

Verification Report

New Hope City Hall & Police
New Hope, MN

ENERGY DESIGN ASSISTANCE



October 3, 2019
4017528

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Introduction

This report documents the results of verification for several energy conservation strategies for the New Hope City Hall & Police project and shows the results of verification as compared to the baseline model. This report serves as a final document for verifying energy savings strategies implemented at this new building located in New Hope, MN.

Xcel Energy and CenterPoint Energy offers the Energy Design Assistance to assist owners and design teams in evaluating potential energy conservation strategies for new and renovated building projects during the design and construction processes. During the design phase, the building owner selected a number of energy conservation strategies. In response, Xcel Energy and CenterPoint Energy offered an incentive for the implementation of these strategies.

For this project, the owner selected Bundle 2 for implementation. For more information about selected results, please see the Bundle Requirements Document (from January 8, 2018). Upon construction completion, Willdan has verified the selected strategies via Construction Documents review, on site verification of the strategies selected (on July 17, 2019), and construction submittals. These measures provide projected energy cost savings of over \$50,000 per year, in relation to the building baseline.

The simple payback analysis shows that the Xcel Energy and CenterPoint Energy incentive has helped reduce the incremental costs associated with the energy conservation strategy investments in this building, resulting in a payback of 4.0 years.

Energy Conservation Investments - Simple Payback Analysis

Project Incremental Construction Cost	\$254,222
Final Xcel Energy and CenterPoint Energy Incentive	\$49,851
Project Adjusted Incremental Cost	\$204,371
Annual Energy Cost Savings	\$50,932
Payback, with incentive (in years)	4.0

For more information, please refer to the following report.

Process

The following list provides the process steps for this energy conservation program.

- Energy Design Assistance
 - Establish goals and intentions
 - Computer modeling of baseline, strategies, and bundles
- Bundle selection by the owner
- Bundle Requirements Document
 - Summarizes key features/verification plan for all bundle strategies
- Verification study (following project completion and occupancy)
 - Request construction documents
 - Request submittals (e.g., glazing, insulation, cooling, heating plants)
 - Locate the energy conservation measures on site
- **Final Verification Report**
 - **Detail the findings of the verification process**
 - **Estimate of final energy savings for the building**
 - **Document final incentive**
- Xcel Energy and CenterPoint Energy incentive payment

List of Verified Strategies

The following table provides 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	95% efficient condensing gas boiler, aggressive temperature reset	5%	Yes	5%
VAV-City Hall	10% improved DX cooling efficiency	2%	Yes	2%
VAV-Police	10% improved DX cooling efficiency	3%	Yes	3%
VAV-City Hall	Standard efficiency DX compressor part load performance	5%	Yes	5%
VAV-Police	Standard efficiency DX compressor part load performance	7%	Yes	8%
Facility	VFD on building heating water pump	< 1%	Yes	< 1%
VAV-City Hall	Demand control ventilation for Office-City Hall Meeting	1%	Yes	1%
VAV-City Hall	Demand control ventilation for Office-City Hall	2%	Yes	2%
VAV-Police	Total heat recovery	9%	Partial	8%
MAUs	CO sensor control of ventilation beyond ASHRAE 90.1-2010	9%	Yes	9%
MAUs	Direct-fired furnace	4%	Yes	4%
Architectural				
Garages	Wall R-16	< 1%	Yes	< 1%
Office-Police	Wall R-16	< 1%	Yes	< 1%
Office-City Hall Meeting	Wall R-16	< 1%	Yes	< 1%
Office-City Hall	Wall R-16	< 1%	Yes	< 1%
Fitness	Roof R-24	< 1%	Yes	< 1%
Office-Police	Roof R-24	< 1%	Yes	2%
Office-City Hall Meeting	Roof R-24	< 1%	Yes	< 1%
Office-City Hall	Roof R-24	< 1%	Yes	1%
Office-Police	Glazing medium solar gain, metal frame	4%	Partial	3%
Office-City Hall Meeting	Glazing medium solar gain, metal frame	1%	Partial	1%
Office-City Hall	Glazing medium solar gain, metal frame	2%	Partial	2%
Electrical				
Facility	Exterior site lighting reduced to 4.13 kW	3%	Partial	1%
Office-Police	Dimming daylighting control, 100% of space	4%	Yes	4%
Office-City Hall Meeting	Dimming daylighting control, 100% of space	2%	No	0%
Office-City Hall	Dimming daylighting control, 100% of space	2%	Yes	2%
Garages	Dual level occupancy sensor control, 100% of space	< 1%	Yes	< 1%
Fitness	Vacancy sensor controls, 100% of space	< 1%	Yes	< 1%
Office-Police	Vacancy sensor controls, 100% of space	3%	Yes	3%
Office-City Hall Meeting	Vacancy sensor controls, 100% of space	1%	Yes	1%
Office-City Hall	Vacancy sensor controls, 100% of space	1%	Yes	1%

Space Asset Area	Strategy Description	Portion of Total \$ Savings Modeled	Verified as Modeled?	Portion of Total \$ Savings Verified
Fitness	Lighting power in Fitness reduced to 0.44 W/ft ²	< 1%		Partial < 1%
Garages	Lighting power in Garages reduced to 0.28 W/ft ²	7%	Yes	10%
Office-Police	Lighting power in Office-Police reduced to 0.45 W/ft ²	13%		Partial 13%
Office-City Hall	Lighting power in Office-City Hall reduced to 0.45 W/ft ²	4%		Partial 3%
Office-City Hall Meeting	Lighting power in Office-City Hall Meeting reduced to 0.54 W/ft ²	2%		Partial 2%
Service Water Heating				
Facility	95% SWH efficiency	< 1%	Yes	< 1%
Total Savings		100%		102%

Summary

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

Wall Assembly

- The verified wall assembly R-value of R-20 is higher than the expected R-16, resulting in more savings.

Roof Assembly

- The verified roof assembly R-value of R-43 is higher than the expected R-24, resulting in more savings.

Glazing

- The verified windows glazing U-factor is lower than expected, resulting in more savings. The verified windows glazing SHGC is higher than expected, resulting in less savings. Overall, resulting in less savings.

Daylighting

- We were unable to locate photosensors in the Office – City Hall Meeting areas, resulting in no savings.

Lighting Design

- The verified lighting power densities in the police, city hall, meeting, and fitness are higher than expected, resulting in less savings. The verified lighting power density in the garage is lower than expected, resulting in more savings. Overall, resulting in slightly more savings.
- The verified exterior parking lot surface area is less than originally modeled, resulting in less savings. The main parking lot was not included in this review.

DX Cooling

- The verified police and city hall AHU DX full load cooling improvement of 10.2% is better than the expected 10.0%, resulting in more savings
- The verified police and city hall AHU DX part load cooling performance is higher than expected, resulting in more savings.

Total Heat Recovery

- The verified Police heat recovery effectiveness of 70.4% sensible and 55.7% latent is less effective than the expected 75% sensible/latent, resulting in less savings.

Further detail about these strategies may be found in the “Individual Strategy Verification Results” section of this report.

Individual Strategy Verification Results

The following table(s) provides the field verification detailed findings for the applicable strategies. In addition, the appendices have further information and calculations.

Mechanical Strategy Verification Results

Mechanical

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Facility	95% efficient condensing gas boiler, aggressive temperature reset	Install a condensing gas boiler with 95% peak efficiency and specify an aggressive temperature reset schedule with return water temperatures ranging from 140°F (60°C) at peak winter conditions to 90°F (32.2°C) at mild conditions.	Explicit efficiency percent: 95 % Aggressive reset	The verified value meets the strategy requirements.
VAV-City Hall VAV-Police	10% improved DX cooling efficiency	Improve cooling efficiency by 10%	10.2% improved 10.8 EER	The verified value meets the strategy requirements.
VAV-City Hall VAV-Police	Standard efficiency DX compressor part load performance	Improve compressor part load performance beyond baseline minimum requirements.	High efficiency 14.1 IEER	The verified value resulted in more savings.
Facility	VFD on building heating water pump	Install VFD control rather than constant speed drives on the loop pump motors.	Implemented	The verified value meets the strategy requirements.

Conditioning of Outside Air

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
VAV-City Hall VAV-City Hall	Demand control ventilation for Office-City Hall Meeting	Use CO2 sensors, occupancy sensor control of zone ventilation, or other methodology to reduce the outside air during times of partial occupancy.	Implemented	The verified value meets the strategy requirements.
VAV-Police	Total heat recovery	Provide 75% effective sensible and latent heat recovery on 90% of the building exhaust air.	70 % Sensible 56 % Latent	The verified value resulted in less savings than planned.

Garage

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
MAUs	CO sensor control of ventilation beyond ASHRAE 90.1-2010	Provide carbon monoxide sensors that control the garage ventilation rates so that ventilation is reduced during times of low occupancy.	Implemented	The verified value meets the strategy requirements.
MAUs	Direct-fired furnace	Provide direct fired gas furnaces for garage heating. Direct fired furnaces vent their exhaust air directly into the space.	Implemented	The verified value meets the strategy requirements.

Site Photos



Image of typical VFD



Image of typical boiler



Image of typical condensing unit



Image of hot water heaters

Architectural Strategy Verification Results

Wall

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Garages Office-Police Office-City Hall Meeting Office-City Hall	Wall R-16	Install a wall with a total R-value, including thermal bridging of R-16 (U-0.063)	R-20	The verified value resulted in more savings than planned.

Roof

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Fitness Office-Police Office-City Hall Meeting Office-City Hall	Roof R-24	Install a roof with a total assembly value, including thermal bridging of R-24 (U-0.042)	R-43	The verified value resulted in more savings than planned.

Glazing

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Office-Police Office-City Hall Meeting Office-City Hall	Glazing medium solar gain, metal frame	Unit U-value 0.42 Center of Glass U-value 0.29 SHGC 0.29 VT 0.62	0.38 0.25 0.37 0.67	The verified value resulted in less savings than planned.

Electrical Strategy Verification Results

Daylighting Control

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Office-Police	Dimming daylighting control, 100% of space	Provide automatic dimming (down to 10%) daylighting controls for 100% of the area with daylight harvesting potential. Dimming daylighting controls are assumed to control the area within the first 15 feet (4.57 meters) from the perimeter walls or two window head heights, whichever is smaller.	Area covered: 9,616 ft ²	The verified value meets the strategy requirements.
Office-City Hall Meeting	Dimming daylighting control, 100% of space	Provide automatic dimming (down to 10%) daylighting controls for 100% of the area with daylight harvesting potential. Dimming daylighting controls are assumed to control the area within the first 15 feet (4.57 meters) from the perimeter walls or two window head heights, whichever is smaller.	Not found	The verified value resulted in no savings.
Office-City Hall	Dimming daylighting control, 100% of space	Provide automatic dimming (down to 10%) daylighting controls for 100% of the area with daylight harvesting potential. Dimming daylighting controls are assumed to control the area within the first 15 feet (4.57 meters) from the perimeter walls or two window head heights, whichever is smaller.	Area covered: 6,481 ft ²	The verified value meets the strategy requirements.

Lighting Controls

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Garages	Dual level occupancy sensor control, 100% of space	Provide dual level occupancy sensors in all applicable enclosed spaces such as private offices that only provide 2/3 light level unless a switch or button is pressed.	Area covered: 21,000 ft ²	The verified value meets the strategy requirements.
Fitness	Vacancy sensor controls, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the building such that manual switches are used to turn lights on and the sensors automatically turn lights off when the space is unoccupied.	Area covered: 2,100 ft ²	The verified value meets the strategy requirements.
Office-Police	Vacancy sensor controls, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the building such that manual switches are used to turn lights on and the sensors automatically turn lights off when the space is unoccupied.	Area covered: 21,210 ft ²	The verified value meets the strategy requirements.
Office-City Hall Meeting	Vacancy sensor controls, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the building such that manual switches are used to turn lights on and the sensors automatically turn lights off when the space is unoccupied.	Area covered: 7,261 ft ²	The verified value meets the strategy requirements.
Office-City Hall	Vacancy sensor controls, 100% of space	Provide vacancy sensors in 100% of the applicable spaces throughout the building such that manual switches are used to turn lights on and the sensors automatically turn lights off when the space is unoccupied.	Area covered: 14,255 ft ²	The verified value meets the strategy requirements.

Lighting Power Density

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Facility	Exterior site lighting reduced to 4.13 kW	Reduce exterior site lighting power by 50% below the baseline allowance.	2.45 kW below baseline	The verified parking lot area is less than originally modeled, resulting in less savings.

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Fitness	Lighting power in Fitness reduced to 0.44 W/ft ²	Reduce lighting power density by 50% below the Baseline specified by building allowances.	Improved power density: 0.56 W/ft ²	The verified value resulted in less savings than planned.
Garages	Lighting power in Garages reduced to 0.28 W/ft ²	Reduce lighting power density by 50% below the Baseline specified by building allowances.	Improved power density: 0.13 W/ft ²	The verified value resulted in more savings than planned.
Office-Police	Lighting power in Office-Police reduced to 0.45 W/ft ²	Reduce lighting power density by 50% below the Baseline specified by building allowances.	Improved power density: 0.47 W/ft ²	The verified value resulted in less savings than planned.
Office-City Hall	Lighting power in Office-City Hall reduced to 0.45 W/ft ²	Reduce lighting power density by 50% below the Baseline specified by building allowances.	Improved power density: 0.55 W/ft ²	The verified value resulted in less savings than planned.
Office-City Hall Meeting	Lighting power in Office-City Hall Meeting reduced to 0.54 W/ft ²	Reduce lighting power density by 40% below the Baseline specified by building allowances.	Improved power density: 0.55 W/ft ²	The verified value resulted in less savings than planned.

Site Photos



Images of typical office lighting



Image of garage lighting



Image of meeting lighting

Other Strategy Verification Results

Service Water Heating

Space Asset Area	Strategy Description	Strategy Requirements	Verification Review	Verification Findings
Facility	95% SWH efficiency	Install an 95% efficient natural gas service hot water heater.	Explicit efficiency percent: 96 %	The verified value meets the strategy requirements.

Verified Bundle Results and Incentive

The tables on the next pages show the calculated energy cost savings for these energy investments with the included Xcel Energy and CenterPoint Energy incentive. The table also provides payback analysis of the verified bundle.

Energy Parameter	Selected Bundle, As Modeled	Selected Bundle, As Built
Energy Cost Savings	\$49,970	\$50,932
Percent Energy Cost Savings	37%	38%
Electric Demand Savings	85 kW	78 kW
Percent Electric Demand Savings	38%	35%
Electric Consumption Savings	261,787 kWh	262,012 kWh
Percent Electric Consumption Savings	35%	35%
Gas Consumption Savings	1,988 dekatherm	2,335 dekatherm
Percent Gas Consumption Savings	40%	46%
Total Incremental First Cost	\$233,910	\$254,222
Estimated Xcel Energy Electric Incentive	\$44,471	\$41,680
Estimated CenterPoint Energy Gas Incentive	\$6,959	\$8,171
Estimated Total Incentive	\$51,430	\$49,851
Simple Payback with Incentive	3.7	4.0

Energy Parameter	Baseline	Selected Bundle, As Modeled	Selected Bundle, As Built
Building Results			
Energy Use Intensity (EUI)	114.9 KBtu/ft ² /yr	71.1 KBtu/ft ² /yr	65.8 KBtu/ft ² /yr
EUI Savings		43.8 KBtu/ft ² /yr	49.0 KBtu/ft ² /yr
Percent EUI Savings		38%	43%

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 a building that has not been built.

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 design team 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 Xcel Energy and CenterPoint Energy or Willdan. Savings are not guaranteed.

Appendix A. Project Information

Building Summary			
Location	New Hope, MN		
Space Asset Areas	Area	Number of Stories	
Office-City Hall	14,255 ft ²	1	
Office-City Hall Meeting	7,261 ft ²	1	
Office-Police	21,210 ft ²	1	
Fitness	2,100 ft ²	1	
Garages	21,000 ft ²	1	
Total	65,826 ft²	2	
Utilities			
Electric Utility	Xcel Energy		
Gas Utility	CenterPoint Energy		
Schedule			
Construction Documents Complete	11/01/2017		
Construction Start	01/15/2018		
Occupancy	06/27/2019		
Baseline Reference	ASHRAE 90.1-2010		
Other Notes			

Systems Summary	
Selected HVAC	VAV air handlers with DX cooling will be supplied with hot water heat from gas boilers and heat recovery. Hot water will also be supplied to hydronic heat and VAV reheat boxes. The garage area will have a gas fired make-up air unit.

Average Grid Peak*

Bundle	Grid Peak kW Savings
Description	
Selected Bundle	75.8 kW

*Xcel Energy use only, not used for incentive calculation

Appendix B. 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	Gas Savings (Therm)	Energy Cost Savings	Inc. Cost
Fitness	Lighting power in Fitness reduced to 0.44 W/ft ²	0	2,067	-54	\$248	\$1,332
Garages	Lighting power in Garages reduced to 0.28 W/ft ²	6	52,837	-504	\$5,497	\$13,315
Office-Police	Lighting power in Office-Police reduced to 0.45 W/ft ²	9	68,107	-1,027	\$6,987	\$13,448
Office-City Hall	Lighting power in Office-City Hall reduced to 0.45 W/ft ²	5	12,124	-297	\$1,739	\$9,039
Facility	95% efficient condensing gas boiler, aggressive temperature reset	0	-400	4,161	\$2,520	\$6,993
Garages	Dual level occupancy sensor control, 100% of space	0	4,587	-38	\$483	\$1,470
VAV-City Hall	Demand control ventilation for Office-City Hall Meeting	0	109	1,015	\$650	\$2,868
VAV-City Hall	Demand control ventilation for Office-City Hall	0	246	1,326	\$854	\$5,631
Garages	Wall R 16	0	0	193	\$119	\$945
Office-Police	Wall R 16	0	198	317	\$284	\$624
Office-City Hall Meeting	Wall R 16	0	69	103	\$97	\$229
Office-City Hall	Wall R 16	0	126	149	\$146	\$355
VAV-City Hall	Standard efficiency DX compressor part load performance	7	19,359	0	\$2,857	\$13,985
VAV-Police	Standard efficiency DX compressor part load performance	9	33,097	0	\$4,442	\$15,152

Space Asset Area	Strategy Description	Peak kW Savings	kWh Savings	Gas Savings (Therm)	Energy Cost Savings	Inc. Cost
MAUs	CO sensor control of ventilation beyond ASHRAE 90.1-2010	0	9,335	6,824	\$5,022	\$1,680
Fitness	Vacancy sensor controls, 100% of space	0	1,705	-45	\$183	\$525
Office-Police	Vacancy sensor controls, 100% of space	2	17,484	-264	\$1,811	\$3,712
Office-City Hall Meeting	Vacancy sensor controls, 100% of space	1	5,234	-39	\$579	\$1,271
Office-City Hall	Vacancy sensor controls, 100% of space	2	6,555	-160	\$777	\$2,495
MAUs	Direct-fired furnace	0	0	3,697	\$2,267	\$3,276
Office-Police	Glazing medium solar gain, metal frame	3	1,111	1,941	\$1,750	\$35,099
Office-City Hall Meeting	Glazing medium solar gain, metal frame	1	662	666	\$631	\$12,893
Office-City Hall	Glazing medium solar gain, metal frame	1	544	917	\$867	\$19,971
VAV-Police	Total heat recovery	7	-2,300	5,486	\$4,409	\$41,400
Office-City Hall Meeting	Lighting power in Office-City Hall Meeting reduced to 0.54 W/ft ²	2	9,499	-64	\$1,205	\$2,020
Facility	95% SWH efficiency	0	0	169	\$104	\$2,567
VAV-City Hall	10% improved DX cooling efficiency	6	3,963	0	\$1,364	\$8,069
VAV-Police	10% improved DX cooling efficiency	7	7,010	0	\$1,798	\$8,741
Fitness	Roof R-24	0	19	147	\$133	\$665
Office-Police	Roof R-24	2	11	1,235	\$1,081	\$6,717
Office-City Hall Meeting	Roof R-24	1	-151	332	\$318	\$2,299

Space Asset Area	Strategy Description	Peak kW Savings	kWh Savings	Gas Savings (Therm)	Energy Cost Savings	Inc. Cost
Office-City Hall	Roof R-24	1	290	815	\$788	\$4,514
Facility	Exterior site lighting reduced to 4.13 kW	0	9,085	0	\$813	\$1,090
Facility	VFD on building heating water pump	0	2,107	-37	\$170	\$538
Office-Police	Dimming daylighting control, 100% of space	5	17,245	-450	\$2,157	\$5,303
Office-City Hall Meeting	Dimming daylighting control, 100% of space	0	0	0	\$0	\$0
Office-City Hall	Dimming daylighting control, 100% of space	4	7,862	-221	\$1,234	\$3,991

Appendix C. Project Participants

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