

CUSTOM BUILDING IMPROVEMENTS ASSISTANCE

Final Verification Report

Kane Passive House Project - Fraley St
Kane, PA

July 27, 2023
4022335

Prepared for



Met-Ed • Penelec • Penn Power • West Penn Power

energysavePA-business.com

Executive Summary

This report documents the results of verification for several energy conservation strategies for the Kane Passive House Project - Fraley St project and shows the results of verification as compared to the baseline model. During preliminary and final analysis, the customer and Willdan worked together to understand how the building will use energy and where cost-effective savings can be realized. In response, West Penn Power offered an incentive for the implementation of these strategies.



Enrollment



Analysis



Results



Verification



Incentives

Verification generally includes the following:

- Willdan sends a Bundle Requirements Document to the customer to assure that the selected bundle is implemented, tailored to the Selected Bundle strategies.
- One month before construction completion, Willdan will request the most recent version of Construction Documents and Specifications (electronic format).
- Customer sends final invoice, customer utility bill, Letter of Attestation and Incentive Payment Request Form to Willdan.
- Willdan completes a field Verification Report, as to status of strategy implementation, and sends it to the customer.
- Willdan, on behalf of West Penn Power, provides the incentive payment to the customer based on the final Verification Report.

The final West Penn Power incentive is \$16,483.

This document includes:






- Whole Building Results Summary – savings from energy sources
- List of Selected Strategies – summary list of strategies and their relative impacts
- Selected Strategies and Requirements – detailed requirements for individual strategies
- Detailed Appendices – utility incentive calculations and detailed energy model results

The costs of energy efficiency programs are recovered through customer rates in accordance with PA Act 129 of 2008. For a complete list of commercial, industrial, residential, and low-income energy efficiency programs, please visit energysavePa.com. FirstEnergy's Pennsylvania utilities, their parents, subsidiaries, employees, affiliates and agents assume no responsibility for the performance of the equipment or equipment warranty, the quality of the work, labor and/or materials supplied, and/or the acts or omissions of any contractor.

By participating in these energy efficiency and peak demand reduction programs, customers agree to allow their utility to retain ownership of all Capacity Rights which refers to the demand reduction associated with any energy efficiency and peak demand reduction measure for which incentives were provided by the Company. Your utility will aggregate these energy efficiency demand reduction attributes into the PJM capacity market with proceeds being used to offset the program costs.

Whole Building Results Summary

The following results are based on an ASHRAE 90.1-2013 Appendix G baseline.

	Baseline	Selected Bundle	Verified Bundle	
	Annual Energy Cost	\$23,110	\$10,471	\$9,498
	Annual Energy Cost Savings		\$12,639	\$13,612
	% Annual Energy Cost Savings		55%	59%
	Annual Electric Consumption (kWh)	237,756	107,730	97,719
	Annual Electric Consumption Savings		130,026	140,037
	% Annual Electric Consumption Savings		55%	59%
	Electric Peak (kW)	57.1	25.1	21.9
	Electric Peak Savings		32.0	35.2
	% Electric Peak Savings		56%	62%
	EUI (kBtu/sf/yr)	46.9	21.2	19.3
	EUI Savings		25.7	27.6
	% EUI Savings		55%	59%
	Final West Penn Power Incentive		\$15,202	\$16,483

List of Verified Strategies

The following pages include a complete list of the modeled energy conservation strategies that were selected by the project team for installation. All savings percentages in the table below are relative to the selected bundle savings.

Space Asset Area	Strategy Description	Portion of Total \$ Savings Modeled	Verified as Modeled?	Portion of Total \$ Savings Verified
Mechanical				
Facility	Variable refrigerant flow, Alternate 1	49%	Yes	49%
Facility	Total heat recovery	N/A	Added*	4%
Architectural				
Facility	Wall R-43.78	18%	Yes	18%
Facility	Roof R-48	8%	Yes	8%
Facility	Proposed glazing	16%	Yes	16%
Electrical				
Stairwells	Vacancy sensor control, 100% of space	< 1%	Yes	< 1%
Restrooms	Vacancy sensor control, 100% of space	< 1%	Yes	< 1%
Mech/Elec	Vacancy sensor control, 100% of space	< 1%	Yes	< 1%
1st Floor/South 2nd Floor Offices	Vacancy sensor control, 100% of space	< 1%	Yes	< 1%
North 2nd Floor Offices	Vacancy sensor control, 100% of space	< 1%	No	0%
3rd Floor Offices	Vacancy sensor control, 100% of space	< 1%	Yes	< 1%
Facility	Lighting power density reduced to 0.34 W/ft ²	10%	Partial	6%
Other				
Facility	Regenerative elevator	N/A	Added*	5%
Total Savings		100%		108%

* Denotes additional strategy that exceeds modeled goals and may offset other strategies that do not meet the modeled goals.

Summary of Variances

The list below details items that are different from the selected bundle.

Heat Recovery

- Total heat recovery was installed. A new strategy has been added to the energy model to account for these savings.

Lighting Control

- Vacancy sensors were not installed in the North 2nd Floor Offices, resulting in no savings.

Lighting Design

- The verified lighting power density is lower than expected in the North 2nd Floor Offices and Basement areas and higher than the expected 0.34 W/ft² in all other areas, resulting in a variation in savings by space. For more details, please see the Electrical Strategy Verification Results section of this report.
- The lighting fixtures submitted for fixture types FP1, FT1-3, FE1-3, FI, FF1-3, and FQ are not DLC or Energy Star-listed, resulting in a reduced incentive from West Penn Power.

Elevator

- A regenerative elevator was installed. A new strategy has been added to the energy model to account for these savings.

Further details about these strategies may be found in the following sections of this report.

Verified Strategies and Requirements

For this project, the owner selected Bundle 1 for implementation. Upon construction completion, Willdan has verified the selected strategies via review of construction documents and submittals. The following tables provide the detailed verification findings for the applicable strategies. In addition, the appendices have further information and calculations.

Mechanical Strategy Verification Results

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Facility	Variable refrigerant flow, Alternate 1	Specify VRF system with efficiencies of 11.7 EER and 3.72 COP.	Implemented	The verified value meets the strategy requirements.
Facility	Total heat recovery	Install total heat recovery on building exhaust air.	Implemented	The verified value results in an additional strategy.

Architectural Strategy Verification Results

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Facility	Wall R-43.78	Install a wall with a total assembly R-value (including thermal bridging) of R-43.78.	R-43.78	The verified value meets the strategy requirements.
Facility	Roof R-48	Install a roof with a total assembly R-value (including thermal bridging) of R-48.	R-48	The verified value meets the strategy requirements.
Facility	Proposed glazing	Unit U: 0.17 SHGC: 0.20 VT: 0.22	Unit U: 0.17 SHGC: 0.20 VT: 0.22	The verified value meets the strategy requirements.

Electrical Strategy Verification Results

Space Type Lighting Power Density

Space Asset Area	Baseline LPD (W/ft ²)	Target LPD (W/ft ²)	Verified LPD (W/ft ²)	DLC-Adjusted LPD* (W/ft ²)
Basement	0.01	0.34	0.12	0.12
Stairwells	0.63	0.34	0.47	0.51
Restrooms	0.98	0.34	0.40	0.62
Mech/Elec	0.42	0.34	0.42	0.42
1st Floor/South 2nd Floor Offices	1.44	0.34	0.47	0.83
3rd Floor Offices	1.23	0.34	0.40	0.85
North 2nd Floor Offices	1.23	0.34	0.28	0.52
Building Average	0.92	0.34	0.36	0.59

* Values in this column are calculated by setting wattages for fixtures that are not DLC- or Energy Star-listed to the baseline value. This method is used by Willdan and FirstEnergy to determine the effective lighting power density that is eligible for incentives.

Lighting Controls and Design

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Stairwells	Vacancy sensor control, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the Space Asset Area.	Area covered: 100%	The verified value meets the strategy requirements.
Restrooms	Vacancy sensor control, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the Space Asset Area.	Area covered: 100%	The verified value meets the strategy requirements.
Mech/Elec	Vacancy sensor control, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the Space Asset Area.	Area covered: 100%	The verified value meets the strategy requirements.
1st Floor/South 2nd Floor Offices	Vacancy sensor control, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the Space Asset Area.	Area covered: 100%	The verified value meets the strategy requirements.
North 2nd Floor Offices	Vacancy sensor control, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the Space Asset Area.	Not Implemented	The verified value results in no savings.
3rd Floor Offices	Vacancy sensor control, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the Space Asset Area.	Area covered: 100%	The verified value meets the strategy requirements.
Facility	Lighting power density reduced to 0.34 W/ft ²	Reduce lighting power density by 30% below the baseline specified by Space Asset Area allowances.	0.36 W/ft ²	The verified value results in less savings than planned.

Other Strategy Verification Results

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Facility	Regenerative elevator	Install a regenerative traction elevator model.	Implemented	The verified value results in an additional strategy.

Site Photos



Outdoor VRF unit.



Rooftop energy recovery unit.



First floor café lighting design.



Typical corridor lighting design.

Appendix A. Utility Bundle Results and Incentive

The tables below show the calculated energy cost savings for these energy investments with the included FirstEnergy PA incentive. These tables also provide payback analysis of the verified bundle.

Energy Parameter	Bundle 1, As Modeled*	Bundle 1, As Built
Building Results		
Energy Cost Savings	\$12,639	\$13,612
Percent Energy Cost Savings	55%	59%
Electric Demand Savings	32.0 kW	35.2 kW
Percent Electric Demand Savings	56%	62%
Electric Consumption Savings	130,026 kWh	140,037 kWh
Percent Electric Consumption Savings	55%	59%
Total Results		
Total Incremental First Cost	\$88,242	\$106,728
Final West Penn Power Incentive	\$15,202	\$16,483**
Simple Payback with Incentive (years)	5.8	6.6

* The figures in this column are reprinted from the January 25, 2023 Bundle Requirements Document for this project which provided the basis for the original energy savings projections.

** The total customer incentive of \$16,483 is calculated by the lesser of the two calculations or capped at \$500,000:

- 1) $\$0.08 \text{ kWh/savings} \times 140,037 \text{ kWh}$ (electric consumption savings as noted in the chart above)
 +
 $\$150/\text{kW savings} \times 35.2 \text{ kW}$ (electric demand savings as noted in the chart above) = \$16,483
- 2) 75% of the incremental cost, which is \$106,728 for this project = \$80,046

Energy Parameter	Baseline	Bundle 1, As Modeled	Bundle 1, As Built
Building Results			
Energy Use Intensity (EUI)	46.9 kBtu/ft ² /yr	21.2 kBtu/ft ² /yr	19.3 kBtu/ft ² /yr
EUI Savings		25.7 kBtu/ft ² /yr	27.6 kBtu/ft ² /yr
Percent EUI Savings		55%	59%

Note: Subject to the following qualifications, the computer model offers sophisticated predictions of energy savings with estimations as good as any other means available for improvements that have not been completed.

The strategy and bundle results compare relative differences in net energy use for design alternatives. The results are not appropriate for system design and/or equipment selection; these are responsibilities of the registered design professionals of record. The actual energy use of this building will be different from simulated results. Building systems and other operating parameters provided by the customer and modeled by Willdan approximate actual conditions, but differences in weather, operating parameters, occupancy level, and changes that occur through the bidding and construction process will result in annual energy costs that will be different from what is predicted here. However, when a bundle of strategies is selected relative to other alternatives, its energy (and dollar) conserving value can be expected to remain constant relative to the other alternatives, and the magnitude of the cost should be approximately as predicted. Thus, implementation of a bundle of strategies offers the opportunity for energy savings, but the realization of those savings is the responsibility of the owner/operator of the building – not West Penn Power or Willdan. Savings are not guaranteed.

Appendix B. Project Information

Building Summary			
Location	Kane, PA		
Narrative	Renovation and design to meet Passive House standards		
Space Asset Areas	Area	Number of Stories	
Basement	3,400 ft ²	1	
Stairwells	2,100 ft ²	3	
Restrooms	900 ft ²	3	
Mech/Elec	900 ft ²	3	
1st Floor/South 2nd Floor Offices	4,800 ft ²	2	
North 2nd Floor Offices	1,900 ft ²	1	
3rd Floor Offices	3,400 ft ²	1	
Total	17,400 ft²	3 + Basement	
Utilities			
Electric Utility	West Penn Power		
Gas Utility	N/A for incentive purposes		
Schedule			
Construction Documents Complete			
Construction Start			
Occupancy	09/30/2022		
Baseline Reference	ASHRAE 90.1-2013 Appendix G		
Other Notes			
Systems Summary			
Selected HVAC	VRF system, EER 11.7, COP 3.72		

Appendix C. Verified Isolated Strategy Results

The table below includes detailed results modified based on verification findings shown earlier in this report.

Space Asset Area	Strategy Description	Peak kW Savings	kWh Savings	Energy Cost Savings	Inc. Cost
Facility	Variable refrigerant flow, Alternate 1	17.7	66,475	\$6,461	\$50,000
Facility	Total heat recovery	0.0	7,360	\$716	\$14,486
Facility	Wall R-43.78	1.7	24,065	\$2,339	\$18,677
Facility	Roof R-48	1.9	10,466	\$1,017	\$14,971
Facility	Proposed glazing	8.7	21,076	\$2,049	\$596
Stairwells	Vacancy sensor control, 100% of space	0.0	26	\$3	\$514
Restrooms	Vacancy sensor control, 100% of space	0.0	42	\$4	\$224
Mech/Elec	Vacancy sensor control, 100% of space	0.0	122	\$12	\$216
1st Floor/South 2nd Floor Offices	Vacancy sensor control, 100% of space	0.0	375	\$36	\$1,198
3rd Floor Offices	Vacancy sensor control, 100% of space	0.0	105	\$10	\$841
Facility	Lighting power density reduced to 0.34 W/ft ²	0.0	7,391	\$718	\$528
Facility	Regenerative elevator	0.0	17,371	\$1,689	\$4,000