C2C: Clean Energy *to* Communities

U.S. DEPARTMENT OF ENERGY

Expert Match TA

Bridget Rathsack

City of Burnsville – Sustainability Coordinator

Jeetika Malik

Lawrence Berkeley National Laboratory (LBNL) – Expert

Melake Getabecha

National Renewable Energy Laboratory (NREL) – Community TA Lead

April 29, 2024

Photos clockwise, starting in upper left: iStock, 1282045969; by Werner Slocum, NREL 65138; iStock, 945938110; by Erik Nelsen, NREL 64276; iStock, 1372334808

Work Area 1

HVAC Replacement & EE considerations for Heart of the City Parking Ramp

Deliverable: *Memo/Slide deck summarizing review of proposed HVAC options, their efficiency and financing estimates, and important considerations during overall building retrofit process*

Heart of the City Park & Ride, Burnsville
Source: Google Street View imagery

Current HVAC systems

- Two existing HVAC systems installed, one each for west tower and east tower.
- Type -Single Split System
- Capacity -West Tower Rooftop Unit is 8.5 Tons (bus side – restrooms and elevator), East Tower Rooftop Unit is 5 Tons (elevators and stairwells).
- Age - Installed in 2003, Being replaced this year, 2024
- Operation schedule- 24/7
- Other notes: Nothing in the HVAC system is gas. It’s all electric heating and cooling.
- Code compliance- ASHRAE 90.1.2016

Work Area 1

East Tower

Parameter	Description
Existing HVAC System type	Single split system
Existing system size	5 tons
Area (Sq. Foot)	1000
Replacement Option 1	Type: Central air-source heat pump
	Min efficiency as per 90.1 2016= 14 SEER, 8.2 HSPF
	Estimated Total Cost (equipment &installation)= $6200-$8600 Normalized cost per kBtu/hr = $102-$143
Replacement Option 2	Type: Ground-source Heat Pump
	Min efficiency as per 90.1 2016= 18 EER, 3.7 COP
	Estimated Total Cost (equipment &installation) = $29700 Normalized cost per kBtu/hr =$495

West Tower

Parameter	Description
Existing HVAC System type	Single split system
Existing system size	8.5 tons
Area (Sq. Foot)	2550
Replacement Option 1	Type: Central air-source heat pump
	Min efficiency as per 90.1 2016= 10.8 EER, 3.3 COP
	Estimated Total Cost (equipment &installation)= $10400-$14500 Normalized cost per kBtu/hr = $102-$143
Replacement Option 2	Type: Ground-source Heat Pump
	Min efficiency as per 90.1 2016= 18 EER, 3.7 COP
	Estimated Total Cost (equipment &installation)= $50490 Normalized cost per kBtu/hr= $495

Notes:

1. Cost estimates are for minimum efficiency and existing sizing. Higher efficiency and/or larger sizing of systems may be more expensive.
2. Other efficient heat pump options such as Mini-split heat pumps may not be a feasible option. Minisplit heat pumps may require removal or repurpose of the existing ductwork.
3. Cost estimates are based on 2022 prices and reflect national averages and may be based on existing conditions on site, local economy, and geographic location. The cost estimates do not include any rebates or tax incentives that may be available such as heat pump rebates by local utility. For cost data sources, see slide notes.

Work Area 1

Key Considerations	Air-source Heat pump	Ground-source Heat Pump
Operations and Maintenance	Repairs are simpler and less expensive	More difficult to repair
Installation effort and compatibility with existing HVAC distribution systems	Relatively easier and cheaper, can be connected to the existing ductwork* for distribution of conditioned air. **subject to sizing and condition of existing ductwork.*	Intrusive, expensive, and lengthy. Site conditions and land availability must be considered. Such systems may utilize existing ductwork*. **subject to sizing and condition of existing ductwork.*
Suitability in Cold Climate	Efficient, Extremely cold climates may need supplemental heating (such as electric resistance that is far less efficient)	Most efficient, specially in extremely cold weather.
System Lifetime	15-25 years	Longer lifetime for ground loop (50 + years)

Informational Resources:
https://www.energy.gov/energysaver/geothermal-heat-pumps
https://www.energy.gov/energysaver/air-source-heat-pumps
https://www.energysage.com/heat-pumps/compare-air-source-geothermal-heat-pumps/

Work Area 2

Assessment of financing options and financial support for Fire Station 1 PV system

Deliverable: *Spreadsheet/list of incentives and financing options, including incentives and benefits still in development at the local, state and national levels.*

Rebate/Incentive	Implementing agency	Description	Remarks
Investment Tax Credit (ITC)	Federal	• Base Credit: 6% - 30% (depending on project status and labor factors) • Low-Income Community Bonus: 10% additional	Considered for PV techno-economic analysis (Work area 3)
Storage on Public Buildings	State	• Proposed incentive: $250 per kWh • Must have a solar energy system paired onsite. • Capacity of 50kWh or less. • Not in Xcel Energy territory. • Available until June 30, 2027.	Proposed, not yet implemented
Solar Grant Program: Public Buildings	State	Grants for up to 100% of costs for systems the smaller of (a) up to 40 kW or (b) up to 120% of the building's annual average electric consumption.	Not eligible
Wind and Solar-Electric (PV) Systems Exemption	State	100% exemption from real property taxes	Eligibility check required

Work Area 3

Techno-economic analysis of PV system on Fire Station 1

Fire station 1 at 14275 Newton Ave, Burnsville

Source: Google Street View imagery

Available information:

- Roof space available: 13891 sq. ft
- Electricity rate: Rate 70 – fully interruptible with generator
- Existing 15-min interval energy data with 4 power outages (4-6 hours each)
- Net metering system size limit: 39.9 kW
- 400 kW Natural gas generator back up available

Considerations-

- Life cycle- 25 years
- Financing with available federal incentives (See work area 2 findings)

Work Area 3

Scenario 1: With an objective of financial savings & resilience to power outages, this scenario estimates the optimized PV size without storage for fire station building under current electricity tariffs.

Scenario 2: With an objective of financial savings & resilience to power outages, this scenario estimates the optimized PV size with storage for fire station building under current electricity tariffs.

Scenario 3: With an objective of financial savings & resilience to power outages, this scenario considers a 30% increase in electricity tariffs and estimates the optimized PV +storage size for fire station building.

Assumptions:

- All scenarios consider 30% Federal ITC and an additional 10% bonus credit for low-income communities. Additional state incentives for battery may reduce the capital cost but are not considered in the analysis.
- All scenarios consider the existing natural gas generator available during power outage.
- The analysis considers fixed PV array with a Standard (crystalline silicon) module with an approximate efficiency of 15%.
- These results assume perfect prediction of solar irradiance, wind speed, and electrical and thermal loads.

Work Area 3

Parameters	Business-as-usual	Scenario 1	Scenario 2
PV size	-	6 kW	9 kW
Battery Size	-	0 kWh	10 kWh
Annual Demand met from Grid	99.7%	98.4%	97.6%
Annual Demand met from Solar	-	1.3%	2.1%
Annual Demand met by Generator	0.3%	0.3%	0.3%
Total Life cycle cost (25 years)	$575,682	$575,161	$572,835
Technology Capital Costs + Replacements, After Incentives	-	$4,434	$14,377
Total Utility Electricity costs (life cycle)	$481,065	$474,868	$461,872
Net Present Value	-	$521	$2848
Payback period	-	10.5 years	11.1 years
Internal Rate of return	-	7%	8 %
Levelized Cost of Energy	-	$0.068 per kWh	$0.068 per kWh

Work Area 3

Parameters	Business-as-usual	Scenario 3
PV size	-	81 kW
Battery Size	-	0 kWh
Annual Demand met from Grid	99.7%	81.7%
Annual Demand met from Solar	-	18%
Annual Demand met by Generator	0.3%	0.3%
Total Life cycle cost (25 years)	$548,928	$545,935
Technology Capital Costs + Replacements, After Incentives	-	$63,478
Total Utility Electricity costs (life cycle)	$454,311	$370,512
Net Present Value	-	$2993
Payback period	-	11.2 years
Internal Rate of return	-	7%
Levelized Cost of Energy	-	$0.068 per kWh

Work Area 3 : Summary

- Existing utility electric rate plan- Rate 70 fully interruptible has a significantly low electricity price per kWh. Switching to solar PV (Scenario 1) or PV+ Storage (Scenario 2) would be financially feasible only for smaller capacities (accounting for less than 4% to total annual electricity share).

- In case there is an increase in existing electricity prices (assuming 30% increase), a higher capacity PV serving 18% of annual load may be financially feasible (Scenario 3).

- Even though Scenario 3 has a PV capacity higher than net metering limit, the option is still financially feasible given that negligible amount of electricity produced is being sent back to grid annually at wholesale rate.

C2C: Clean Energy
***to* Communities**
U.S. DEPARTMENT OF ENERGY

Thank You!