

Mechanical System Options: System No.1 and No. 2 Compared to Base System

System Option	Opinion of Probable Construction Cost (\$)	Estimated Annual Operating Cost (\$)	Life Cycle Cost Evaluation (\$)	Simple Payback (Years)
Base System (Hybrid/VRF)	\$2,383,622.00	\$55,081.00	\$3,674,109.00	-
System No. 1 (VRF)	\$1,772,200.00	\$57,238.00	\$3,162,433.00	-
System No. 2 (Geothermal)	\$3,318,097.00	\$32,319.00	\$4,209,930.00	41.1

Mechanical System Options: System No. 2 Compared to System No. 1 (without incentives)

System Option	Opinion of Probable Construction Cost (\$)	Estimated Annual Operating Cost (\$)	Life Cycle Cost Evaluation (\$)	Simple Payback (Years)
System No. 1 (VRF)	\$1,772,200.00	\$57,238.00	\$3,162,433.00	-
System No. 2 (Geothermal)	\$3,318,097.00	\$32,319.00	\$4,209,930.00	62

Mechanical System Options: System No. 2 Compared to System No. 1 (with Inflation Reduction Act Clean Energy tax incentive applied to System No. 2)

System Option	Opinion of Probable Construction Cost (\$)	Estimated Annual Operating Cost (\$)	Life Cycle Cost Evaluation (\$)	Simple Payback (Years)
System No. 1 (VRF)	\$1,772,200.00	\$57,238.00	\$3,162,433.00	-
System No. 2 (Geothermal)	\$2,322,668.00	\$32,319.00	\$3,214,501.00	22.1

Mechanical System Options: System No. 2 Compared to System No. 1 (with Inflation Reduction Act Clean Energy tax incentive and Utility Clean Heat Program incentive applied to Systems No. 1 and No. 2)

System Option	Opinion of Probable Construction Cost (\$)	Estimated Annual Operating Cost (\$)	Life Cycle Cost Evaluation (\$)	Simple Payback (Years)
System No. 1 (VRF)	\$1,642,360.00	\$57,238.00	\$3,032,593.00	-
System No. 2 (Geothermal)	\$2,172,748.00	\$32,319.00	\$3,064,581.00	21.3

II. INTRODUCTION

A. General

1. The intent of this Schematic Basis of Design Report is to provide a comparison between mechanical system replacement options for the Town Hall Building, located at 2300 Elmwood Avenue, Rochester, New York, with respect to net present cost, simple payback, and estimated amount of CO2 reduction. This is to provide the Town with system information for development of future phased projects and cost estimating purposes.

B. Applicable Codes and Standards

1. Work will be in compliance with the following Codes.
 - a. 2020 Building Code of New York State
 - b. 2020 Existing Building Code of New York State
 - c. 2020 Fire Code of New York State
 - d. 2020 Plumbing Code of New York State
 - e. 2020 Mechanical Code of New York State
 - f. 2020 Fuel Gas Code of New York State
 - g. 2020 Property Maintenance Code of New York State
 - h. 2020 Energy Conservation Construction Code of New York State
 - i. NYStretch Energy Code - 2020, Version 1.0
 - j. New York State Department of Labor Rules and Regulations
 - k. New York State Department of Health
 - l. NFPA 13, Standard for the Installation of Sprinkler Systems, 2016 Edition

- m. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 2016 Edition
- n. NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2016 Edition
- o. NFPA 70, National Electric Code (NEC), 2014 Edition
- p. NFPA 72, National Fire Alarm and Signaling Code, 2013 Edition
- q. NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems, 2015
- r. NFPA 101, Life Safety Code, 2012 Edition
- s. NFPA 110, Standard for Emergency and Standby Power Systems, 2013
- t. All Local Codes and Ordinances

C. Commissioning Requirements

- 1. In accordance with the New York State Energy Conservation Construction Code, Building Commissioning (Cx) of the following systems is required:
 - a. HVAC Systems
 - b. Temperature Control Systems
 - c. Air and Water Systems Balancing

III. HEATING, VENTILATING AND AIR CONDITIONING

A. Design Criteria:

- 1. Heating, Ventilating and Air Conditioning:
 - a. System load calculations should be based on the following outdoor design conditions:

Winter: 0°F Dry Bulb

Summer: 95°F Dry Bulb
 73°F Wet Bulb
 - b. Design Conditions - Indoor:
 - 1) Systems should maintain the following temperature and humidity conditions:

<u>Space</u>	<u>Temperature</u>	<u>Humidity RH</u>
Offices	70-75°F	< 60%
Meeting Rooms	70-75°F	< 60%
Other	70 -75°F	<60%

2. Utility

- a) The Clean Heat Program custom incentive is \$80/MMbtu of annual energy saved. The potential incentives for the individual systems is approximately \$129,840.00 for the VRF system and \$149,920.00 for the Geothermal WSHP system.
- b) Applying the full value of the potential Utility incentive for the Geothermal WSHP system, the simple payback is reduced to 34.5 years when compared to the base Hybrid VRF system. When compared to the VRF system, the simple payback is reduced to 61.2 years.

B. CO2 Emissions

1. The base system (Hybrid/VRF) estimated yearly natural gas usage is approximately 17,469 therms. Eliminating this natural gas usage would result in a reduction of approximately 203,770 lbs (102 tons) of CO2 from being released into the atmosphere.
2. Based on NYSERDA's Projected Emissions Factors for New York State Grid Electricity, the long run marginal emissions factor for greenhouse gas emissions is 897 lbs CO2eq/MWh for 2023.
 - a) The estimated CO2eq emissions generated by the utility to operate System No. 1 (VRF) is approximately 366,732 lbs (408,843 kWh/1000 x 897 lbs/MWh). Compared to the base system's (Hybrid/VRF) natural gas and electric usage, System No. 1 releases approximately 140,678 lbs (70.3 tons) less CO2 into the atmosphere.
 - b) The estimated CO2eq emissions generated by the utility to operate System No. 2 (Geothermal WSHP) is approximately 207,072 lbs (230,849 kWh/1000 x 897 lbs/MWh). Compared to the base system's (Hybrid/VRF) natural gas and electric usage, System No. 2 releases 300,338 lbs (150.2 tons) less CO2 into the atmosphere.

C. Replacement Costs

1. 2019 ASHRAE Handbook lists the Median Service Life of various mechanical equipment (below). Median service life indicates the highest age at which the survival rate remains at or above 50%. Several factors, such as maintenance, affect the life expectancy of equipment.

<u>Equipment</u>	<u>Median Service Life, Years</u>
Heat Pump (water-to-air)	19
Heat Pump (air-to-air)	15
Packaged Rooftop (heat pump)	15
Packaged DOAS unit (heat pump)	15
Base Mounted Pumps	20
Fan Coil Unit	20

2. Assuming a service life of 20 years for both system types, and an annual inflation rate of 3%, the replacement costs(labor and material) for each system type is as follows: