SIEMENS

PROPOSAL
Torrington Middle School | Siemens - Existing Building Retro-commissioning Energy Project

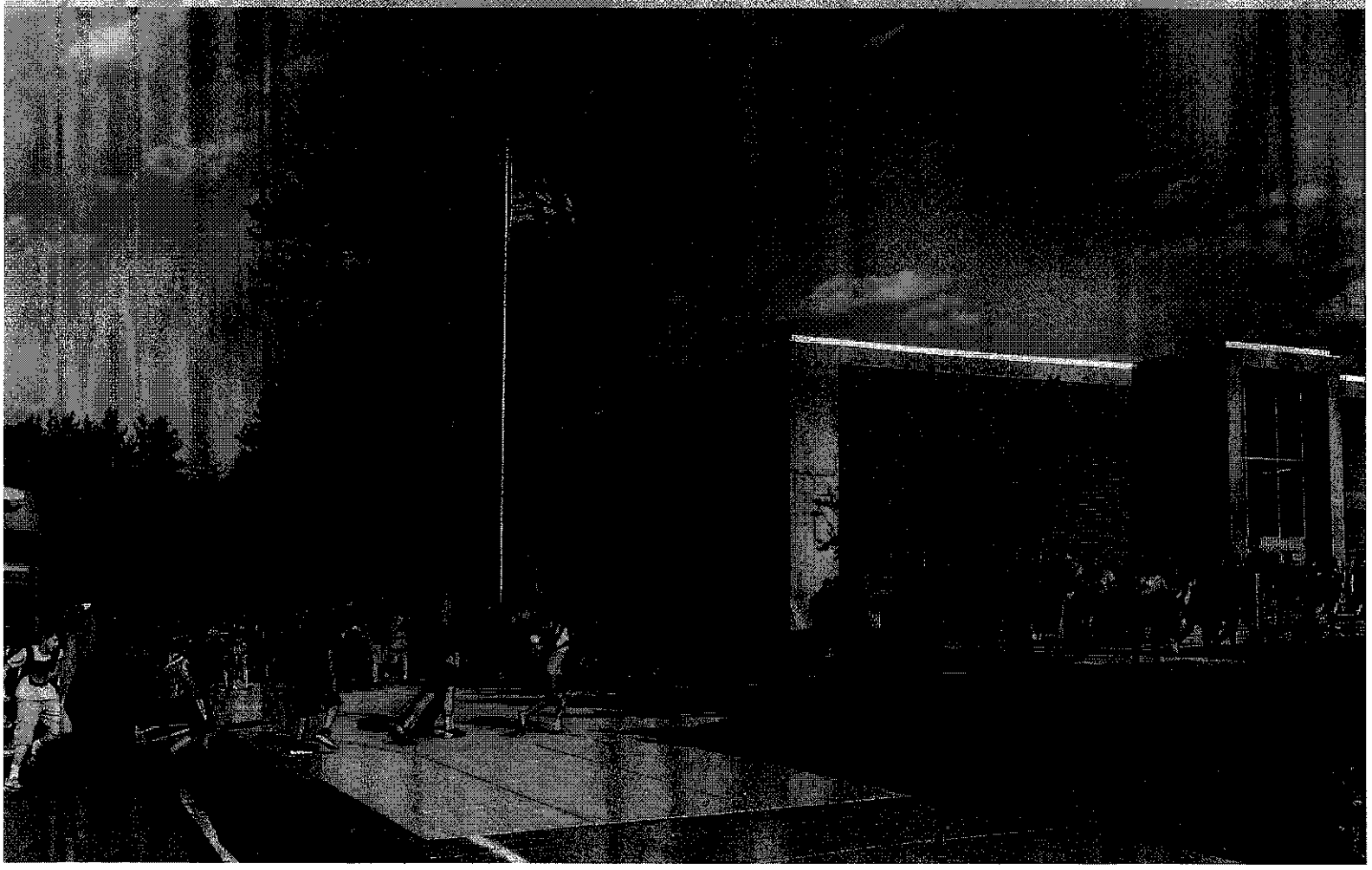
PREPARED BY
Siemens Industry, Inc. ("Siemens")

PREPARED FOR
Torrington Public Schools

DELIVERED ON
August 22, 2024

K12 EDUCATION

Transforming the Everyday



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Contact Information

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Date:	August 22, 2024

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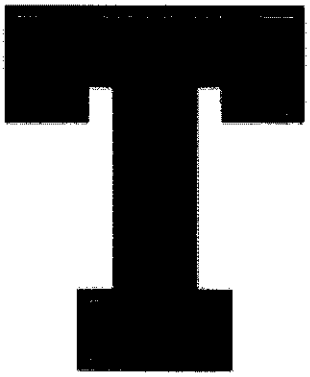
Customer:	Torrington Public Schools
Address:	355 Migeon Avenue
	Torrington, CT 06970
Services shall be provided at:	Torrington Middle School
	200 Middle School Drive
	Torrington, CT 06970

Scope of Work

Siemens is pleased to provide the following scope of work for Torrington Public Schools and the Torrington Middle School:



Project:

Torrington Public Schools has asked Eversource and Siemens to identify energy conservation measures (ECMs) via the Eversource Existing Building Retro-Commissioning (RCx) program, with the goal of reducing energy consumption at the Middle School. The resulting recommendations aim to conserve energy, lower operational costs and reduce the town of Torrington's carbon footprint, while providing better control of the indoor air environment.

Eversource's RCx program enables cooperation between Siemens and a third-party engineering firm (Resource Innovations) to identify ECMs. ECMs include upgrades to HVAC, lighting, building envelope, etc. Siemens and Resource Innovations provided a full scope of work and associated costs for the ECMs identified. Resource Innovations and Eversource also provided related energy savings calculations, secured all available incentives, and will provide post-install measurement and verification of scope & energy savings.

The proposed Scope of Work will modernize critical HVAC systems, reduce operational costs through energy savings, and extend investment dollars through outside funding via the Eversource Incentives.

Existing Building Retro-Commissioning Scope of Work:

ECM 1 - Schedule Operation of AHUs and Fans

All but one of the 21 AHUs, 10 return air fans, and 30 exhaust fans currently run between the hours of 6 AM and 9 PM, Monday through Friday, even though the areas they serve are not usually occupied after school hours. AHU-1, that serves the music area, currently is scheduled to operate from 6:00 am to 4:00 pm Monday through Friday. Resource Innovations recommends modifying the schedules for all of the AHUs, return fans, and exhaust fans so they are energized one hour before the space they serve is normally occupied but are de-energized at the end of the normal occupied period, typically 4:00 pm M-F.

During unoccupied mode the AHUs will cycle on to maintain the setback temperature. Ventilation air will not be provided during unoccupied mode, but economizer operation will be enabled. Scheduling the AHUs will reduce electrical consumption and heating and cooling energy since outside air will not need to be conditioned during unoccupied periods. Increased savings could be realized from using an optimum start/ stop sequence and ensuring ventilation air is not used during the morning warm-up/ cool-down period.

For Torrington Middle School to implement this measure, the school should continue to use the existing BMS for scheduling but include scheduled override functionality for after school events. For a space that has after hour events, the building operator can override the associated AHU for the duration of the event. The schedule will then be reset back to normal operation after the special event is over

Siemens Scope of Work:

- Siemens will provide expert engineering specialist support to update programming to adjust scheduling for all of the mechanical equipment listed above.
- Siemens will provide training on how to manipulate scheduling via the building automation system for future use by Torrington Facilities Staff
- Siemens will provide professional project management support and assistance with commissioning.

ECM 2 - Implement Optimal Start-Stop for AHUs and Fans

All of the AHUs in the school operate on the same schedule every day. Resource Innovations recommends implementing a start/stop time optimization (SSTO) control strategy. With SSTO, each AHU is programmed to meet the desired set points for space temperature and ventilation air based on programmed occupancy schedules and optimal warmup and cooldown times rather than fixed schedules for starting and stopping.

Over time, the BMS learns how long it will take to bring the building up or down to the space temperature setpoint before the time the space is scheduled to be occupied. In similar fashion, the BMS will shut off the HVAC systems when conditions will allow the space to remain comfortable until it is unoccupied. The reductions in run time before and after the space is occupied result in fan energy, cooling energy, and heating energy savings.

Siemens Scope of Work:

- Siemens will provide expert engineering specialist support to implement Optimal Start-Stop (SSTO) for all of the AHUs controlled by the Siemens building automation system.

- Siemens will provide professional project management support and assistance with commissioning.

ECM 3 - Restore Economizer Functionality and Reduce OA

During the investigation phase it was observed that most of the economizers were not working correctly, possibly due to a need for calibration or possibly due to failed sensors or economizer motor failure.

Resource Innovations recommends restoring the economizer's functionality and reducing the minimum outside air flow. This would be achieved by adjusting the outdoor air dampers, and modifying the economizer control strategy so the outdoor air damper opens when the outdoor air dry-bulb temperature is lower than 65°F. In economizer mode (also called free-cooling mode), the air handler increases the amount of outdoor air brought in which saves energy since the outdoor air will be cooler and require less mechanical cooling than the air returning from the space. The amount of cooler outside air entering the air handler is optimized based on the outside air temperature and the supply air temperature setpoints. When the outdoor air temperature exceeds the economizer setpoint, the economizer is disabled and the outdoor and return air dampers modulate to supply the minimum amount of outdoor air required for ventilation.

Siemens Scope of Work:

- Siemens will provide programming for the new system functionality, as well as graphics for visibility and intuitive command and control capability by facilities operators
    - Mechanical repair/installation is excluded, Siemens assumes the AHU damper modulation is in good working order. Siemens is only providing updated sensing/calibration and programming for the implementation of this measure.
- Siemens will provide professional project management support and assistance with commissioning.

ECM 4 - Modulate AHU Fan Speeds Based on Load

Of the 21 AHUs serving the Torrington Middle School, 18 are equipped with either variable frequency drives (VFDs) or inlet guide vanes (IGVs). The IGVs are no longer working and the VFDs are all set to maintain 90% speed. None of the AHU fans speeds modulate their speeds at present.

All of the AHUs supply air to cabinet coils in the supply ducts of the spaces they serve. The cabinet coils consist of a housing with an inlet damper, cooling coil, and heating coil. The inlet dampers open full when the space is in occupied mode and close to a pre-determined minimum in unoccupied mode. Since the occupancy sensors in all the rooms were disconnected during a recent lighting renovation, all the rooms stay in occupied mode whenever the BMS schedules their AHUs to the occupied setting.

The AHUs with variable speed fan controls were intended to modulate their fan speeds based on duct static pressure. Since the cabinet coil units no longer close their dampers during occupied hours, and very few of them closed them before the occupancy sensors were disconnected, the static pressure control is no longer viable. Changing the dampers to modulate in response to room temperature would require changing all 124

cabinet damper actuators to variable speed actuators and would require different controllers for each cabinet coil unit. The existing controllers are Siemens TECs that have analog points for the chilled water and hot water coil control valves but only digital on-off (maximum or minimum setting) controls for the dampers.

Resource Innovations recommends installing VFDs on all of the AHUs with fans of 5 hp or larger and connecting the existing VFDs to the BAS. The fan speed control algorithms for the variable speed AHUs will be modified so that the BMS will poll all of the chilled water and hot water coils associated with an AHU and reduce the fan speed by 5% every 5 minutes until one control valve is more than 95% full open. In the heating mode, the fan speed will be controlled by the position of the hot water coil control valve in a similar fashion. The minimum fan speed will be limited to the minimum ventilation air required for the rooms served by each AHU. An additional enhancement would be to install a relative humidity sensor set to 55% (adjustable) that would signal the fan speed to increase if the humidity increases over that point.

This measure will provide electric and natural gas savings by reducing fan speed and reducing the amount of outdoor air supplied to the rooms being served.

Siemens Scope of Work:

Siemens will provide, install and wire (9) new VFDs for supply air fans for AHUs 1, 5-8,11,12,14 and 18. Siemens will also provide, install and wire (6) new VFDs for return air fans on AHUs 5-8, 14 and 20.

- Siemens will provide, install and wire (4) new 10HP ABB ACH580 variable frequency drives for supply air fans on AHUs 5-8.
- Siemens will provide, install and wire (4) new 5HP ABB ACH580 variable frequency drives for return air fans on AHUs 5-8.
- Siemens will provide, install and wire (1) new 7.5HP ABB ACH580 variable frequency drives for the return air fan on AHU 20.
    - AHU 20 has an existing to remain VFD on the supply air fan.
- Siemens will provide, install and wire (1) new 7.5HP ABB ACH580 variable frequency drives for the supply air fan on AHU 14.
- Siemens will provide, install and wire (1) new 5HP ABB ACH580 variable frequency drives for the return air fan on AHU 14.
- Siemens will provide, install and wire (4) new 5HP ABB ACH580 variable frequency drives for the supply air fans on AHUs 1, 11, 12 and 18.

For all of the above:

- Siemens will utilize MS/TP networking to integrate to each VFD, providing command and control capability from the existing Siemens Desigo Optic building automation system (BAS).
- Siemens will utilize existing controllers, end devices, power supplies, cabinet hardware, etc. as no new infrastructure is required for network integration
- Siemens excludes all typically hard-wired points for the VFDs, meaning that a communications/ network loss will result in loss of control of the VFD. This is acceptable industry practice for non-critical spaces. The AHUs will continue to function at last commanded state, until communication is restored.

Siemens will provide MS/TP network cabling and integration programming for existing VFDs not currently tied into the building automation system.

- Siemens will provide network cabling runs to (5) existing Eaton H-Max Series VFDs, located on AHUs 2, 9, 10, 16 and 20.
    - Siemens will utilize MS/TP networking to integrate to each VFD, providing command and control capability from the existing Siemens Desigo Optic building automation system (BAS).

ECM 5 - Implement Demand Control Ventilation (DCV) for the Auditorium, Gymnasium, and Cafeteria

Occupancy of the auditorium, gymnasium, and cafeteria varies throughout the day and throughout the school year. The AHUs serving these areas are designed to provide adequate ventilation during times of peak occupancy, and therefore the area is over-ventilated most of the time. Outdoor air is typically the most significant part of the heating and cooling loads on an AHU. Excess ventilation does not improve the comfort or safety of the occupants in a room that is only partially occupied, but it does increase the energy costs for that room.

Resource Innovations recommends implementing demand-controlled ventilation (DCV) controls in the auditorium, gymnasium, and cafeteria. A typical installation involves installing CO2 sensors in the breathing zone of the space or the return air duct and connecting them to the control system. Siemens may be able to use a combination temperature sensor and CO2 sensor to minimize installation costs.

With the DCV control, the outdoor air dampers will then modulate to maintain a breathing zone CO2 level below approximately 900 ppm (adjustable). The dampers will be allowed to modulate between the current minimum position and a new pre-determined minimum position. This reduced minimum position will be determined to provide ventilation based on area as required by ASHRAE 62.1. In the event of concerns about any airborne contaminants in these spaces, the CO2 threshold setting can be set lower to increase the amount of outdoor air without any additional equipment or program changes.

Siemens Scope of Work:

- Siemens will provide, wire and install (4) new CO2 sensors in the return air ducts of AHU 2, 10, 15 and 16.
    - Siemens will utilize existing controllers, air handling controls, sensors, end devices, etc. unless otherwise stated
- Siemens will provide updated programming for the new system functionality, as well as graphics for visibility and intuitive command and control capability by facilities operators
- Siemens will provide professional project management support and assistance with commissioning

ECM 6 - Upgrade Chiller Plant Controls

Note: This ECM requires further investigation in determining the baseline/existing operation of the chillers to identify savings and incentives for the proposed measures. Siemens recommends proceeding with installation as a part of this project, and final incentives and savings calculations will be provided in an amendment to the existing LOA from Eversource

At present the chillers, chilled water pumps, condenser water pump, and cooling tower fan are controlled by a field fabricated relay panel in the mechanical room. Since the controls are primarily electro-mechanical relays, the potential to operate the chiller plant in an energy efficient manner is very limited. For example, when the panel receives a call for cooling from the BMS, even at low part loads, it energizes both chillers and both primary chilled water pumps, the secondary chilled water pump, one of the condenser water pumps, and the cooling tower fan. The chiller controls stage on the third and fourth condensers based on return water temperature but none of the control sequences of operation can be modified or optimized.

Resource Innovations recommends installing additional modules in the Siemens control panel in the chiller room and adding the chillers, pumps, and cooling tower to the BMS. This measure will enable the school to take advantage of strategies such as optimal chiller start-stop, chilled water reset, variable speed secondary chilled water pump control, and condenser water reset among others.

Siemens Scope of Work:

Siemens will provide, wire and install a new Siemens control panel to provide command and control capabilities of the existing chilled water plant.

- Siemens will provide, wire and install (1) new PXC modular series controller, in a new 34" Siemens enclosure
    - Siemens will provide and install new I/O controller modules, associated panel hardware and licensing required
    - Siemens will disconnect, categorize and reconnect existing chilled water plant control wiring to the new chilled water plant control panel
        - Existing wiring to remain, any inoperable sensors/devices will be identified and repaired as separate, billable items
- Siemens will provide and install (2) new BACnet communications cards for the existing Daikin chillers
    - Siemens will provide new MS/TP network wiring to each chiller
    - Siemens will provide new integration capability for each existing chiller
- Siemens will provide the necessary energy conservation programming and commissioning support to retro-commission the chilled water plant on the existing Siemens building automation system.
    - Siemens will provide all new graphics on the existing Siemens Desigo Optic building automation system, providing intuitive graphical command and control capability
- Siemens will provide new documentation including sequence of operations, as-builts, etc. for future reference

Exclusions

Excluded:

- Any previously developed or proposed ECMs that are not specifically outlined in this proposal are excluded
- Temporary cooling
- Hazardous material handling
- Work to be conducted during normal business hours (Monday - Friday, 8AM - 5PM)
- Customer IT department to provide IP addressing & configuration support as required
    - Siemens will provide all necessary electrical and networking installation as a part of this project.
- Existing controllers , building and floor level systems, end devices, etc. are to remain (unless otherwise stated, i.e. chiller plant controller, VFDs, specific new sensors)
- Cut, Patch, Paint, Asbestos Abatement, Piping or Insulation
- Any devices found to be inoperable will be identified and repaired as separate billable items
- Excludes Tax

Project Investment

ECM Description	ECM Implementation Cost
ECM 1 - Schedule Operation of AHUs and Fans	$7,208.00
ECM 2 - Implement Optimal Start-Stop for AHUs and Fans	$8,332.00
ECM 3 - Restore Economizer Functionality and Reduce OA	$10,662.00
ECM 4 - Modulate AHU Fan Speeds Based on Load	$177,556.00
ECM 5 - Implement Demand Control Ventilation (DCV) for the Auditorium, Gymnasium, and Cafeteria	$20,008.00
ECM 6 - Convert Chiller Plant to DDC Controls via Siemens BMS	$73,606.00

Total Project Investment	**$297,392.00**

This price is firm for 30 days from the date of this proposal.

Savings Tables

Savings Tables from the Current Eversource LOA, including Measurement & Verification costs from Eversource Technical Advisor, Resource Innovations:

Excludes savings and incentives from ECM - 6, but will include savings and incentives for the measure once data collection is complete This table from Eversource shows the $139,644.09 in incentive money being provided to Torrington Public Schools to proceed with the project in its entirety.

[illegible]	[illegible]
[illegible]	Torrington, CT
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

* Costs Include CxP Fees

ECM No	Measure Description	Electrical Savings: Annual kWh	Summer Peak kW	Winter Peak kW	Annual Savings, $	Customer Heating Savings: Gas CCF	Annual Savings $	Total Project Savings, $	Siemens Quoted Installation Cost, $	Resource Innovations Quoted Verification Cost, $	Total * Implementation Cost, $	Incentive Breakdown: Electric, $	Gas, $	Years Payback w/ Incent.	
ECM-1	Schedule operation of AHUs and fans	169,922	36.11	85.8	$28,547	31,034	$27,527	$56,074	$7,208	$5,338	$ 12,546	$ 3,193.49	$ 3,079.39	0.1	
ECM-2	Optimal Start/stop of AHUs and fans	34,651	11.29	11.5	$5,821	6,065	$5,380	$11,201	$8,332	$7,117	$ 15,449	$ 4,014.57	$ 3,709.93	0.7	
ECM-3	Restore economizer functionality and reduce OA	8,542	12.12	0.0	$1,435	2,099	$1,862	$3,297	$10,662	$3,559	$ 14,221	$ 3,095.07	$ 4,015.18	2.2	
ECM-4	Modulate AHU fan speeds based on loads	58,702	9.10	20.5	$9,862	2,003	$1,777	$11,639	$177,556	$12,455	$ 190,011	$ 29,351.00	$ 10,015.00	12.9	
ECM-5	Implement DCV in auditorium, gym, and café	1,330	2.52	0.0	$223	4,468	$3,963	$4,186	$20,008	$1,779	$ 21,787	$ 581.39	$ 10,312.23	7.6	
ECM-6	Convert chiller plant to Siemens BMS control (On Hold)	-	-	-	-	-	-	-			-	-	-	-	
	Distressed Incentive											$ 18,276.84	$ 50,000.00	-	
	PROJECT TOTALS:	273,147	73.13	117.8	$ 45,889	45,668	$ 40,508	$ 86,397	$ 223,766	$ 30,247	$ 254,013	$ 58,512.36	$ 81,131.78	1.3	(Overall project)
											TOTAL IMPLEMENTATION INCENTIVE:	$ 139,644.09			

Final Savings Table - Worst Case Financial Scenario

ECM No	Measure Description	Estimated Total Project Financials: Electric Savings kWh	Electric Savings	Gas Savings CCF	Gas Savings	Total Impl. Costs	Incentives Electric	Incentives Gas	Net Install Costs	Estimated ROI	Siemens Proposal
ECM-1	Schedule Operation of AHUs and Fans	169,922	$ 28,547.00	31,034	$ 27,527.00	$ 12,546.00	$ 3,193.49	$ 3,079.39	$ 6,273.12	0.11	$ 7,208.00
ECM-2	Optimal Start Stop of AHUs and Fans	34,651	$ 58,211.00	6,065	$ 5,380.00	$ 15,449.00	$ 4,014.57	$ 3,709.93	$ 7,724.50	0.12	$ 8,332.00
ECM-3	Restore Economizer Functionality & Reduce OA	8,542	$ 1,435.00	2,099	$ 1,862.00	$ 14,221.00	$ 3,095.07	$ 4,015.18	$ 7,110.75	2.16	$ 10,662.00
ECM-4	Modulate AHU Fan Speeds	58,702	$ 9,862.00	2,003	$ 1,777.00	$ 190,011.00	$ 29,351.00	$ 10,015.00	$150,645.00	12.94	$177,556.00
ECM-5	Implement DCV in Auditorium, Gym, and Café	1,330	$ 225.00	4,468	$ 5,963.00	$ 21,787.00	$ 581.39	$ 10,312.23	$ 10,893.38	1.76	$ 20,008.00
ECM-6	Chiller Controls (Includes FIRM Impl. Costs)		$0.00	-	$ -	$ 78,944.00	$	$ -	$ 78,944.00	#DIV/0!	$ 73,606.00
	Bonus Incentive: (Electric Incentive Bonus will increase with ECM 6)						$ 18,276.84	$ 50,000.00	-		
	Totals:	273,147	$ 98,280.00	45,669	$ 42,509.00	$ 332,958.00	$ 58,512.36	$ 81,131.73	$193,313.91	1.37	$297,372.00

*This is a worst case financial model, with no savings or incentives associated with the chiller plant controls upgrade. Torrington would be responsible for $193,313.19 at the culmination of the project, however, Eversource is proposing a cost-neutral, 0% interest on bill financing offer to completely eliminate the need for capital budget money to be allocated.

The worst case scenario, simple ROI for this project is 1.37 years, with the ROI improving even more after final savings and incentives are calculated. The project must proceed in its entirety to realize the incentives and savings proposed in these tables.*

Payment Terms

Payment Terms Acceptance Agreement

The total price of: $297,392.00 and the estimated return on investment are based on the items outlined in this proposal. ANY STATEMENTS MADE HEREIN REGARDING SAVINGS THAT MAY BE ACHIEVED BY IMPLEMENTING THE SERVICES OFFERED IN THIS PROPOSAL ARE ESTIMATES ONLY. NO WARRANTY, EITHER EXPRESSED OR IMPLIED, SHALL BE CONSTRUED TO ARISE FROM SUCH STATEMENTS, NOR SHALL SUCH STATEMENTS BE CONSTRUED AS CONSTITUTING A GUARANTEE BY SIEMENS THAT SUCH SAVINGS WILL OCCUR IF THE SERVICES ARE IMPLEMENTED.

The Buyer acknowledges that when accepted by the Buyer as proposed by Siemens Industry, Inc., this Proposal and the Siemens RAM Projects Business Standard Terms and Conditions, (together with any other documents, including any applicable Rider(s), incorporated herein) shall constitute the entire agreement of the parties with respect to its subject matter. BY EXECUTION HEREOF, THE SIGNER CERTIFIES THAT (S)HE HAS READ ALL OF THE TERMS AND CONDITIONS AND DOCUMENTS, THAT SIEMENS OR ITS REPRESENTATIVES HAVE MADE NO AGREEMENTS OR REPRESENTATIONS EXCEPT AS SET FORTH THEREIN, AND THAT (S)HE IS DULY AUTHORIZED TO EXECUTE THE SIGNATURE PAGE ON BEHALF OF THE BUYER.

Proposal is valid for thirty (30) days from the delivery date of August 22, 2024. Payment is due within 30 days of invoice date.

Payment Terms: 25% mobilization in advance, progress payments
Total: $297,392.00

Terms & Conditions Link(s)

[redacted]
Terms & Conditions (Unrestricted) (www.siemens.com/standard-terms-project-unrestricted)

Extended Warranty:

Siemens will extend the standard warranty, outlined in the terms and conditions rider, to a period of 30 months.

Price Escalation. If, during the term of this Contract, the price of various materials or labor or logistics are increased as reflected by CRU/IHS Markit/CMAI/COMEX market index, then Siemens may increase the Contract Sum or apply a surcharge to Customer accordingly.

As a result of the global Covid-19 Virus outbreak, temporary delays in delivery, labor or services from Siemens and its sub-suppliers or subcontractors may occur. Among other factors, Siemens' delivery is subject to the correct and punctual supply from sub-suppliers or subcontractors, and Siemens reserves the right to make partial deliveries or modify its labor or services. While Siemens shall make every commercially reasonable effort to meet the delivery or service or completion date mentioned above, such date is subject to change.

To the extent applicable, the following Rider(s) are incorporated and made part of the Siemens Standard Terms and Conditions:

[redacted]
SI Monitoring Rider (www.siemens.com/rider-monitoring)
SI Online Backup and Data Protection (www.siemens.com/rider-data-backup)
SI UBM or Utility Procurement (www.siemens.com/rider-ubm)
SI Software License Warranty (www.siemens.com/rider-software-license)
SI Consulting Rider (www.siemens.com/rider-consuling)
SI Third Party Rider (Smart Air Quality™) (www.siemens.com/rider-air-quality)

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Signature Page

Proposed by:

Siemens Industry, Inc.

Company

Brent Cantliffe

Name

8170858

Proposal #

$297,392.00

Proposal Amount

August 22, 2024

Date

Accepted by:

Torrington Public Schools

Company

Dean Pergola

Name (Printed)

Dean Pergola

Signature

Director of facilities

Title

8-23-2024

Date

Purchase Order #