



Town of Acton & Acton-Boxborough RSD Electrification Roadmap



Andrea Becerra, Director of Sustainability
Town of Acton



Kate Crosby, Energy Manager
Acton-Boxborough Regional School District

Funding for Electrification Roadmap provided by
Municipal Vulnerability Preparedness program of MA EOEEA.



Electrification Roadmap Goals

1. Identify alternative options to convert existing fossil fuel-based systems to all-electric systems, including heat pumps (ground source, air source, air to water, VRF), solar thermal and electric resistance systems.
2. Prepare alternatives analysis. Identify recommended pathways for electrification.
3. Prepare timeline and recommended plan to fully electrify all buildings.
4. Evaluate feasibility for solar PV, solar thermal, and battery storage. Evaluate feasibility for islanding where resilience is a priority.

Salas O'Brien Introduction

Key Team Members:

- Mike Hovanec, PE, LEED AP, Senior Mechanical Engineer
- Ian Davies, PE, Mechanical Engineer
- Jake Shepherd, EIT, Mechanical Engineer



Salas O'Brien Experience

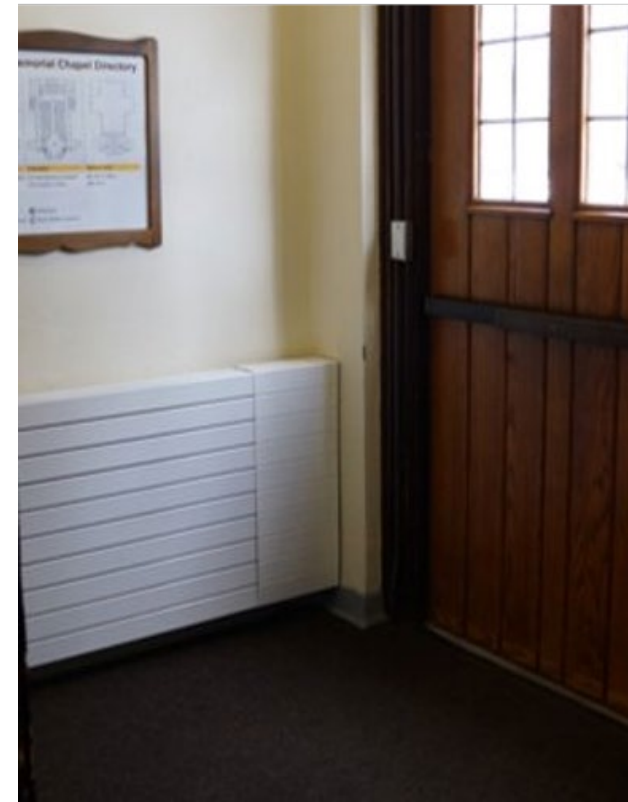


Low Temperature Hot Water Building Conversion

- Replace steam heating equipment with hydronic



Before



After

Thermal Profile Creation Process – Business as Usual (BAU) Model Overview

1. Inputs

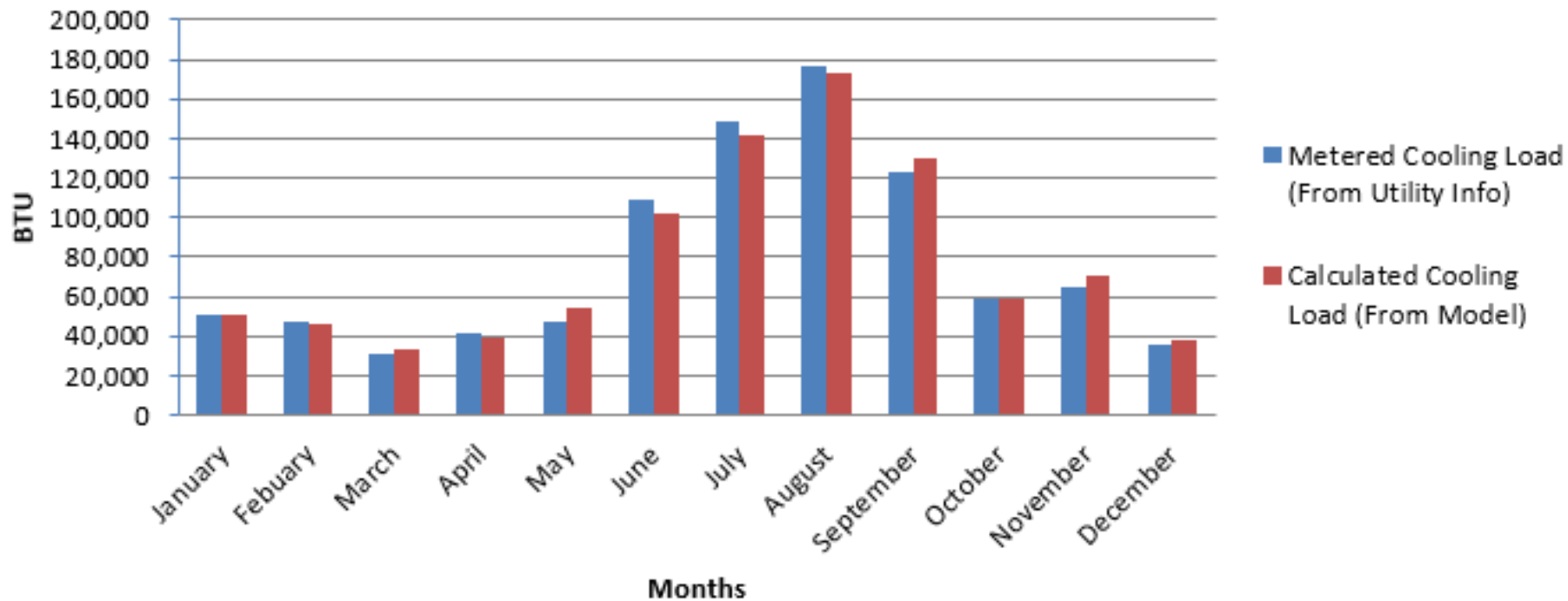
- a. Weather data
- b. Actual utility use data (4-5 year average)
- c. Existing equipment efficiencies
- d. Proposed equipment efficiencies

2. Outputs

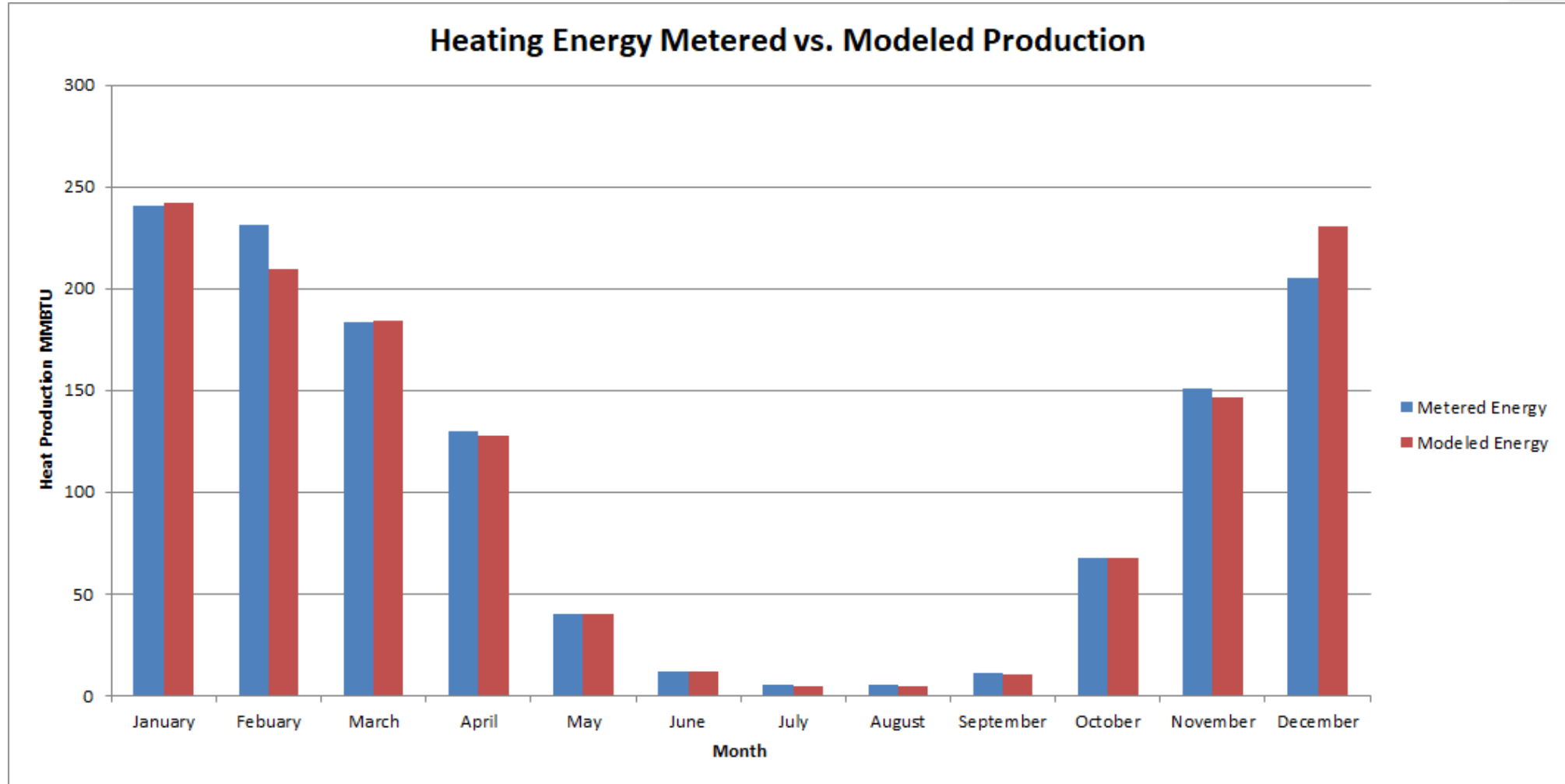
- a. Thermal profiles graphics
- b. Energy use by utility, corresponding carbon emissions and utility cost
- c. For both existing and proposed

Model Calibration – Public Safety Facility

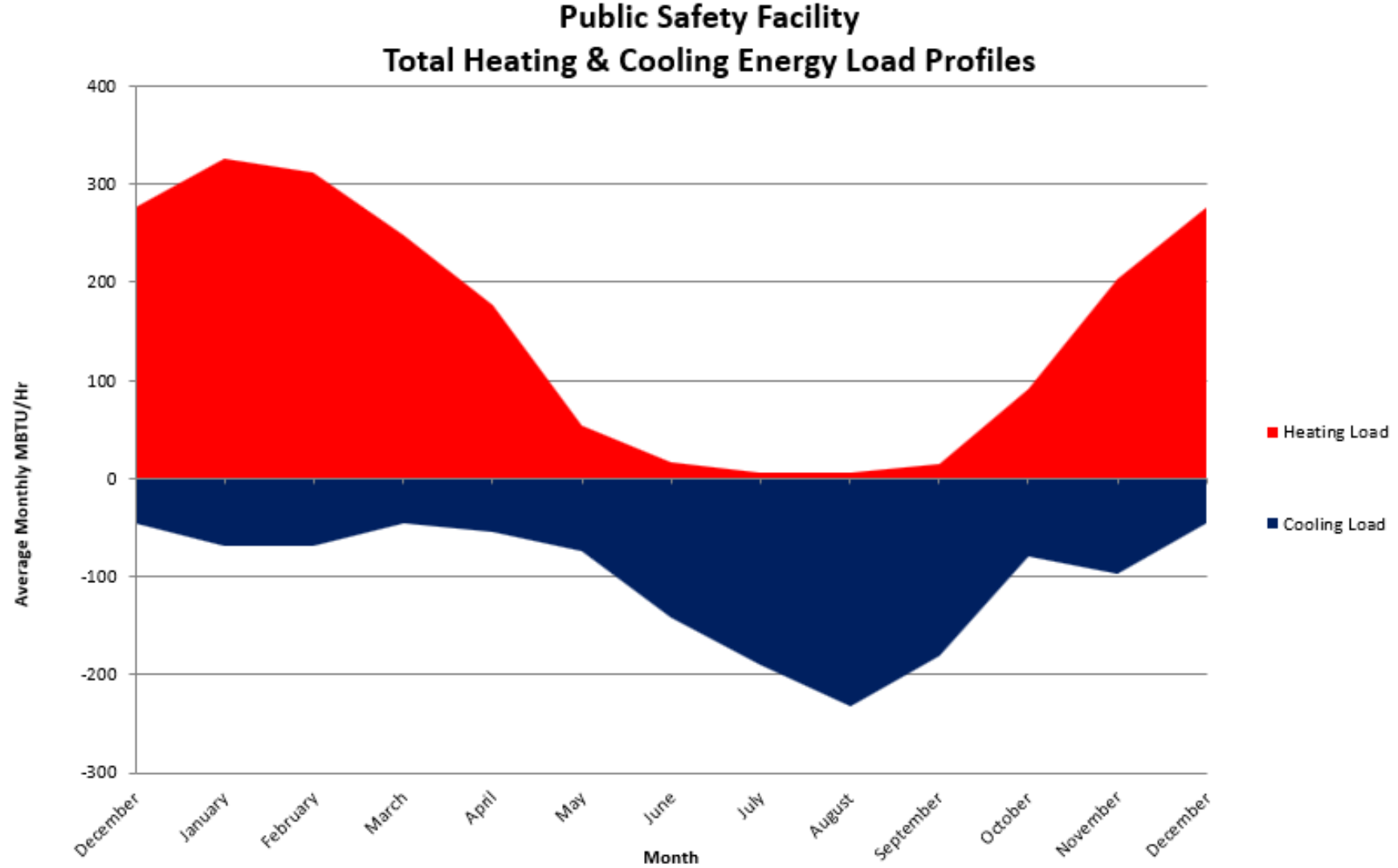
Metered vs Calculated Cooling Production



Model Calibration – Public Safety Facility



BAU Thermal Profile – Public Safety Facility



BAU Performance - Public Safety Facility

	BAU System
Electric Heating/Cooling (KWH/yr)	64,171
Natural Gas Heating (Therm/yr)	19,704
TOTAL Heating/Cooling Energy (MBTU/yr)	2,189,346

	BAU System
Electric Heating/Cooling Utility (\$/yr)	\$12,128
Natural Gas Heating Utility (\$/yr)	\$22,857
TOTAL Heating/Cooling Utility (\$/yr)	\$34,985

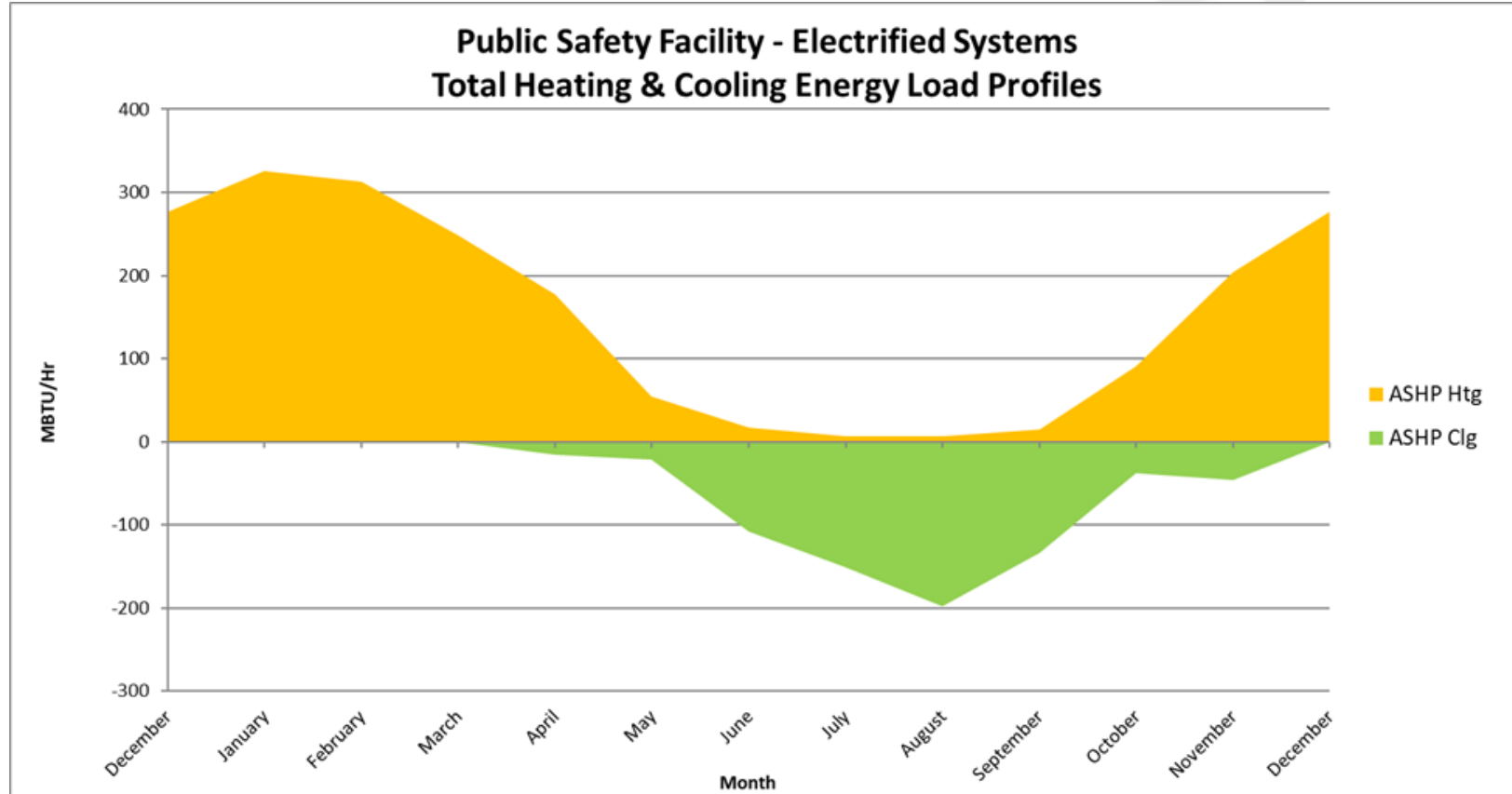
	BAU System
Electric Heating/Cooling (MTCO2e/yr)	19
Natural Gas Heating (MTCO2e/yr)	105
TOTAL Heating/Cooling (MTCO2e/yr)	124

Acton Public Safety Facility Electrified System

Equipment	Capacity	Notes
ASHP	90 Tons	(2) 50 Ton Units

ASHP Heating: 100% peak heating, 100% annual heating energy

ASHP Cooling: 100% peak cooling, 100% annual cooling energy



Public Safety Facility Electrified System Results (2030)

	BAU System	Electrified System	Savings	% Change
Electric Heating/Cooling (KWH/yr)	64,171	199,159	-134,988	210.4%
Natural Gas Heating (Therm/yr)	19,704	0	19,704	-100.0%
TOTAL Heating/Cooling Energy (MBTU/yr)	2,189,346	679,530	1,509,815	-69.0%

	BAU System	Electrified System	Savings	% Change
Electric Heating/Cooling Utility (\$/yr)	\$12,128	\$37,641	-\$25,513	210.4%
Natural Gas Heating Utility (\$/yr)	\$22,857	\$0	\$22,857	-100.0%
TOTAL Heating/Cooling Utility (\$/yr)	\$34,985	\$37,641	-\$2,656	7.6%

	BAU System	Electrified System	Savings	% Change
Electric Heating/Cooling (MTCO2e/yr)	14*	42	-29	210.4%
Natural Gas Heating (MTCO2e/yr)	105	0	105	-100.0%
TOTAL Heating/Cooling (MTCO2e/yr)	118	42	76	-64.1%

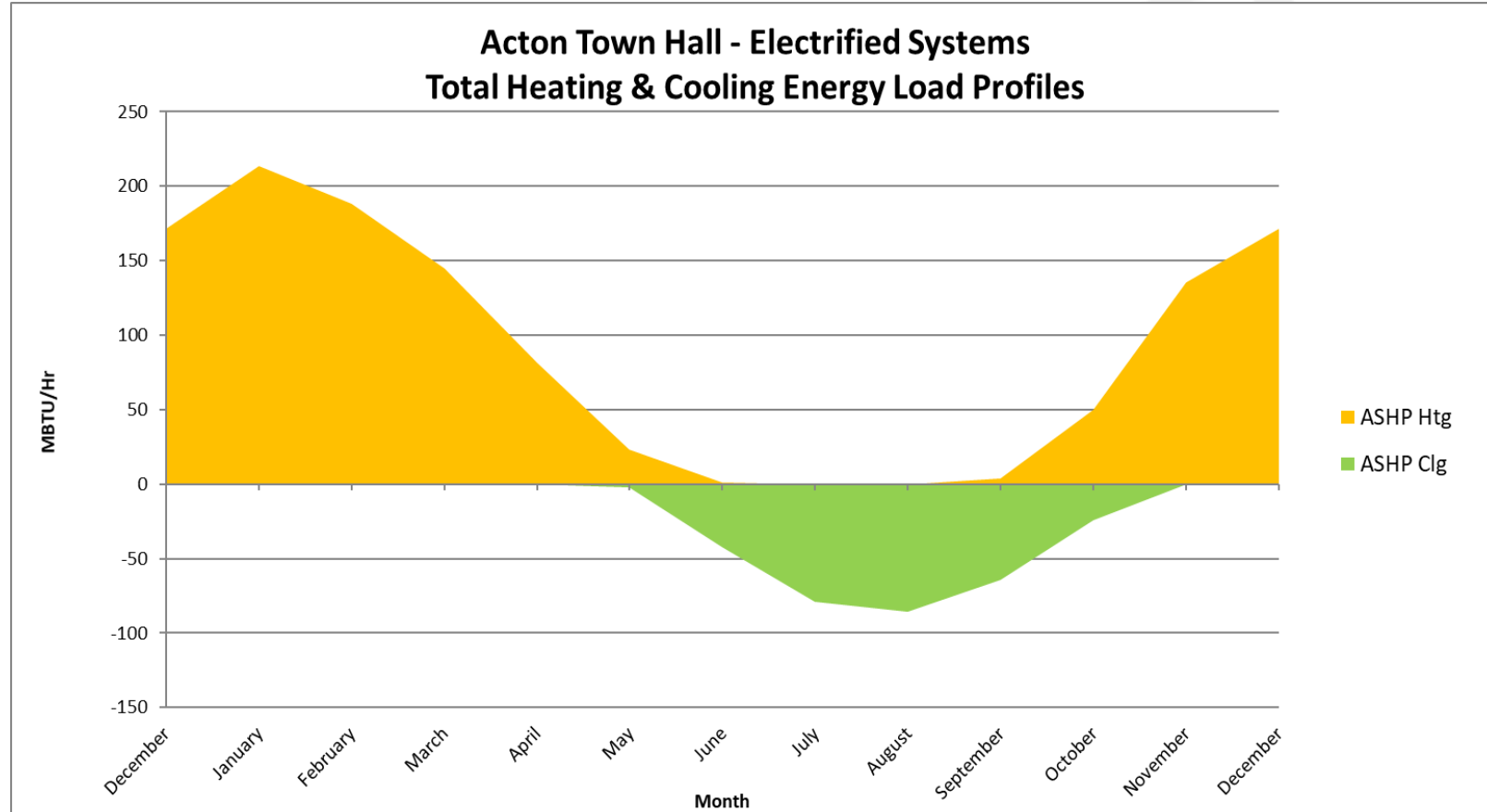
*The Town of Acton offsets nearly all of its municipal buildings with Acton Power Choice 100% GREEN, which entails purchasing Renewable Energy Certificates (RECs) from clean energy projects in the Northeast

Acton Town Hall Electrified System

Equipment	Capacity	Notes
ASHP	75 Tons	(2) 40 Ton Units

ASHP Heating: 100% peak heating, 100% annual heating energy

ASHP Cooling: 100% peak cooling, 100% annual cooling energy



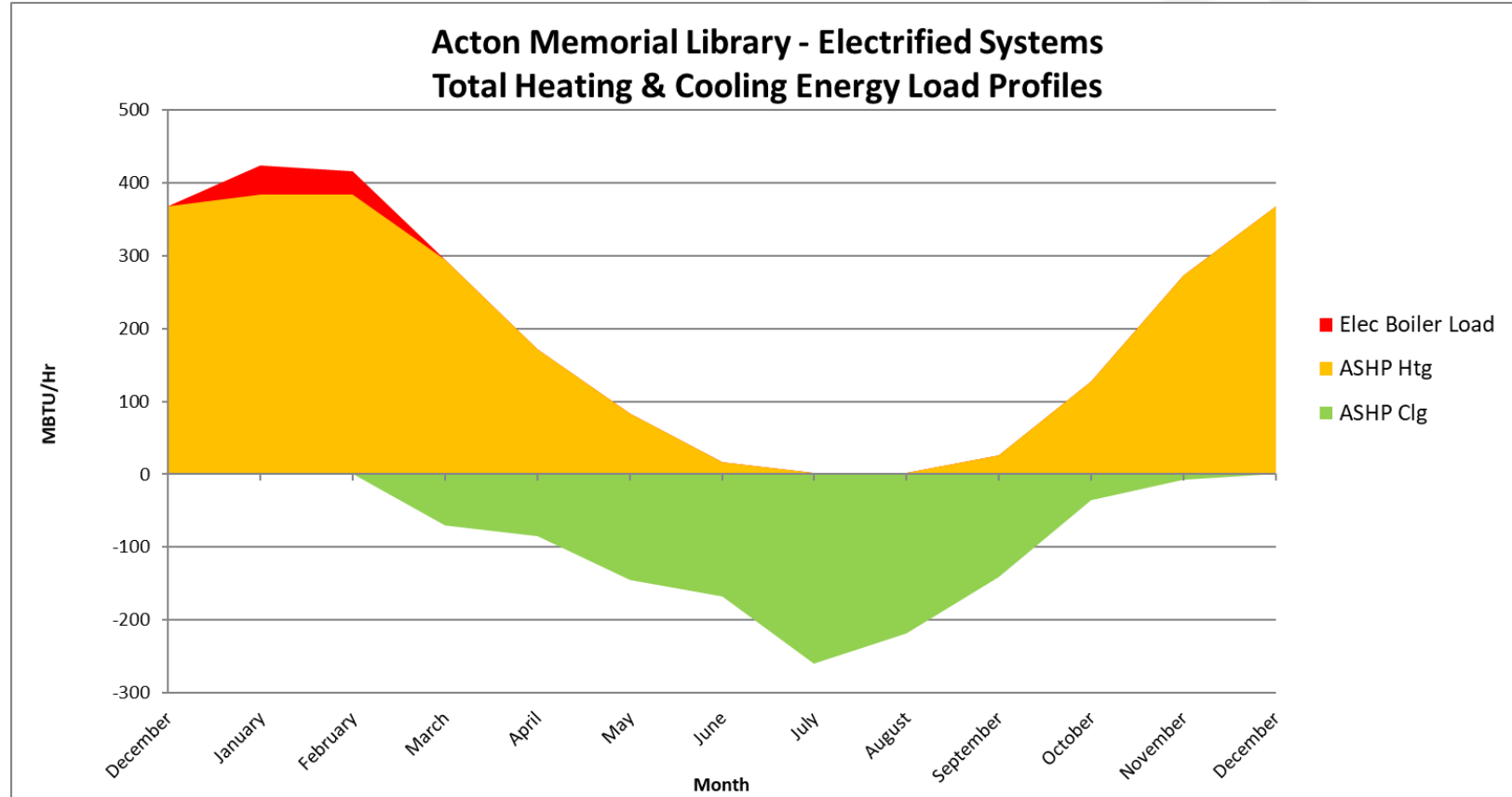
Acton Memorial Library Electrified System

Equipment	Capacity	Notes
ASHP	115 Tons	(2) 63 Ton Units
Electric Boiler	685 MBH	

Elec Boiler Heating: 48% peak heating, 8% annual heating energy

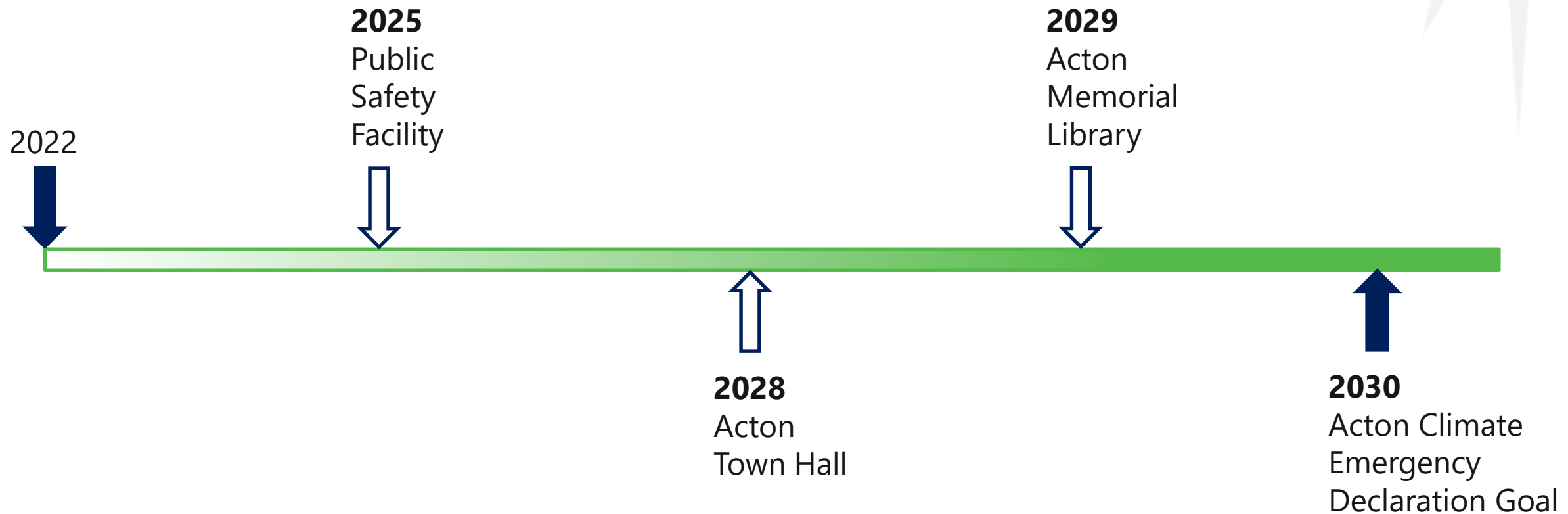
ASHP Heating: 52% peak heating, 92% annual heating energy

ASHP Cooling: 100% peak cooling, 100% annual cooling energy

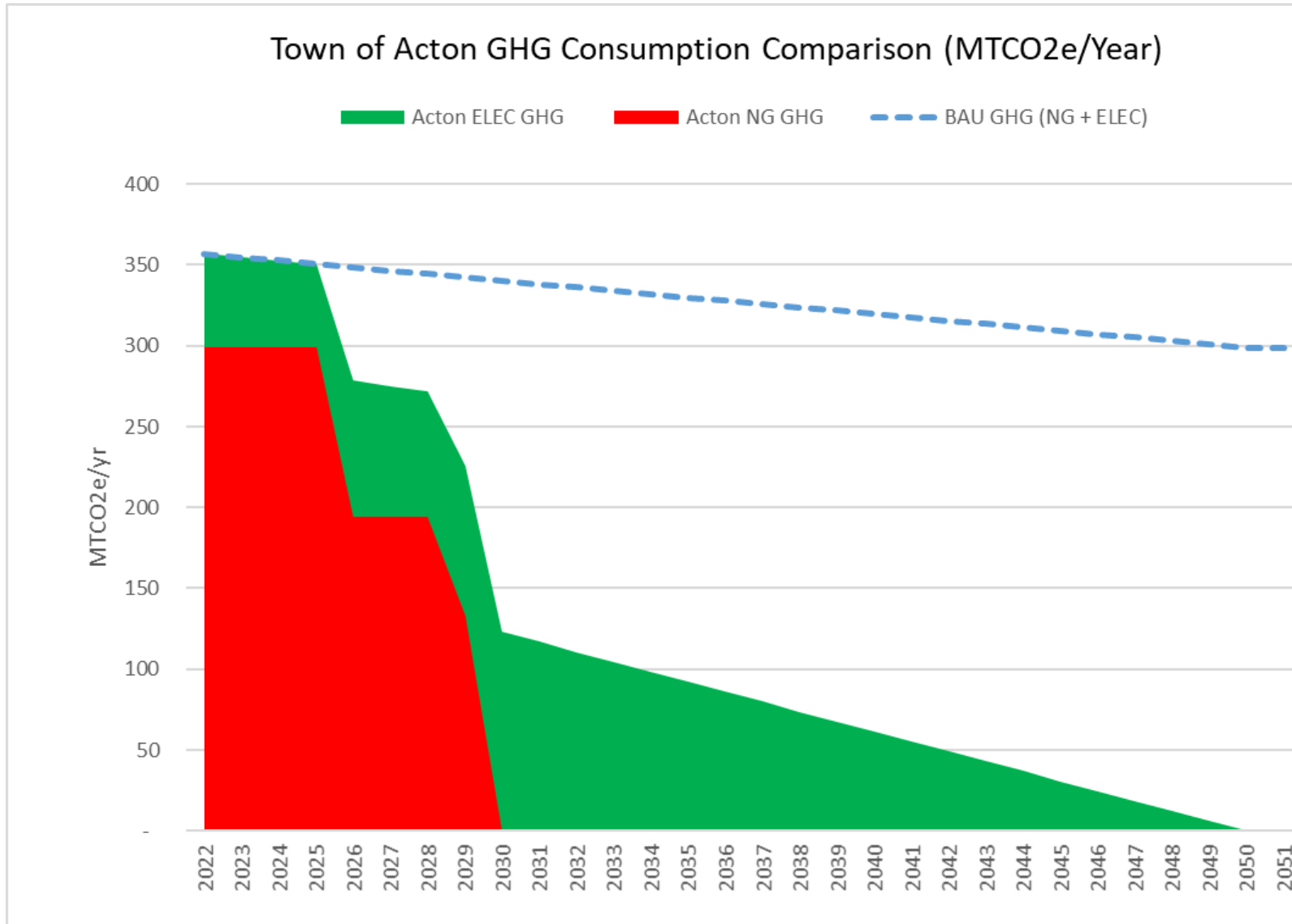


2022-2030 Electrification Investment Plan

Town of Acton Scenario



GHG Emissions – Town of Acton



Cumulative 30 year GHG reduction: 6,050 MTCO₂e

Capital Cost Summary - Town

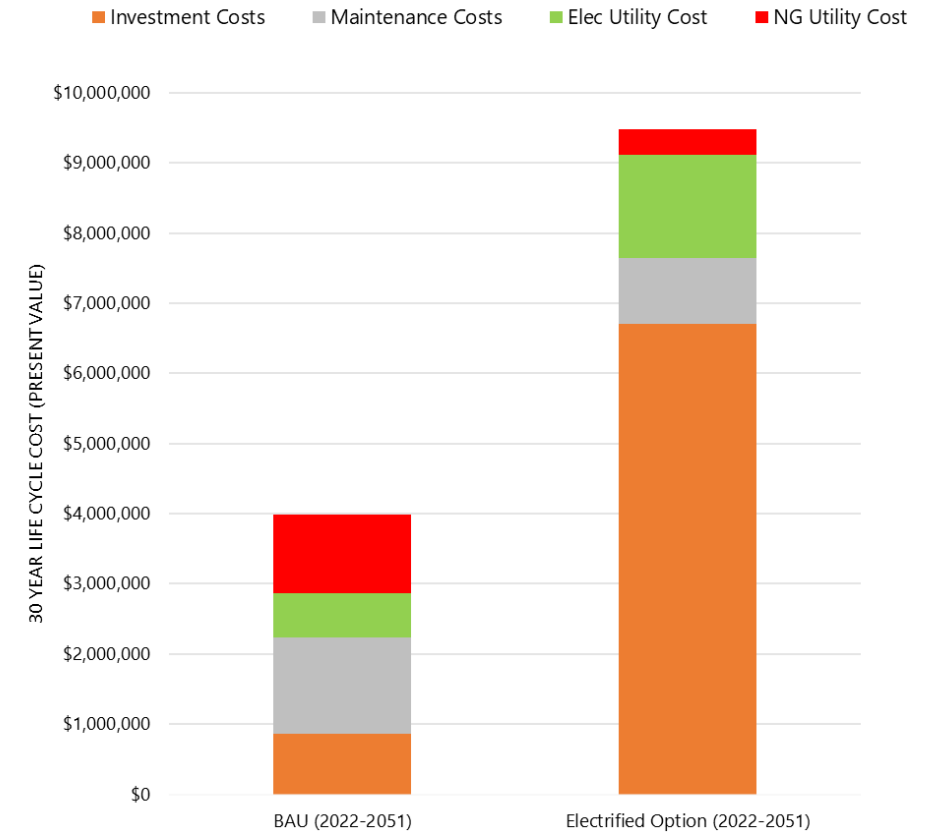
Building Name	Building Conversion Cost	Energy Plant Cost	Total
Acton Memorial Library	\$ 1,689,065	\$ 1,527,000	\$ 3,216,065
Acton Town Hall	\$ 845,040	\$ 1,107,000	\$ 1,952,040
Public Safety Facility	\$ 911,155	\$ 1,443,000	\$ 2,354,155
Total	\$ 3,445,260	\$ 4,077,000	\$ 7,522,260

LCCA Results - Town of Acton

30 Year Life Cycle - Economic Comparison			
Option:	BAU	Electrified Option	Delta
Elec Utility Cost	\$633,386	\$1,476,561	\$843,175
NG Utility Cost	\$1,115,582	\$365,092	-\$750,490
Total Utility Costs	\$1,748,969	\$1,841,654	\$92,685
Maintenance Costs	\$1,368,560	\$931,087	-\$437,473
Investment Costs	\$867,242	\$6,709,989	\$5,842,746
30 Year Life Cycle Cost	\$3,984,771	\$9,482,729	\$5,497,958

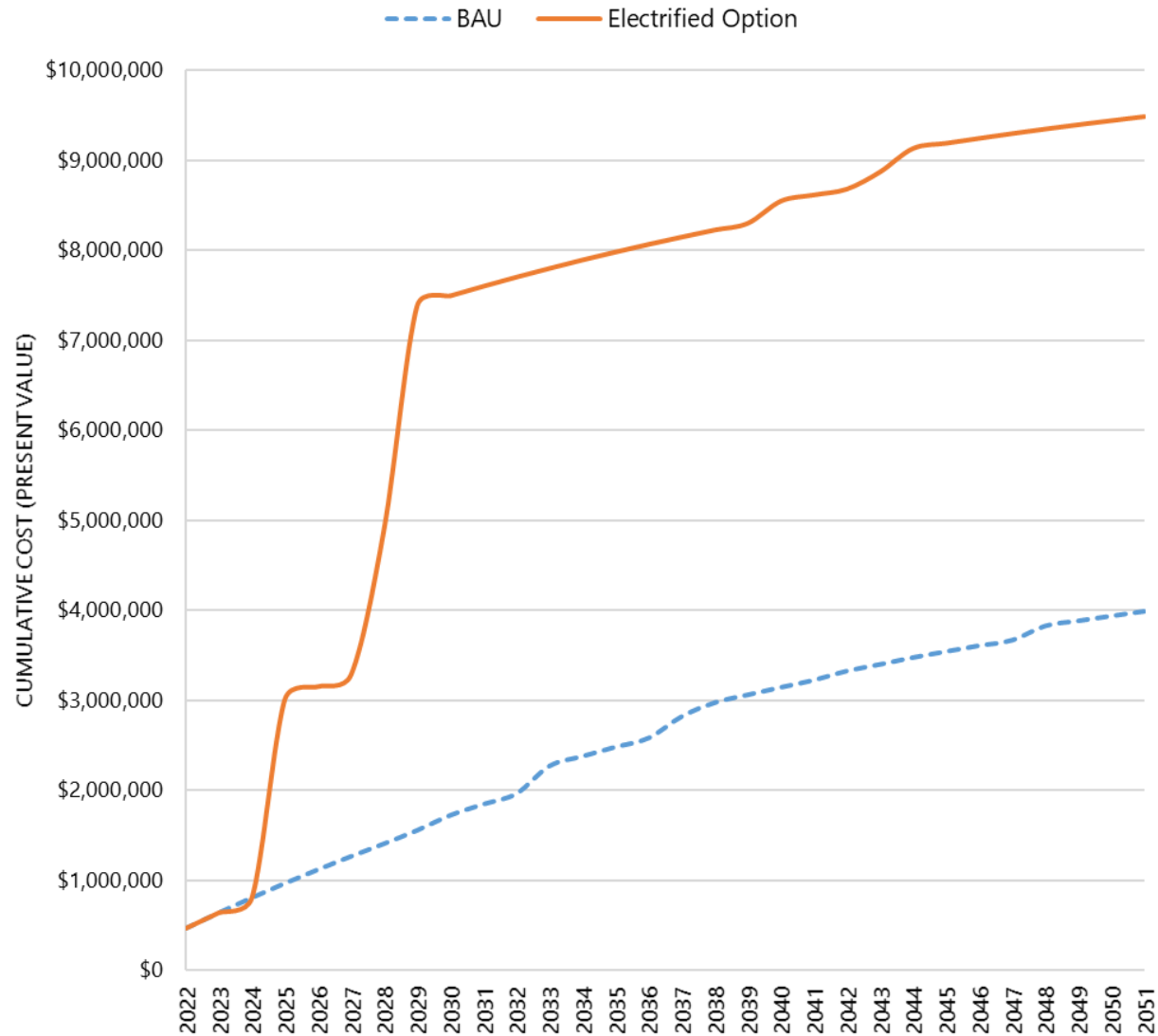
2051 Annual Operating Costs - Economic Comparison			
	BAU	Proposed Option	Delta
Elec Utility Cost	\$37,137	\$110,985	\$73,848
NG Utility Cost	\$64,690	\$0	-\$64,690
Maintenance Costs	\$80,400	\$46,400	-\$34,000
Total Operational Costs	\$182,227	\$157,385	-\$24,842

30 Year Life Cycle Cumulative Costs

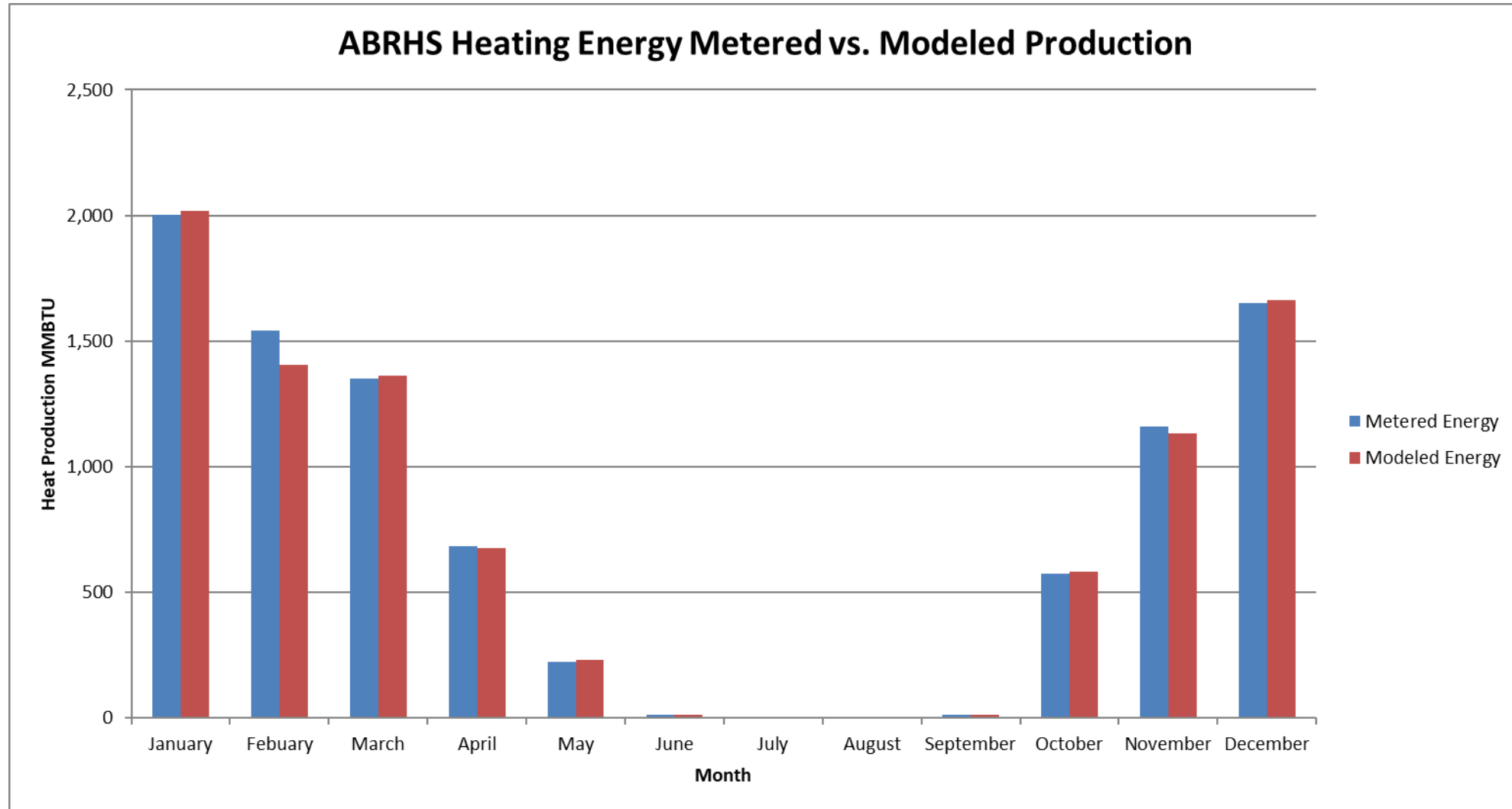


LCCA Results - Town of Acton

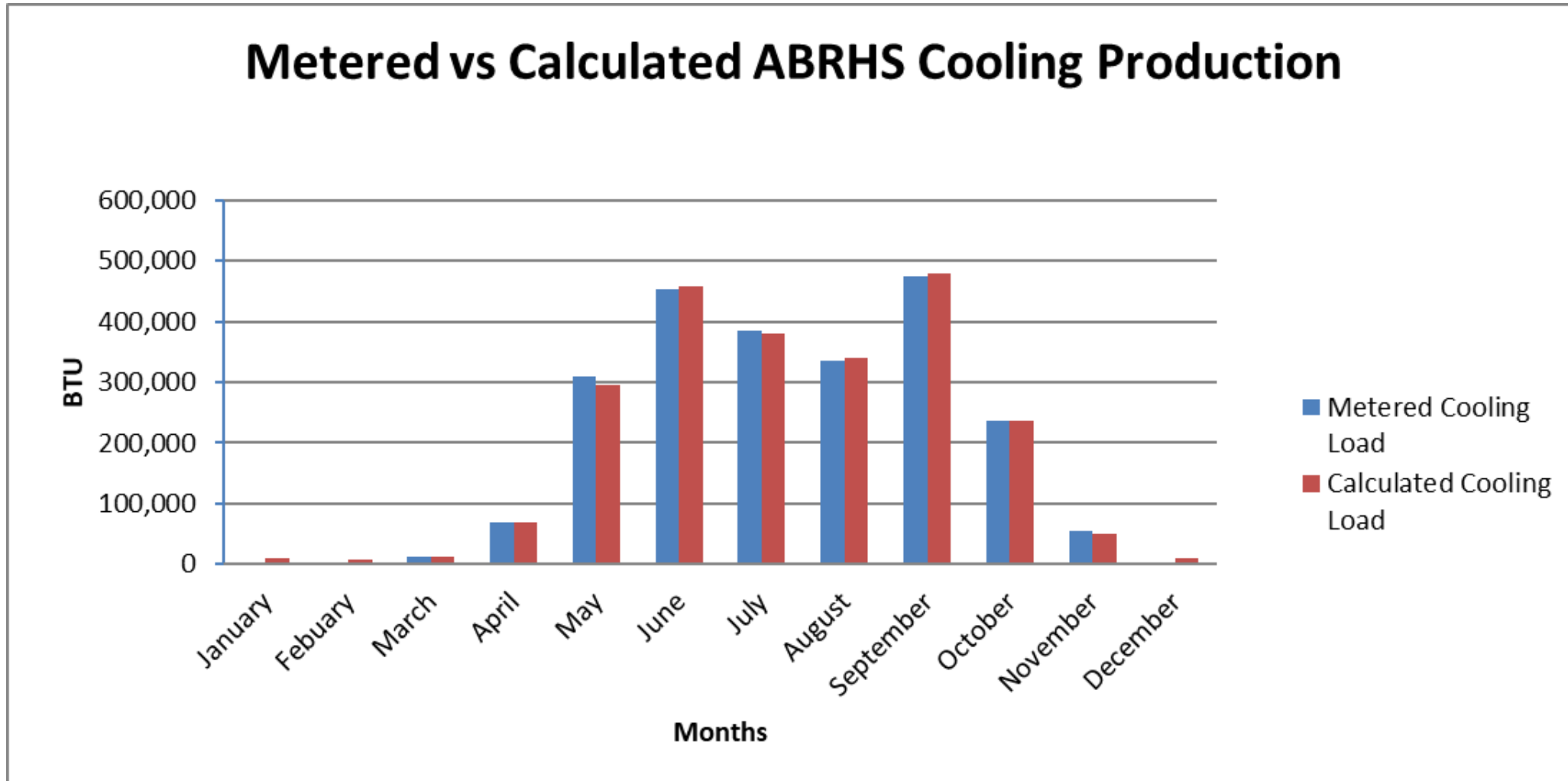
Present Value of Cash Flow



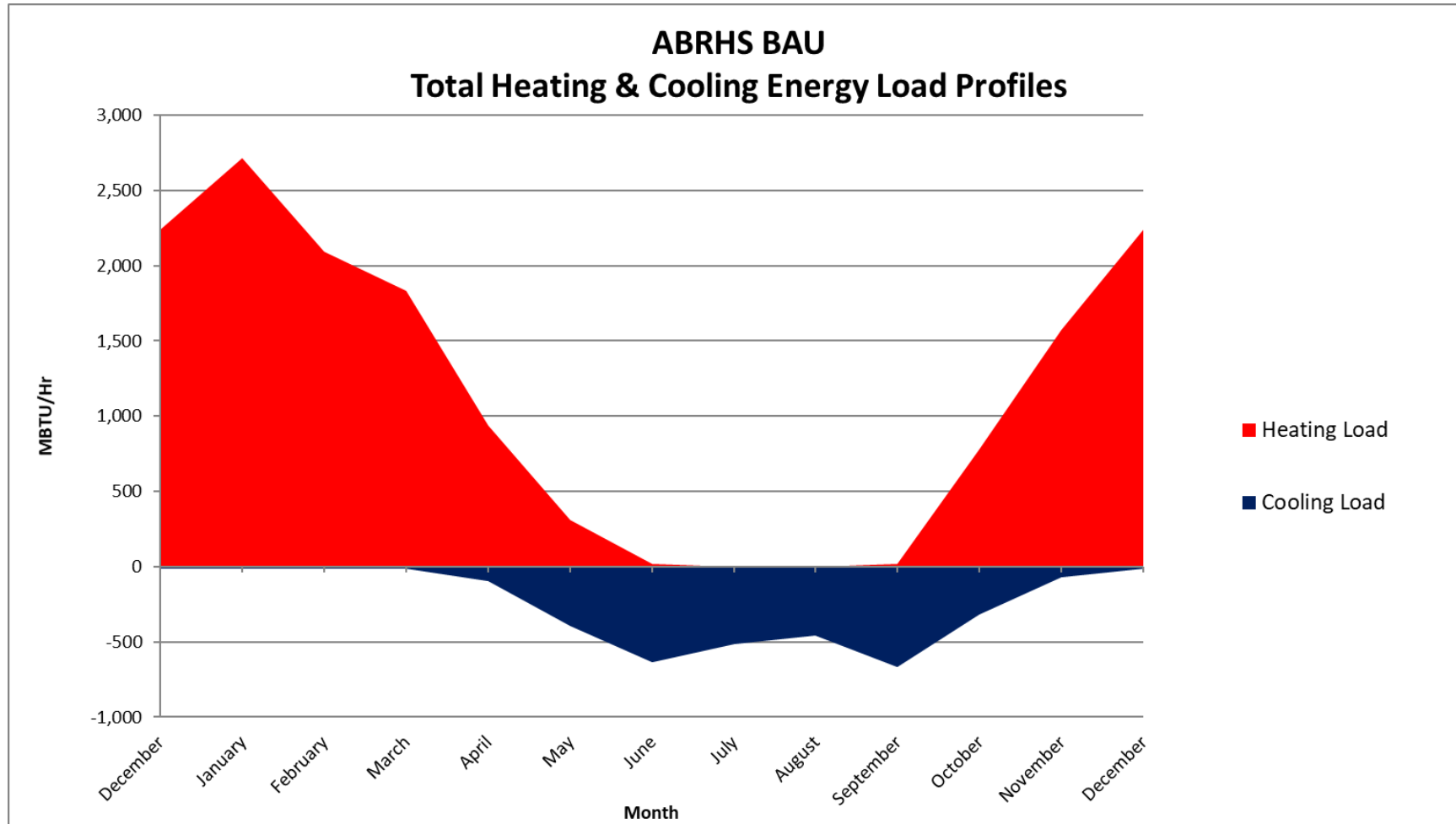
Model Calibration – ABRHS Heating



Model Calibration – ABRHS Cooling



BAU Thermal Profile - ABRHS



BAU Performance – ABRHS (2022)

	BAU System
Electric Heating/Cooling (KWH/yr)	328,485
Natural Gas Heating (Therm/yr)	110,923
TOTAL Heating/Cooling Energy (MBTU/yr)	12,213,090

	BAU System
Electric Heating/Cooling Utility (\$/yr)	\$56,171
Natural Gas Heating Utility (\$/yr)	\$123,125
TOTAL Heating/Cooling Utility (\$/yr)	\$179,295

	BAU System
Electric Heating/Cooling (MTCO2e/yr)	98
Natural Gas Heating (MTCO2e/yr)	589
TOTAL Heating/Cooling (MTCO2e/yr)	687

ABRHS Electrified System

Equipment	Capacity	Notes
Electric Boiler	2,200 MBH	
ASHP	420 Tons	(4) 105 Ton units
Solar Thermal	165 MBH	1500 SF System on roof
Air Cooled Chiller	190 Tons	

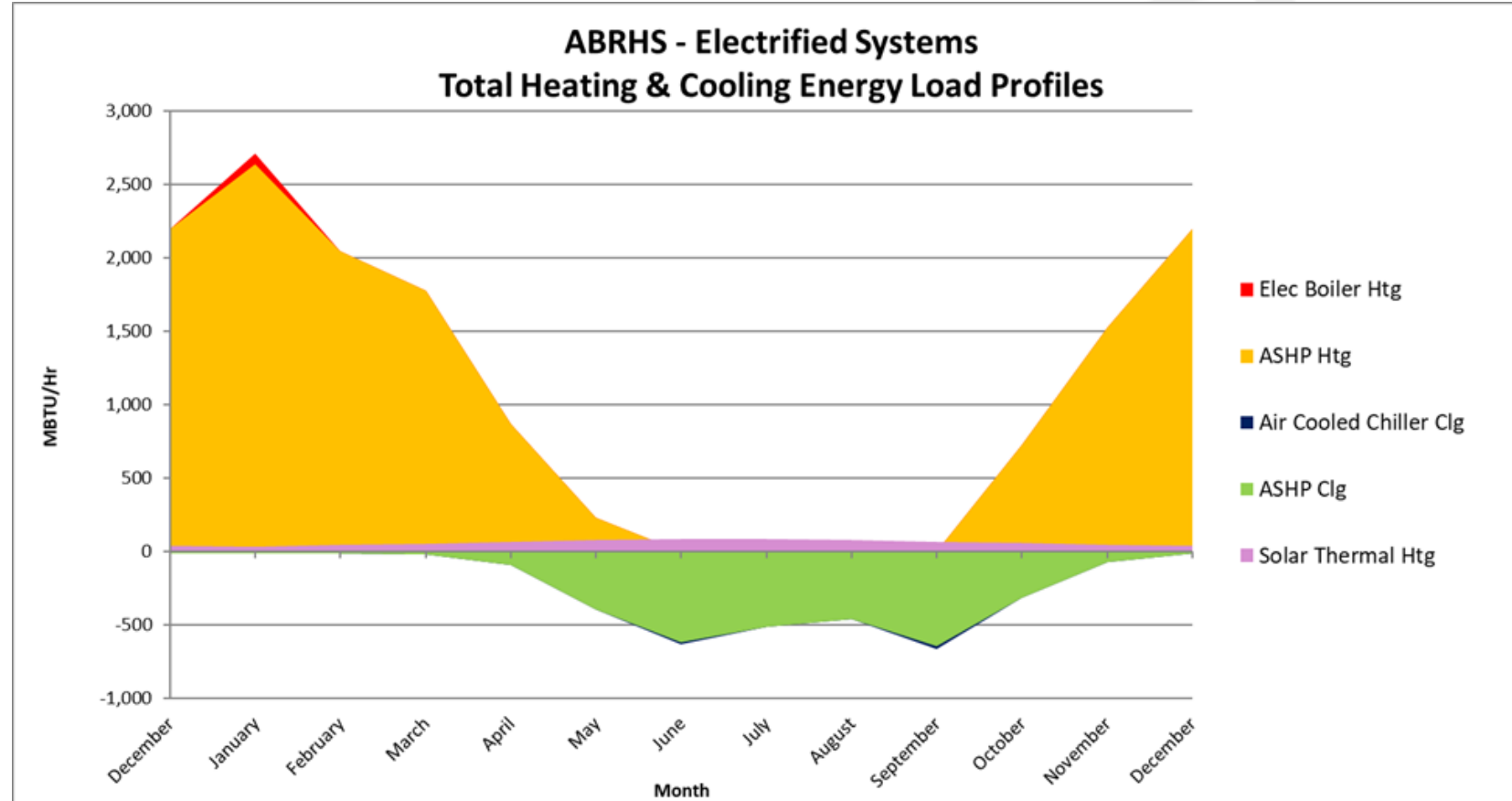
Electric boiler: 10% peak heating, 5% annual heating energy

Solar Thermal: 2% peak heating, 6% annual heating energy

ASHP Heating: 88% peak heating, 89% annual heating energy

ASHP Cooling: 69% peak cooling, 95% annual cooling energy

Air Cooled Chiller: 31% peak cooling, 5% annual cooling energy



ABRHS Electrified System Results (2050)

	BAU System	Electrified System	Savings	% Change
Electric Heating/Cooling (KWH/yr)	328,485	1,364,461	-1,035,977	315%
Natural Gas Heating (Therm/yr)	110,923	0	110,923	-100%
TOTAL Heating/Cooling Energy (MBTU/yr)	12,213,090	4,655,542	7,557,548	-62%

	BAU System	Electrified System	Savings	% Change
Electric Heating/Cooling Utility (\$/yr)	\$56,171	\$233,323	-\$177,152	315%
Natural Gas Heating Utility (\$/yr)	\$123,125	\$0	\$123,125	-100%
TOTAL Heating/Cooling Utility (\$/yr)	\$179,295	\$233,323	-\$54,027	30%

	BAU System	Electrified System	Savings	% Change
Electric Heating/Cooling (MTCO2e/yr)	0	0	0	0%
Natural Gas Heating (MTCO2e/yr)	589	0	589	-100%
TOTAL Heating/Cooling (MTCO2e/yr)	589	0	589	-100%

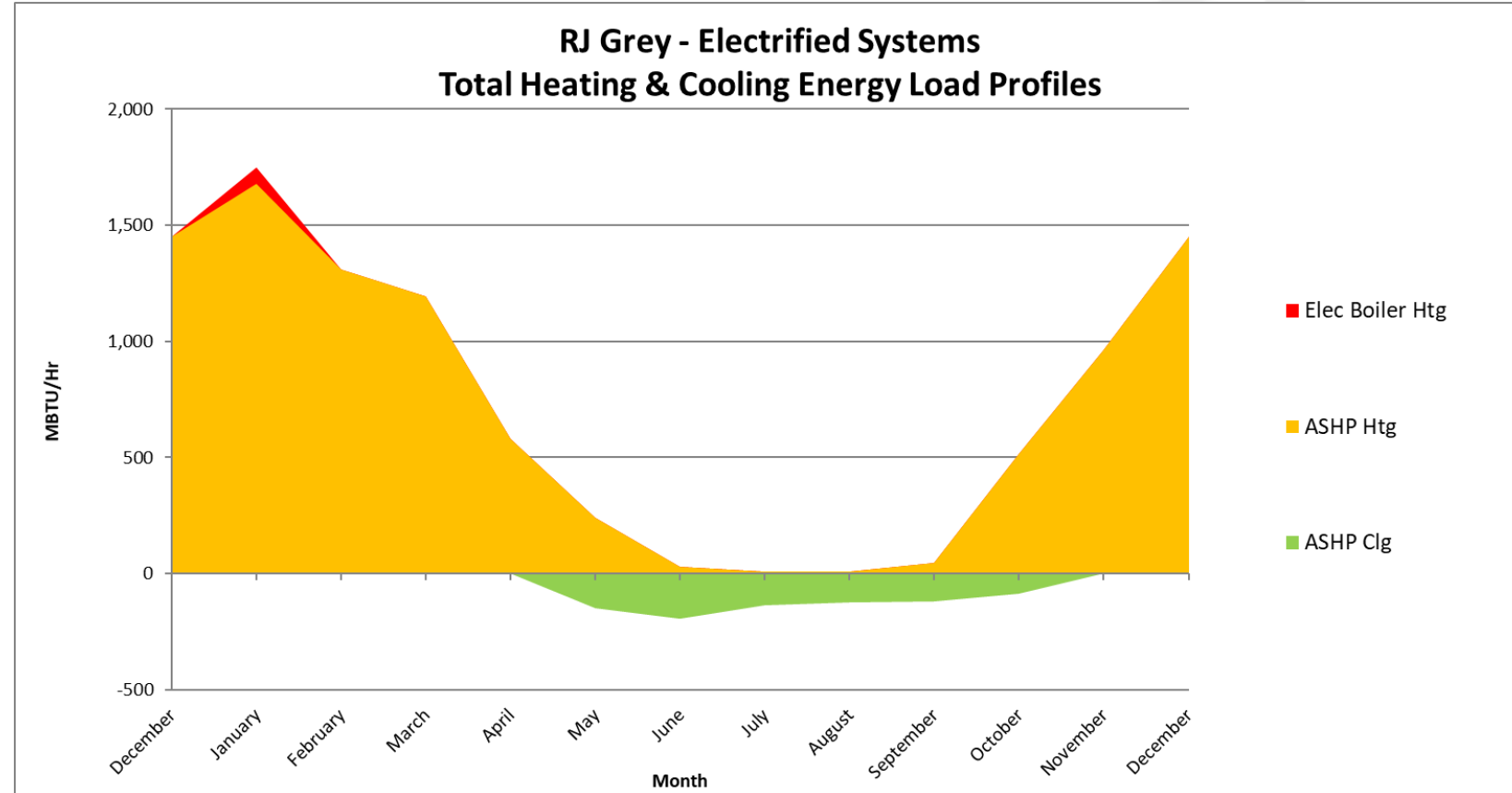
RJ Grey Electrified System

Equipment	Capacity	Notes
Electric Boiler	1,250 MBH	
ASHP	140 Tons	(2) 78 Ton units

Elec Boiler Heating: 48% peak heating, 9% annual heating energy

ASHP Heating: 52% peak heating, 91% annual heating energy

ASHP Cooling: 100% peak cooling, 100% annual cooling energy



Parker Damon Electrified System

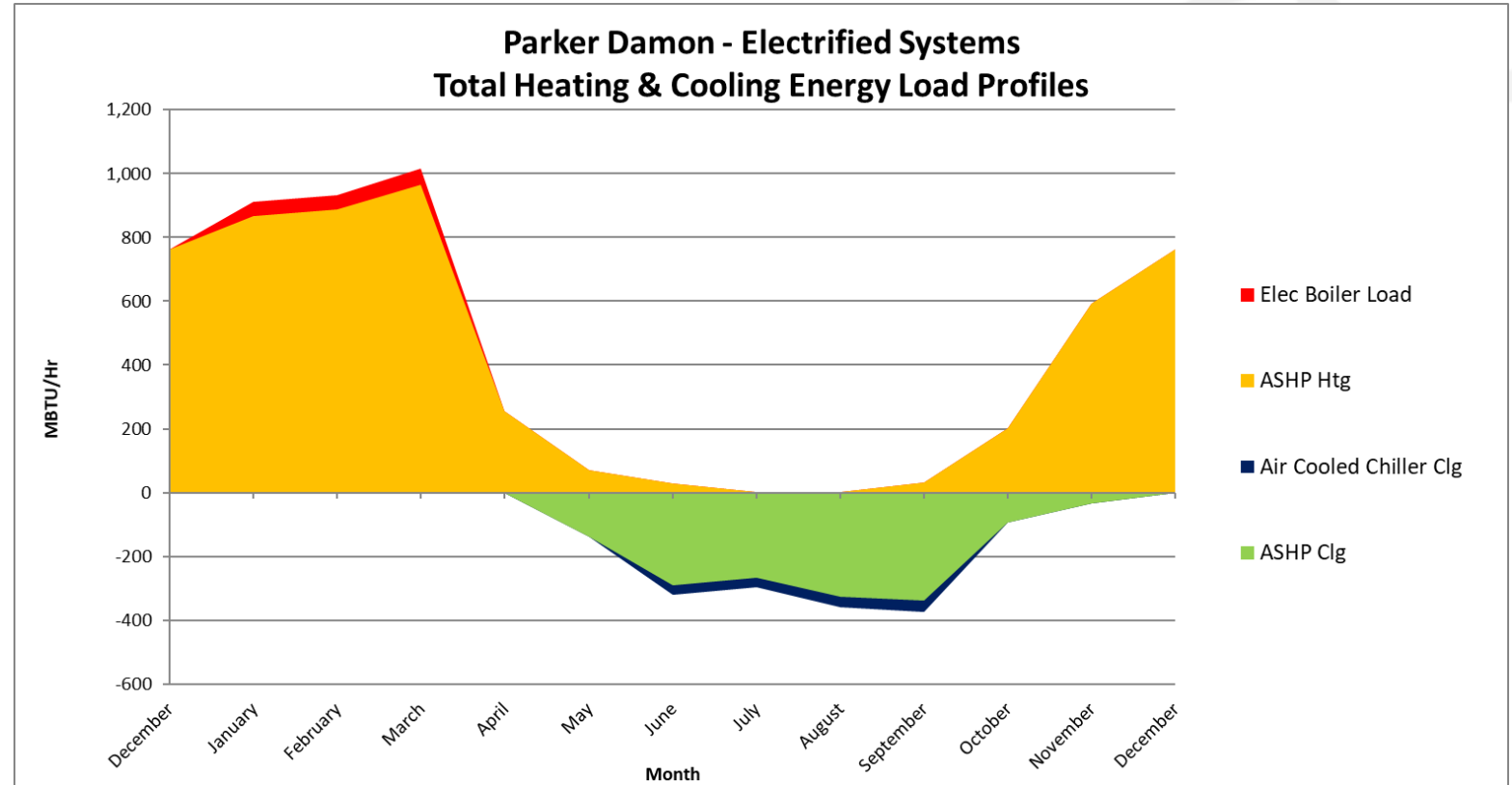
Equipment	Capacity	Notes
Electric Boiler	1,000 MBH	
ASHP	150 Tons	(2) 78 Ton Units
Air Cooled Chiller	224 Tons	

Elec Boiler: 34% peak heating, 5% annual heating energy

ASHP Heating: 66% peak heating, 95% annual heating energy

ASHP Cooling: 32% peak cooling, 72% annual cooling energy

Air Cooled Chiller: 68% peak cooling, 28% annual cooling energy

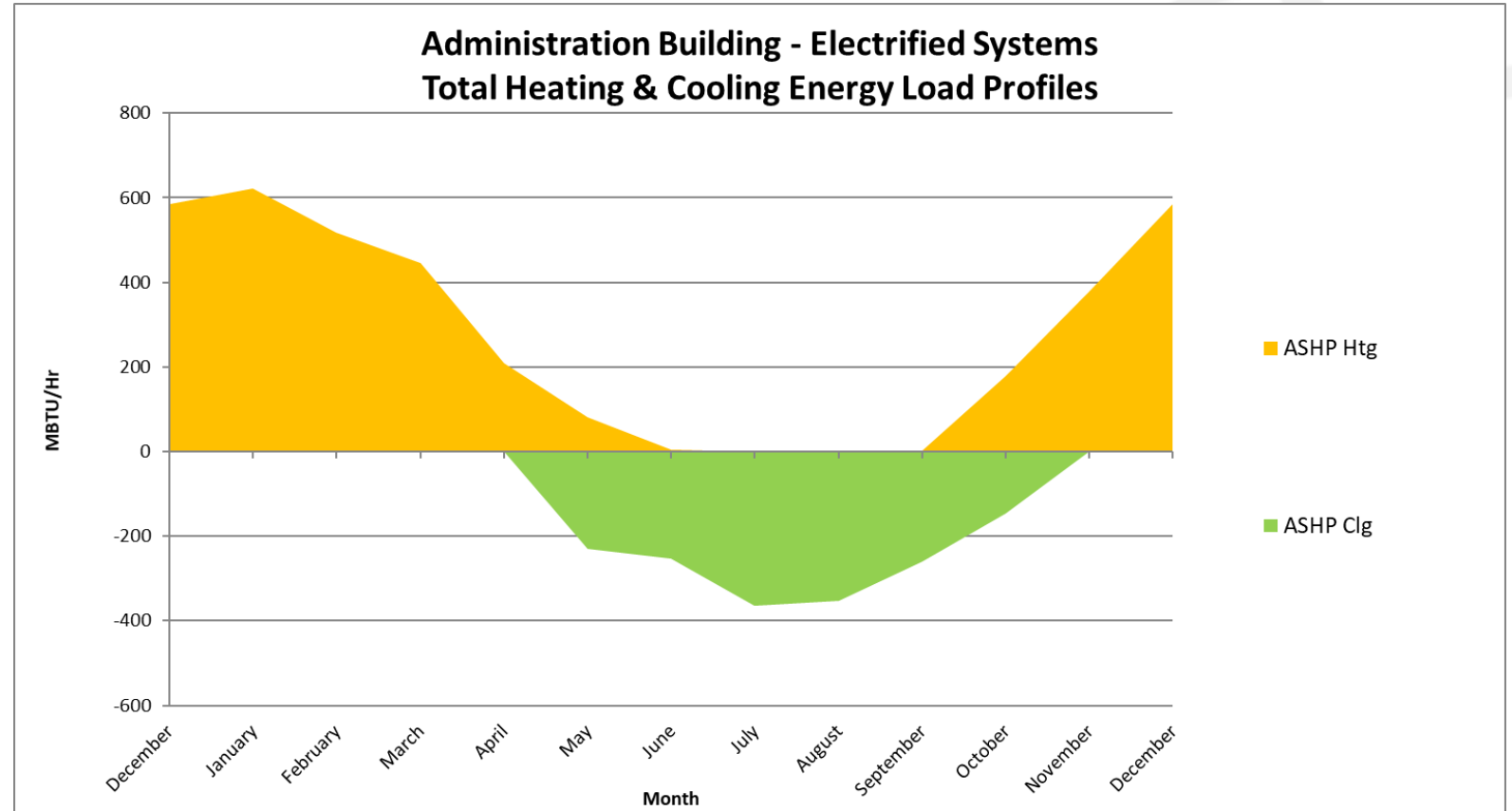


Administration Building Electrified System

Equipment	Capacity	Notes
ASHP	150 Tons	(2) 78 Ton units

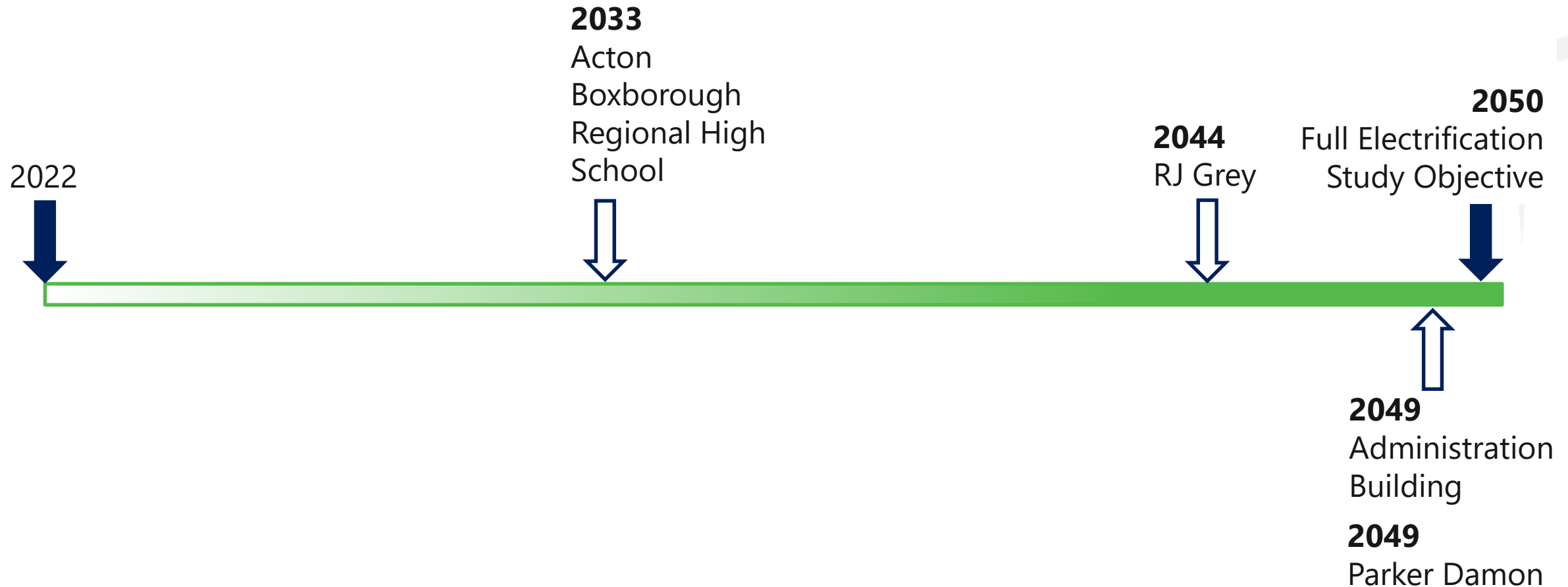
ASHP Heating: 100% peak heating, 100% annual heating energy

ASHP Cooling: 100% peak cooling, 100% annual cooling energy

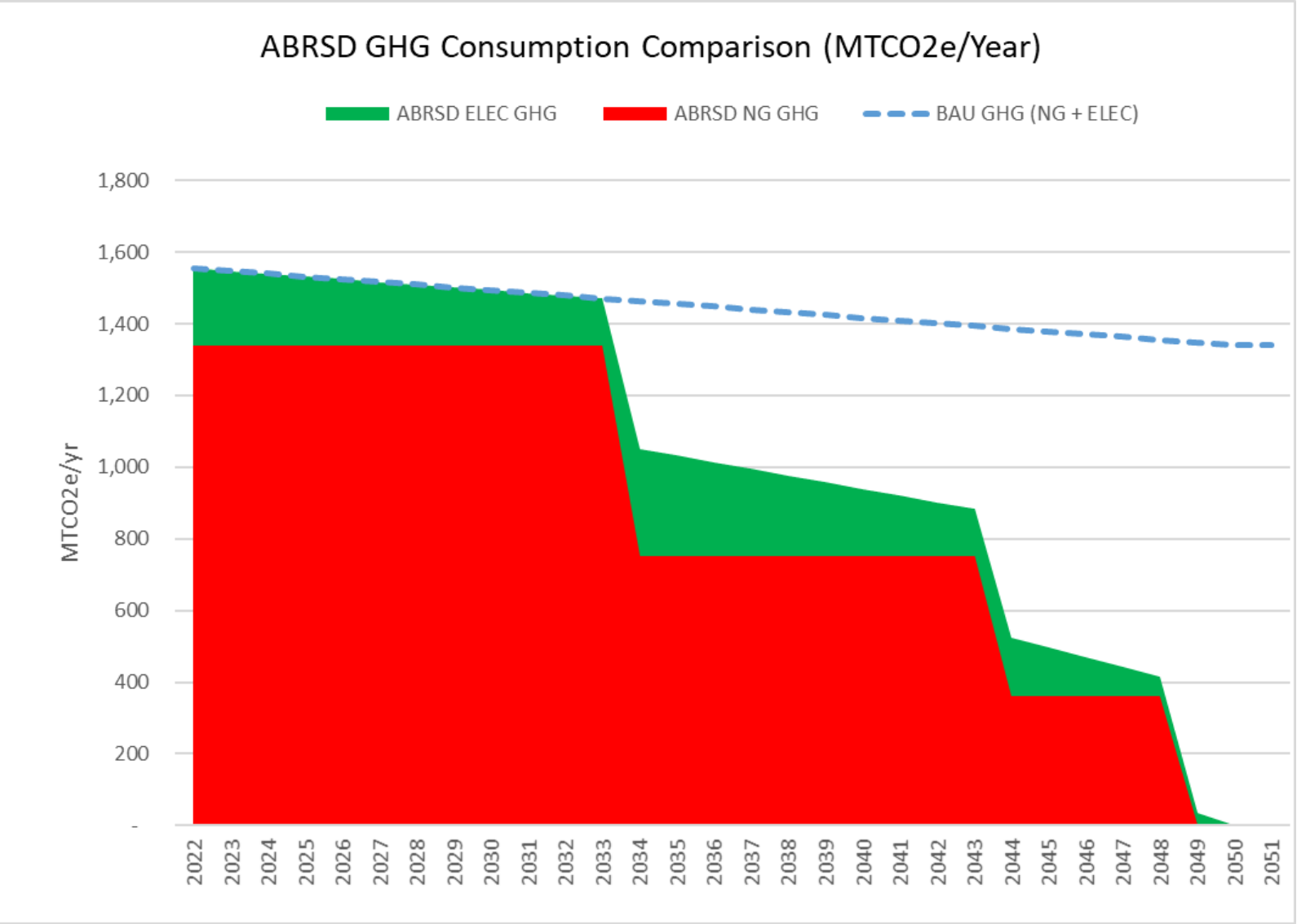


2022-2050 Electrification Investment Plan

ABRSD Scenario



GHG Emissions - ABRSD



Cumulative 30 year GHG reduction: 13,108 MTCO₂e



SALAS O'BRIEN
| expect a difference |

Capital Cost Summary - ABRSD

Building Name	Building Conversion Cost	Energy Plant Cost	Total
Acton Boxborough Regional High School	\$ 13,510,000	\$ 4,700,000	\$ 18,210,000
Administration Building	\$ 1,260,000	\$ 1,604,000	\$ 2,864,000
Parker Damon	\$ 4,970,000	\$ 2,366,000	\$ 7,336,000
RJ Grey Junior High	\$ 5,005,000	\$ 1,728,000	\$ 6,733,000
Total	\$ 24,745,000	\$ 10,398,000	\$ 35,143,000

LCCA Results - ABRSD

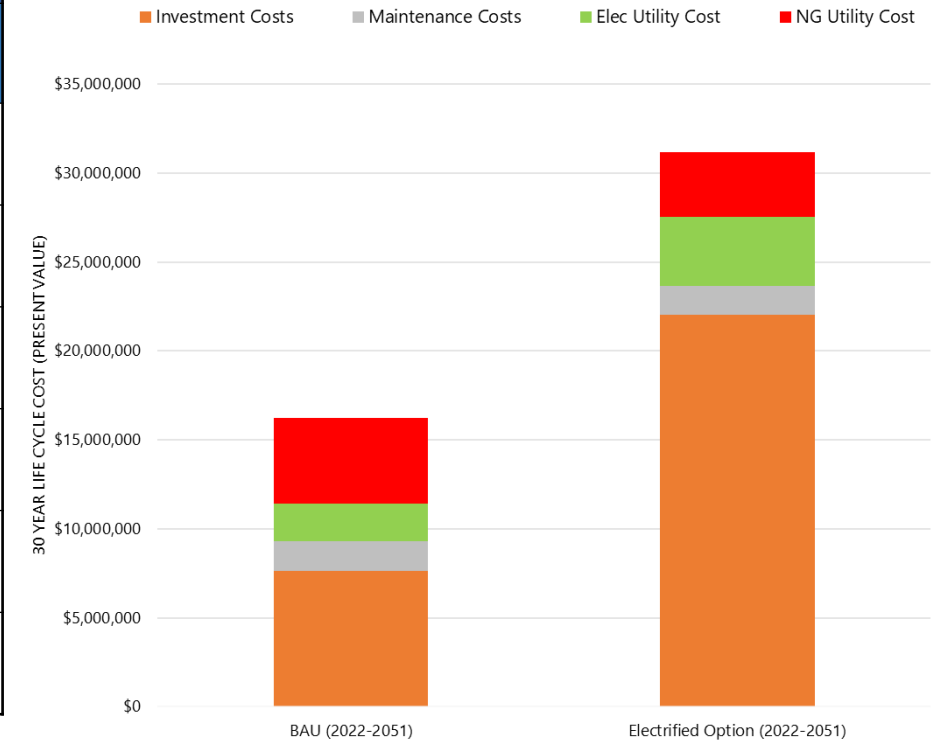
30 Year Life Cycle - Economic Comparison

Option:	BAU	Electrified Option	Delta
Elec Utility Cost	\$2,093,892	\$3,875,115	\$1,781,223
NG Utility Cost	\$4,834,700	\$3,603,578	-\$1,231,122
Total Utility Costs	\$6,928,593	\$7,478,693	\$550,101
Maintenance Costs	\$1,668,145	\$1,622,225	-\$45,921
Investment Costs	\$7,629,167	\$22,050,759	\$14,421,592
30 Year Life Cycle Cost	\$16,225,904	\$31,151,677	\$14,925,773

2051 Annual Operating Costs - Economic Comparison

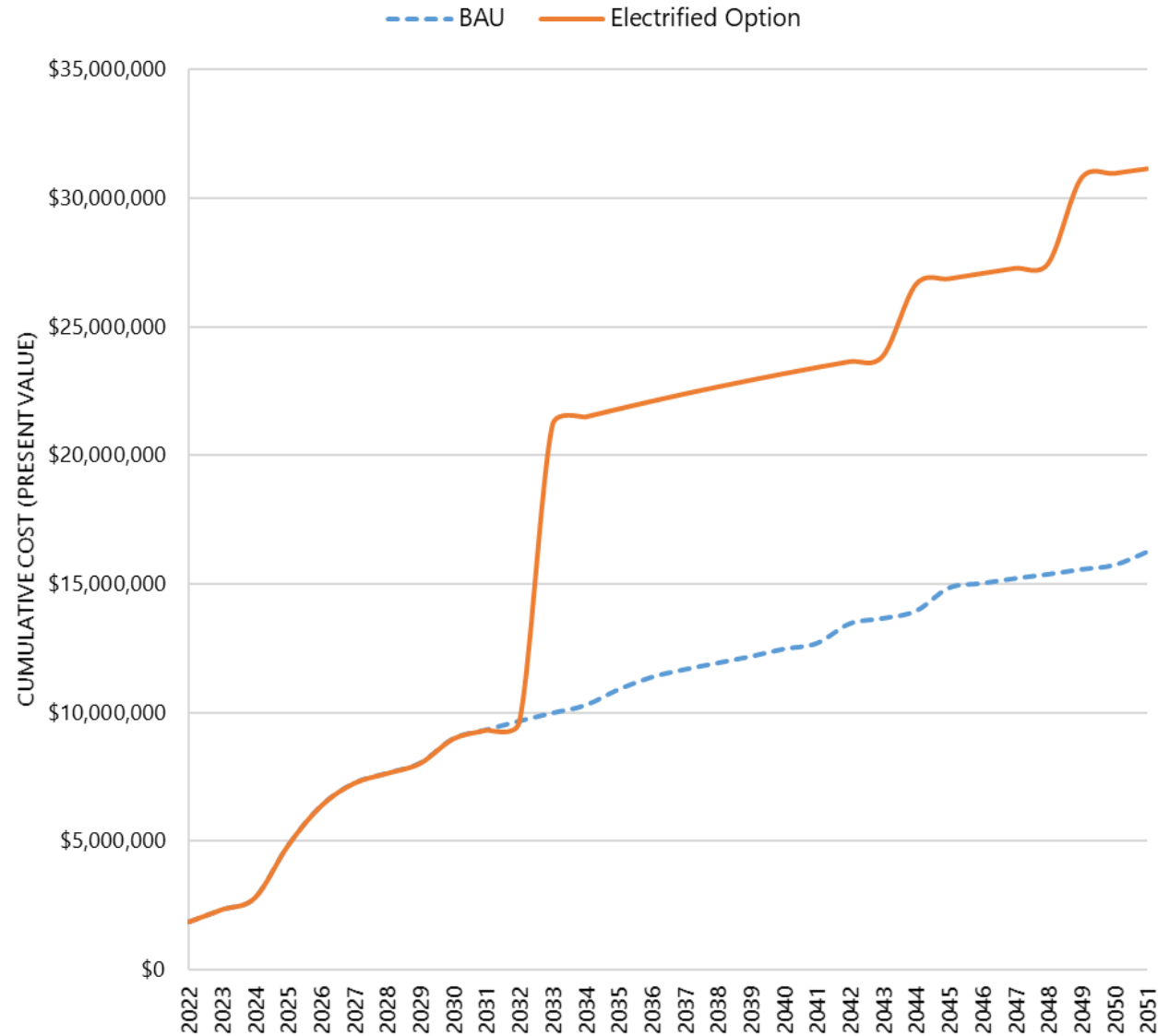
	BAU	Proposed Option	Delta
Elec Utility Cost	\$122,770	\$548,546	\$425,776
NG Utility Cost	\$280,353	\$0	-\$280,353
Maintenance Costs	\$98,000	\$103,300	\$5,300
Total Operational Costs	\$501,123	\$651,846	\$151,723

30 Year Life Cycle Cumulative Costs



LCCA Results - ABRSD

Present Value of Cash Flow



Questions?

