



AGRICULTURE
VENTILATION FAN, AGRICULTURE
SWPR001-01

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MEASURE NAME

Ventilation Fan, Agriculture

STATEWIDE MEASURE ID

SWWP001-01

TECHNOLOGY SUMMARY

This measure is defined as the installation of a high-efficiency agricultural ventilation fan instead of a standard efficiency ventilation fan for agricultural facilities and farming applications. Ventilation fans are often used in conjunction with water sprayers or misters to enhance evaporative cooling.

Agricultural ventilation fans are box, panel, or basket fans that are designated as either low-volume high speed (LVHS) or high-volume low Speed (HVLS). Note that HVLS fans are not included in this measure.

Airflow is measured in cubic feet per minute (cfm). Fan efficiency is measured in units of cfm per Watt (cfm/W). This metric follows a previous test protocol that is no longer followed by the Bioenvironmental and Structural Systems Laboratory (BESS Lab) ventilation fan testing facility at the University of Illinois. The BESS Lab currently conducts fans tests using a protocol typically referred to as a “Thrust Test” (AMCA/ANSI 230-99). This test can accommodate fans that cannot be tested to the traditional BESS Lab test, such as basket fans, and is specifically aimed at circulation fans, as opposed to exhaust fans. This test measures the thrust generated by a fan and calculates the calculated cubic feet per minute (ccfm) by assuming a uniform air velocity across the face of the fan. This calculated cubic feet per minute (ccfm) does not match the cubic feet per minute measured by the traditional test specification. Also, most manufacturers have not yet released their results for this test to the public.

MEASURE CASE DESCRIPTION

The measure case is defined as the installation of a high-efficiency agricultural fan instead of a standard-efficiency fan. The measure offerings are defined by the fan size ranges specified below:

Ventilation fans or box fans – 24-inch to 26-inch

Ventilation fans or box fans – 36-inch retrofits

Ventilation fans or box fans – 48-inch retrofits

See Base Case Description for an explanation of the analysis to determine the base case and measure case specifications from fan efficiency performance test results from the Bioenvironmental and Structural Systems Laboratory (BESS Lab) ventilation fan testing facility at the University of Illinois.

BASE CASE DESCRIPTION

The base case technology for this measure is a low-efficiency ventilation fan. The base case specification was derived from fan efficiency performance test results from the Bioenvironmental and Structural Systems Laboratory (BESS Lab) ventilation fan testing facility at the University of Illinois.

The BESS Lab fan data was arranged in lists by fan size and sorted in ascending order by cfm/W. The lowest 10% of fans for each size were averaged for cfm and watts. The wattage was multiplied by 1.10 to establish the base case wattage for new fans. This wattage was further multiplied by 1.10 to establish base case wattage for retrofit fans. The average cfm for the lowest 10% of fans was then divided by these baseline wattages to establish the minimal allowable cfm/W to qualify for a rebate.

Base Case Specification

Fan Size	Base Case – retrofit (cfm/W)	Base Case – new (cfm/W)	Min. Allowable (cfm/W)	Source
24” – 26”	8.2	9.0	14.0	Pacific Gas and Electric (PG&E). n.d. “BESS Data.xlsx.”
36”	12.6	13.9	20.4	
48”	15.8	17.4	21.9	

Choosing the lowest 10% of the population assumes that many manufacturers of inefficient fans do not have their fans tested by the BESS Lab. The additional reduction factor of 1.10 assumes that manufacturers that test their fans do not typically test their less efficient models. The final reduction factor of 1.10 assumes that older fans in the field are less efficient due to wear, damage, dirt, and corrosion.

CODE REQUIREMENTS

There are no applicable state or federal codes that apply to this measure.

Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20	None.	n/a
CA Building Energy Efficiency Standards – Title 24	None.	n/a
Federal Standards	None.	n/a

NORMALIZING UNIT

Each (per fan).

PROGRAM REQUIREMENTS

Measure Implementation Eligibility

All combinations of measure application type, delivery type, and sector that are established for this measure are specified below. Measure application type is a categorization based on the circumstances and timing of the measure installation; each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements. Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

Note that some of the implementation combinations below may not be allowed for some measure offerings by all program administrators.

Implementation Eligibility

Measure Application Type	Delivery Type	Sector
Normal replacement	DnDeemed	Ag
New construction	DnDeemed	Ag

Eligible Products

A fan must have been tested by the Bioenvironmental and Structural Systems Laboratory (BESS Lab) ventilation fan testing facility at the University of Illinois to the specifications provided in the Base Case Description, and it must meet the minimum allowable cfm/W. (This value is a tradeoff between trying to encourage the highest practical efficiencies and still allowing most manufacturers to have at least one offering within the accepted range.)

Eligible Building Types

The measure is applicable for all existing agriculture facilities of any vintage.

Eligible Climate Zones

The measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

None.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

HVAC

ELECTRIC SAVINGS (KWH)

The calculation of unit energy savings (UES) utilizes fan efficiency performance test results from the Bioenvironmental and Structural Systems Laboratory (BESS Lab) ventilation fan testing facility at the University of Illinois, using the following test specifications:

- AMCA/ANSI 210-99 (equivalent to ASHRAE 51-1999)
- ASABE S565 Oct 2005



The UES is calculated as a function of fan wattage (baseline or measure) and the assumed annual hours of operation.

$$UES = \frac{(W_{base} - W_{measure}) \times EHOURS}{1,000}$$

and

$$W_{base\ fan} = (Average\ CFM) / (cfm/W_{base})$$

$$W_{measure\ fan} = (Average\ CFM) / (cfm/W_{Minimum\ Allowable})$$

$$UES(kWh/yr) = \text{Unit electric energy savings (kWh/hr)}$$

$$W = \text{Fan wattage for base or measure case fan (W)}$$

$$EHOURS = \text{Annual operating hours per year (hrs)}$$

Annual hours of operation were derived from data obtained directly from customers of the Southern California Edison (SCE) 2005 Agricultural Ventilation Fan Efficiency Program. The typical control strategy for the agricultural fan includes a temperature limit, when fans are cycled ON when outdoor air temperature exceeds this limit. The annual hours of operation are a reasonable estimate with the turn-on temperature of about 70 °F in the California Central Valley.

UEC Inputs

Parameter	Fan Size			Source
	24" – 26"	36"	48"	
Annual Hours of Operation	2,175	2,175	2,175	Southern California Edison (SCE). n.d. <i>Agricultural Ventilation Fan Efficiency Program Data</i> . Proprietary database.
Average cfm	6,600	11,500	22,300	Pacific Gas and Electric (PG&E). n.d. "BESS Data.xlsx."
Baseline cfm/W – normal replacement	8.2	12.6	15.8	
Baseline cfm/W – new construction	9.0	13.9	17.4	
Minimum Allowable cfm/W	14.0	20.4	21.9	

For example, the energy savings of a 48" fan, that is a retrofit installation, with 22,300 cfm that operates 2,175 hours per year is calculated as follows:

$$Base\ Case\ Fan\ Wattage\ (W) = 22,300\ cfm / 15.8\ cfm/W = 1,411\ W$$

$$Measure\ Case\ Fan\ Wattage\ (W) = 22,300\ cfm / 21.9\ cfm/W = 1,018\ W$$

$$Energy\ Savings\ (kWh/yr) = (1,411\ W - 1,018\ W) * 2,175\ hrs / 1,000 = 855\ kWh$$

PEAK ELECTRIC DEMAND REDUCTION (KW)

This calculation of peak demand reduction is based upon the assumption that a ventilation fan will operate at a constant load during the peak period of 4 p.m. to 9 p.m., since their control is based upon a temperature setpoint. Average demand reduction of this measure is equal to the annual unit energy savings (UES) divided by the estimated annual hours of operation. Peak demand reduction is equal to the average demand multiplied by a coincident demand factor (CDF).

$$PeakDemandReduction = \frac{UES}{EHOURL} \times CDF$$

- PDR* = Peak demand reduction (kW)
- UES* = Annual electric unit energy savings (kWh)
- EHOURL* = Estimate operating hours per year (hrs)
- CDF* = Coincident demand factor

Peak Demand Reduction Inputs

Parameter	Value	Source
Coincident Demand Factor	1.0	Professional judgement.

GAS SAVINGS (THERMS)

Not applicable.

LIFE CYCLE

Effective useful life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. Remaining useful life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational had the program intervention not caused the replacement or alteration.

The EUL for this measure (below) was derived from data collected from over 60 fan manufacturers and dealers through the course of the 2005 Agricultural Ventilation Fan Efficiency Program.

Note that the RUL value is only applicable to the first baseline period with an applicable code baseline, which is not applicable for this measure.

Effective Useful Life and Remaining Useful Life

Parameter	All Fan Sizes	Source
EUL (yrs)	10.0	Southern California Edison (SCE). n.d. "Agricultural Ventilation Fan Efficiency Program Data." Proprietary database.
RUL (yrs)	n/a	n/a

BASE CASE MATERIAL COST (\$/UNIT)

Base case costs include the cost of the low or standard efficiency fan and mounting hardware. The base case material cost was calculated as the average of vendor quotes provided for free-stall barn fan custom projects installed in the Pacific Gas and Electric (PG&E) service area.

MEASURE CASE MATERIAL COST (\$/UNIT)

The measure case costs include the cost of the high-efficiency fan and mounting hardware. The measure costs were derived from a sample of four installations and costs estimates obtained from the 2006-2012 Dairy Energy Efficiency (DEEP) program and from a survey of California installers.¹

BASE CASE LABOR COST (\$/UNIT)

Base case labor installation cost is assumed to equal the Measure Case Labor Cost.

MEASURE CASE LABOR COST (\$/UNIT)

The estimated measure case labor cost was derived as the average labor cost of a sample of free-stall barn custom project invoices from installations through the 2006-2012 Dairy Energy Efficiency (DEEP) program, NYSERDA, and New York Disaster Relief Programs.²

NET-TO-GROSS

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. The commercial NTG value is based upon the average of all NTG ratios for all evaluated 2006 – 2008 agriculture programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. This sector average NTG (“default”) is applicable to all energy efficiency measures that have been offered through agriculture sector programs for more than two years and for which impact evaluation results are not available.

Net-to-Gross Ratios

Parameter	Value	Source
NTG – agriculture default	0.60	Itron, Inc. 2011. <i>DEER Database 2011 Update Documentation</i> . Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3.

GSIA

The gross savings installation adjustment (GSIA) rate represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. This GSIA rate is the current “default” rate specified for measures for which an alternative GSIA has not been estimated and approved.

¹ Pacific Gas and Electric (PG&E). 2012. “WPenNRPR0001 4 Ventilation_V506 08 12.xlsx.”

² Pacific Gas and Electric (PG&E). 2012. “WPenNRPR0001 4 Ventilation_V506 08 12.xlsx.”

Gross Savings Installation Adjustment Rate

Parameter	Value	Source
GSIA	1.0	California Public Utilities Commission (CPUC), Energy Division. 2013. <i>Energy Efficiency Policy Manual Version 5</i> . Page 31.

NON-ENERGY IMPACTS

Non-energy impacts for this measure have not been quantified.

DEER DIFFERENCES SUMMARY

This section provides a summary of DEER-based inputs and methods, and the rationale for inputs and methods that are not DEER-based.

DEER Difference Summary

DEER Item	Comment / Used for Workpaper
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	No
DEER Measure Case	No
DEER Building Types	No
DEER Operating Hours	No
DEER eQUEST Prototypes	No
DEER Version	n/a
Reason for Deviation from DEER	DEER does not contain this type of measure.
DEER Measure IDs Used	n/a
NTG	Source: DEER READI. The value of 0.60 is associated with NTG ID: <i>Agric-Default>2yrs</i>
GSIA	Source: DEER. The value of 1.0 is associated with GSIA ID: <i>Def-GSIA</i>
EUL/RUL	Source: DEER. The value of 10 years is associated with EUL ID: <i>Agr-VSDWellPmp</i>

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision
01	03/31/2018	Jennifer Holmes, Cal TF Staff	The draft of the text fields for this statewide measure is based upon: Workpaper PGE3PAGR117 Revision 8 (October 12, 2017) Workpaper PGE3PAGR117 Revision 7 (January 1, 2016) Consensus reached among Cal TF members
	03/29/2019	Jennifer Holmes, Cal TF Staff	Revisions for submittal of version 01.

01	8/14/2019	Randy Kwok, PG&E	<p>Corrected error in EAD table where the baseline cost has both material and labor, but measure cost only has the material cost. Also the labor cost for the 48" fan should be \$338, not \$200.</p> <p>Corrections made in EAD file, tab "CostExAnte", and in Measure Data Spec file, tab "Cost Data".</p>
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