

a. Budget Detail

Union Station Area Thermal Energy Network							
Categories	Line Item & Itemized Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Total EPA Funding
CONTRACTUAL	Design-build contractor to design and build geothermal energy network with 285 boreholes of 850 feet deep. @\$50/foot of drilling, inclusive of all piping, laterals, pumping capacity, and other support equipment. Assumes a 10% increase in cost for work performed in the public right of way and an additional 15% increase in cost as a contingency to mitigate against the subsurface and thermal transmissivity risks identified in the Overall Project Summary and Approach	\$1,703,320	\$4,769,297	\$2,271,094	\$340,664	-	\$9,084,375
	Portion of above design-build contract to design and install geothermal heat pump retrofit of Union Station with 200 ton heat pump. Calculated @\$18/square foot for 64,240 square feet of livable area in the building. Includes 25% contingency to address potential electrical upgrades, space constraints, and remediation risks. Cost not include \$800,000 in Energize CT rebates to be claimed by the City (@\$4,000 per ton, 200 tons)	-	\$290,430	\$58,086	\$38,724	-	\$387,240
	TOTAL CONTRACTUAL	\$1,703,320	\$5,059,727	\$2,329,180	\$379,388	-	\$9,471,615
	TOTAL FUNDING FOR UNION STATION AREA THERMAL ENERGY NETWORK	\$1,703,320	\$5,059,727	\$2,329,180	\$379,388	-	\$9,471,615

b. Expenditure of Awarded Funds

The City's accounting system maintains expenditure control at the given appropriation level. The Project Manager, Giovanni Zinn, will be responsible for establishing, administering, and overseeing program

finances. Working with the Office of Management and Budget, the Project Manager will manage accounting and use of funds reporting; assist in drawdowns and eLOCCS-related transactions; provide budget information; and track matching expenditures. The City's accounting system, MUNIS, maintains expenditure control at the budgetary appropriation level with a purchase requisition and purchase order system. The Board of Alders annually appoints an independent CPA firm to audit all City financial transactions. External auditors annually audit the City's internal controls for compliance with Generally Accepted Accounting Principles as they relate to Purchasing, Payroll, Accounts Payable, and Cash Management. The Engineering Department follows the City's contractor procurement and hiring practices.

The project cost is to be contained within a design-build contract to govern all activities associated with the design, development, construction and commissioning of USATEN. All procurement of labor, equipment and materials will be conducted through the design-build contract and all related costs will be included therein. The contract will be designed to include not-to-exceed terms as well as protections against paying for found savings or too much contingency cost. All procurement of labor, equipment and materials will be conducted through the design-build contract and all related costs will be included therein. Existing City staff, led by City Engineer and USATEN Project Manager Giovanni Zinn, will oversee the activities of the selected design-build firm to ensure that work is completed in a timely and efficient manner in line with the project schedule outlined in Section 3.c.

c. Reasonableness of Costs

The budget for this project was developed based on best available pricing from active solution providers and comparison projects currently undergoing construction in the Northeast. This pricing was applied to estimates of the geothermal drilling and piping activity required to construct a thermal energy network with capacity to serve Union Station and the Union Square development.

Geothermal developers consulted by the project team estimated that one ton of heating capacity is required for each 700 to 3,000 square feet, depending on whether new residential units are built to minimum code requirements or passive house standards. With ECC's plan to construct Energy Star standard units, it is conservatively estimated that one ton of heating capacity will serve 1,000 square feet and that the 1,080,000 square feet of residential development will require 1,080 tons of heating capacity. At 4.5 tons of capacity per borehole, it is estimated that the new residential construction will require 240 boreholes. With 200 tons of heating capacity is required for Union Station, 45 boreholes are required. 4.5 tons per 850 borehole is reasonable based on the commonly accepted rule of thumb of [1 ton per 150 to 200 feet of a vertical loop](#).

Recent test drilling at Yale University has reached depths of 850 feet. Based 285 boreholes and a conservative installed cost of \$50 per foot on average, the total cost of the borefield, including all piping, laterals, pumping capacity, and other support equipment, is estimated at \$12,112,500.

The budget also assumes that geothermal components will be installed within the public right of way and thus includes a 10% increase in cost for this work and an additional contingency of 15% to mitigate the subsurface and thermal transmissivity risks identified in the Overall Project Summary and Approach. The 10% increase for work in the public right of way is the typical increase the City assigns to civil engineering projects with activities in the public right of way. Should suitable locations be identified with the Housing Authority and Parking Authority to construct borehole arrays in open spaces adjacent to new construction, this cost may be reduced. With a total cost increase of 25% added to the above

estimate of \$12,112,500, the total cost of the networked geothermal system is estimated at \$15,140,625.

The City will fund 40% of the costs associated with the construction of the networked geothermal system (\$6,056,250). The City expects to be reimbursed through the elective payment process for this amount due to the New Haven-Milford Metropolitan Statistical Area's status as an energy community. The City is requesting EPA funding for the remaining 60% of these costs (\$9,084,375).

The budget breaks out the cost for retrofitting Union Station. Retrofit costs were estimated based off consultations with geothermal and mechanical systems solutions providers, a comparison projects currently undergoing construction in the Northeast, and a review of case studies of similarly scoped projects. The budget assumes a retrofit of Union Station requires a 200 ton geothermal heat pump. The retrofit costs were estimated at \$18 per square foot and applied to the City Assessor's assessment of 64,240 square feet of livable space in the building. The resulting cost is \$1,156,320, or \$1,445,400 with a 25% contingency. A 25% contingency is necessary in order to mitigate primarily against the potential need for electrical panel or service upgrades but also to address the unknown space constraints and remediation risks identified in the Overall Project Summary.

The project team ground-truthed the size of the heat pump for Union Station in two ways: first, by comparing the heat pump capacity estimate to existing boiler capacity in Union Station and second by calculating the implied heating load using the available fossil gas consumption data from the past year. Union Station currently has a significant amount of redundancy: there are three 1799 MBH (150 ton) KN-20 boilers and the Director of Maintenance for the NHPA estimates that at most only 45% of the capacity of one is utilized at any one time. However, in reviewing the gas consumption data over the past year, the highest utilization was 7,813 CCF in January of 2024. With an estimated KN-20 efficiency of 92.7%, the BTU output is 751,800,164 BTU. Publicly available [heating degree day data](#) from the Tweed New Haven (KHVN) weather station shows that there were 847.5 heating degree days (base 65 F) during this time period, yielding a 36,962 BTUs per degree hour. With a [99% heating reference temperature](#) of 2 degrees F, the implied load is 2,328,585 BTU / degree hour or 194 tons.

Through the Energize CT energy efficiency program, the project is eligible for a reimbursement rebate of \$4,000 per ton for the installation of the geothermal heat pump at Union Station. This results in a total geothermal heat pump rebate of \$800,000. The City will fund 40% of the Union Station retrofit costs and will also fund the upfront cost of the anticipated rebate amount of \$800,000. The City is requesting EPA funding of 60% of the Union Station retrofit costs less the anticipated rebate amount of \$800,000. At \$1,445,500 less \$800,000, the remaining amount is \$645,400. This results in an EPA request of \$387,240 for the Union Station retrofit portion of the design-build contract. This results in a City share of \$258,160. The City expects to be reimbursed for this amount through the elective payment process.

The total amount of City funding is 40% of construction of networked geothermal system (\$6,056,250), 40% of the Union Station retrofit cost excluding the value of Energize CT heat pump rebates (\$258,160), and the \$800,000 in anticipated Energize CT rebates. The resulting total is \$7,114,410.

The affordable housing project in-building costs were not included in the budget estimate given that the cost mechanical systems in this new construction would otherwise be borne by the Housing Authority or partnering affordable housing developer. The cost of the geothermal drilling and thermal energy network components includes all work in the right of way, all support equipment and all piping connecting to a point of demarcation at the buildings.

The project costs are reasonable and are based on best practices estimating procedures. The entire grant request is intended to support a contract with a turnkey provider, who will be entirely responsible for delivery of the project and will be required to meet performance obligations indicated in their contract with the City. Because the turnkey provider is subject to procurement procedures, specifically having to abide by proposal submission requirements indicated in an RFP to be issued by the City, the project team expects competitive and highly reasonable costs for the work.