



ComEd Matrix Demand Based Ventilation Fan Controller IPA Program Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Plan Year 9 (PY9)

Presented to
ComEd

DRAFT

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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's PY9 Matrix Demand Based Ventilation Fan Controller (DBVFC) Program. It presents a summary of the energy and demand impacts for the total program and broken out by relevant measure and program structure details. Section 6 presents the impact analysis methodology. PY9 covers June 1, 2016 through December 31, 2017.

2. PROGRAM DESCRIPTION

The PY9 Matrix DBVFC Program optimizes the operating time of an HVAC supply air fan which provides conditioned outside and return air to the building space. The supply air fan can be controlled to provide sufficient outside air and air circulation while saving energy with the DBVFC device. This device saves energy in two ways: 1) by turning the fan motor off when it is not needed and 2) by reducing the energy needed by heating and cooling only the necessary amounts of the outside air brought into the building. The Matrix DBVFC Program is designed for all restaurants and fitness center customers with demand less than 100 kW.

The program had 85 participants in PY9 and installed 177 measures shown in the following table.

Table 2-1. PY9 Volumetric Findings Detail

Participation	
Participants	85
Total Measures	177
Number of Measures/Project	2.1
Installed Projects	85

Source: ComEd tracking data and Navigant team analysis.

3. PROGRAM SAVINGS

Table 3-1 summarizes the incremental energy and demand savings the Matrix DBVFC Program achieved in PY9. The Matrix DBVFC Program achieved net verified energy savings of 737,171 kWh and zero peak demand savings, since the reduced ventilation occurs during the off-peak period. The DBVFC measure saves electricity by turning off a fan motor for a short period of time, limited to less than an hour. Since peak energy is measured in hourly increments, there would be no peak demand savings associated with this measure. This DBVFC measure would not reduce demand over an entire peak period, but rather would reduce the demand for short time windows throughout the period.

Table 3-1. PY9 Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings* (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	828,282	NR	NA
Program Gross Realization Rate	100%	NA	NA
Verified Gross Savings	828,282	78.0	NA
Program Net-to-Gross Ratio (NTGR)	0.89	0.89	NA
Verified Net Savings	737,171	69.41	NA

*NR = Not Reported

Source: ComEd tracking data and Navigant team analysis.

4. PROGRAM SAVINGS BY MEASURE

Since there is only one measure type, this section details only the DBVFC Units, and the associated measure life.

Table 4-1: PY9 Energy Savings by Measure

Enduse Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Technical Measure Life	Persistence	Effective Useful Life (EUL)†
HVAC	DBVFC Unit	828,282	100%	828,282	0.89	737,171	NA	NA	10
	Total	828,282	100%	828,282	0.89	737,171	NA	NA	10

Table 4-2: PY9 Total Demand Savings by Measure

Enduse Type	Research Category	Ex-Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTGR*	Verified Net Demand Reduction (kW)
HVAC	DBVFC Un	NR	NR	77.99	0.89	69.41
	Total	NR	NR	77.99	0.89	69.41

* A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

† EUL is a combination of technical measure life and persistence

Source: ComEd tracking data and Navigant team analysis

5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

5.1 Impact Parameter Estimates

Energy savings are estimated using the following formula as specified in the workpaper¹ provided by Matrix and verified by Navigant in PY9:

$$\text{Deemed Savings (kWh/ton)} \times \text{Total Tons Controlled} = \text{kWh Savings}$$

¹ "Supply Fan Cycling for Small Packaged HVAC" March 31, 2017

Where:

Deemed Savings (24-hour facility) = 801.6 kWh/ton
 Deemed Savings (18-hour facility) = 703.4 kWh/ton
 Total Tons Controlled = total tonnage controlled by DBVFC unit.

The lifetime energy and demand savings are estimated by multiplying the verified savings by the technical measure life for each measure.

The EM&V team conducted research to validate the parameters that were not specified in the TRM. The results are shown in the following table. Quantity is the total number of tons controlled, by building schedule type (18 hours per day or 24 hours per day).

Table 5-1. Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed* or Evaluated?
Quantity (tons controlled, 18-hour)	120.5	Evaluated
Quantity (tons controlled, 24-hour)	927.5	Evaluated
Gross Savings per Unit, Deemed Measures (kWh/ton, 18-hour)	703.4	Deemed*
Gross Savings per Unit, Deemed Measures (kWh/ton, 24-hour)	801.6	Deemed*
Net Savings per Unit, Deemed Measures (kWh/ton, 18-hour)	626.0	Deemed*
Net Savings per Unit, Deemed Measures (kWh/ton, 24-hour)	713.4	Deemed*
Gross Savings per Unit, Deemed Measures (kW/ton, 18-hour)	0.067	Deemed*
Gross Savings per Unit, Deemed Measures (kW/ton, 24-hour)	0.075	Deemed*
Net Savings per Unit, Deemed Measures (kW/ton, 18-hour)	0.059	Deemed*
Net Savings per Unit, Deemed Measures (kW/ton, 24-hour)	0.067	Deemed*
Verified Realization Rate on Ex-Ante Gross Savings (Non-Lighting)	100%	Evaluated

Source: *Supply Fan Cycling for Small Packaged HVAC* March 31, 2017 and Navigant Calculations

5.2 Other Impact Findings and Recommendations

Finding 1. The PY9 Net Energy Savings goal for Matrix DBVFC Program is 5,517,395 kWh. The program met 13 percent of its target net energy savings goal with verified net energy savings value of 737,171 kWh.

Recommendation 1. Navigant recommends further expanding marketing activities and market presence in the ComEd service area by targeting businesses that have period of highest occupant density for short periods of day relative to overall operating hours, but are otherwise substantially less populated like fitness centers and restaurants.

Finding 2. Program participation increased from two participants in PY8 to 85 participants in PY9, indicating that Matrix expanded their marketing activities, as recommended in the PY8 report.

Recommendation 2. Navigant recommends further expanding marketing activities and market presence in the ComEd service area.

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

Navigant performed a thorough review of the workpaper² submitted by Matrix to verify and validate the deemed savings for the DBVFC measure.

The total energy savings from this measure come from two sources: fan energy savings from stopping the fan during periods of low occupancy and cooling energy savings from reducing the amount of outside air brought into the space.

The fan energy savings is calculated by determining the amount of time the fan can be turned off and multiplying by the input demand of the fan's electric motor. Using hourly typical meteorological year (TMY) weather data, the available time for the fan to be turned off can be calculated by determining the fraction of each hour required for space conditioning.

For fan savings during the cooling season, hourly fractions were calculated for outside temperatures above 72°F. For fan energy savings during the heating season, hourly fractions were calculated for outside temperatures below 60°F and for shoulder seasons, hourly fractions were calculated for outside temperatures between 60°F and 72°F. For each hour, the available time to turn the fan off is determined by an occupancy profile in which the average set-point to deactivate the fan is compared against normalized CO₂ threshold values for hours which the outside temperature falls between the two temperature criteria. The sum of the seasonal fan energy savings gives the total annual fan energy savings. The calculations for the annual savings are modeled for a 5-ton DBVFC unit.

7. APPENDIX 2. IMPACT ANALYSIS DETAIL

The tables below show the energy and demand savings by building type (18 or 24 hour) for the Matrix DBVFC Program.

Table 7-1: Energy Savings Detail by Business Type

Facility Type	Number of Projects	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR	Verified Net Savings (kWh)
18 Hour	11	84,762	100%	84,762	0.89	75,438
24 Hour	74	743,520	100%	743,520	0.89	661,733
Total	85	828,282	100%	828,282	0.89	737,171

Source: Navigant analysis

Table 7-2: Demand Savings Detail by Business Type

Facility Type	Number of Projects	Ex Ante Gross Savings (kW)	Verified Gross Realization Rate	Verified Gross Savings (kW)	NTGR	Verified Net Savings (kW)
18 Hour	11	NR	NA	8.05	0.89	7.17
24 Hour	74	NR	NA	69.93	0.89	62.24
Total	85	NR	NA	77.99	0.89	69.41

Source: Navigant analysis

² Supply Fan Cycling for Small Packaged HVAC" March 31, 2017

8. APPENDIX 3. TOTAL RESOURCE COST DETAIL

The Total Resource Cost (TRC) variable table below only includes cost-effectiveness analysis inputs available at the time of finalizing this PY9 DBVFC program impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation at a later date. EULs are subject to change and are not final.

Table 8-1: Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
HVAC	DBVFC Unit	Units	177	10	828,282	NR	828,282	NR