$632	3.2	$28.57	Incremental cost of roof vents (not ridge) install on new build is $2,000.

Based on data consolidated by GDS Associates, Inc. in Wisconsin, with cases collected in collaboration with the Focus on Energy.

[1] *Energy Conservation for Commercial Greenhouses*, Chapter 6: Ventilation and Cooling, Natural Resource, Agriculture, and engineering Service (NRAES) Cooperative Extension, NRAES-3, 2001 revision.

For more information on energy efficiency, see the *Massachusetts Farm Energy Best Management Practices Guides.*