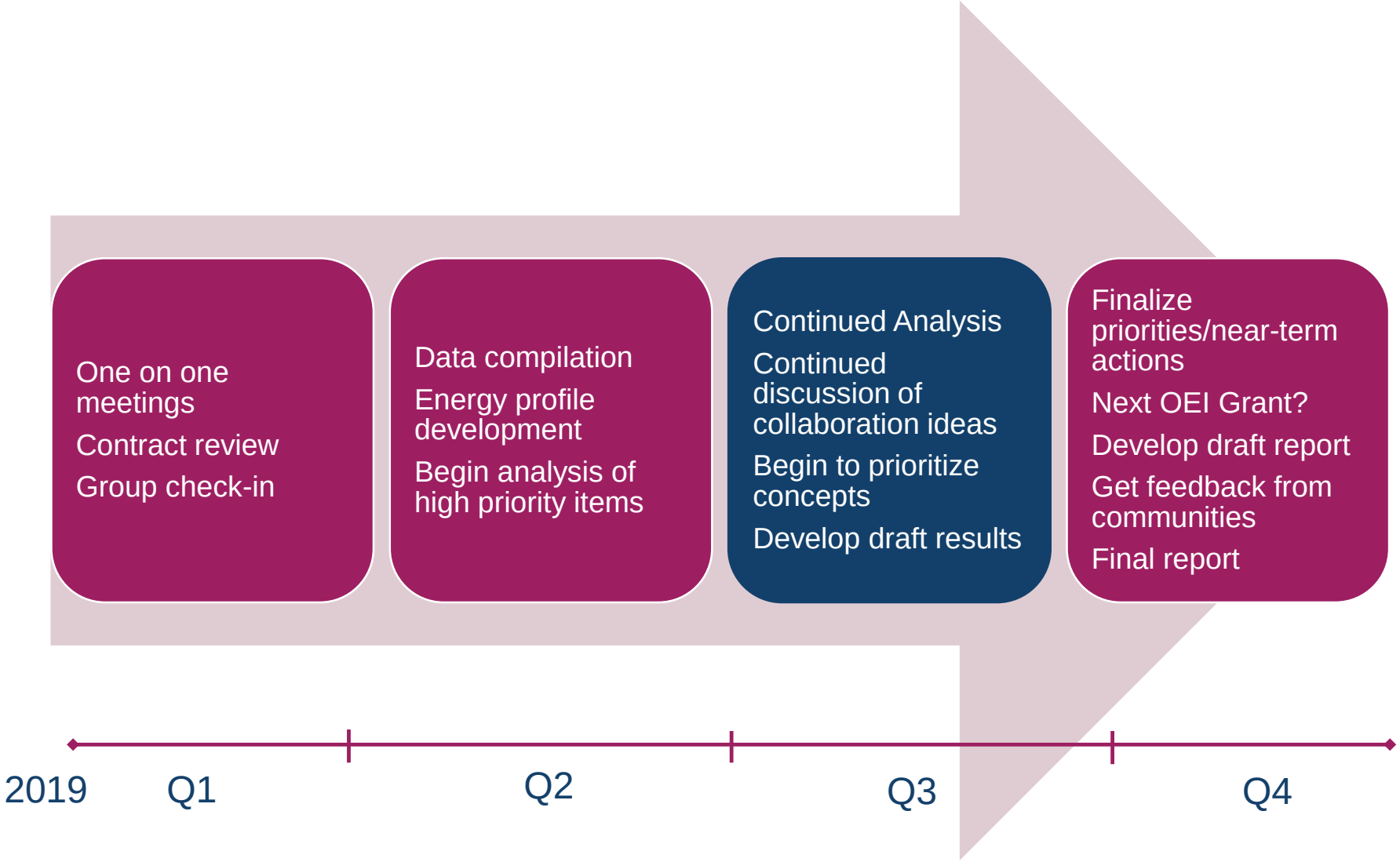
Stoughton– Energy planning update

September 2019

slipstream

Today’s Agenda

- Review progress to date
- Outline of deliverable/report
- Summary of analysis
  - Building efficiency
  - Fleet upgrades
  - Street lighting
  - Distributed energy
- Summary of initial recommendations
- Next steps



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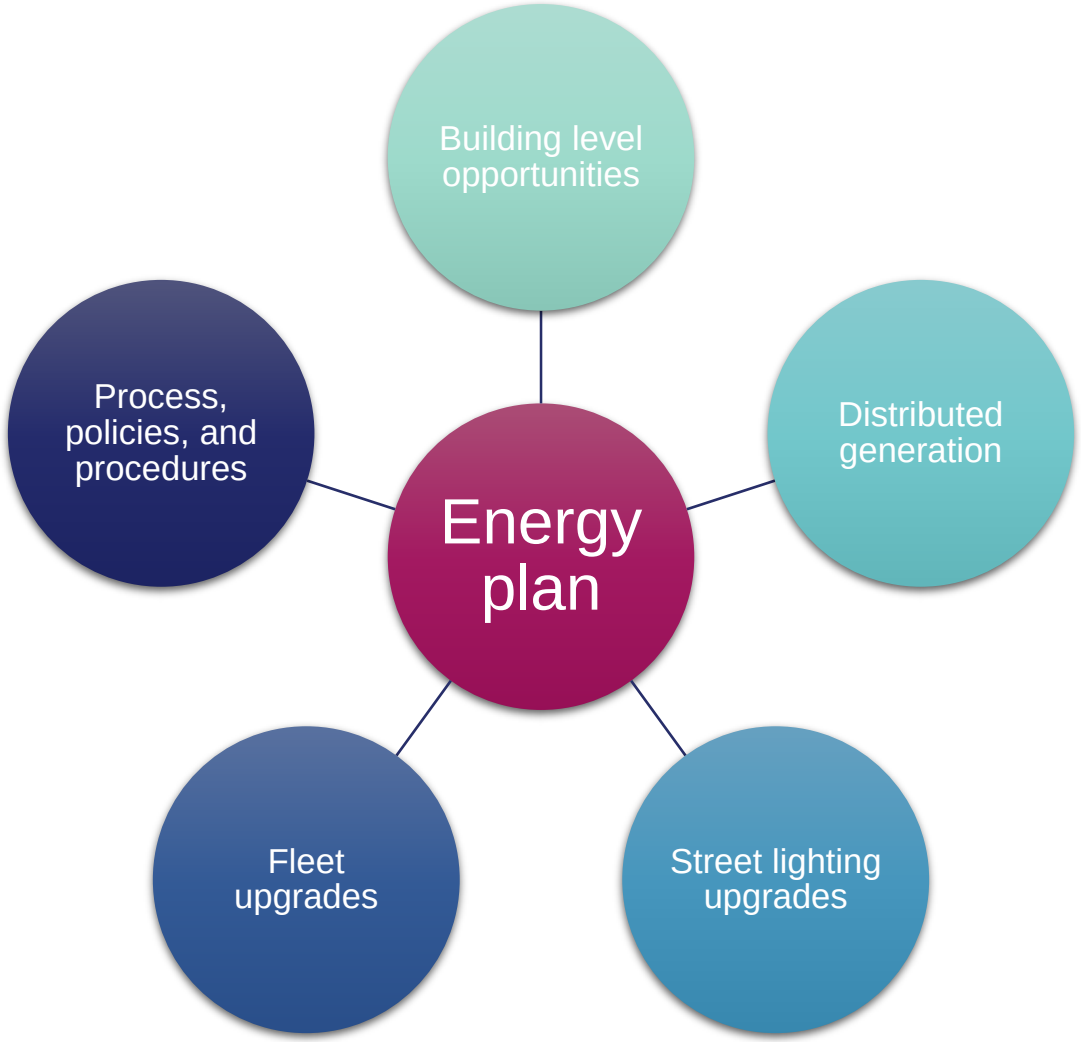
Overview of energy planning



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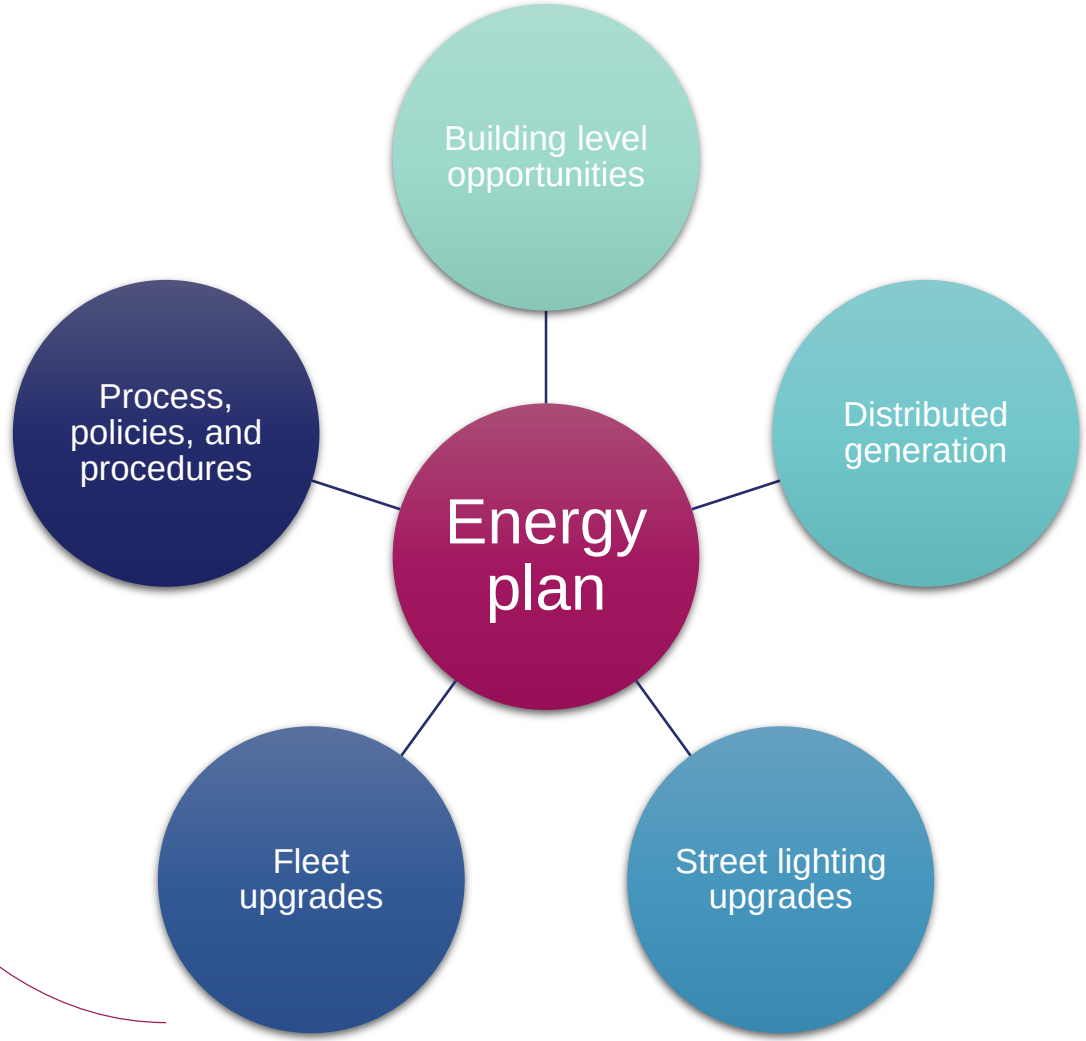
Overview of energy planning

Lessons learned



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Outline of report

- Introduction to communities
- Overview of methods
- Summary of communities' energy consumption and policies
- Overview of recommendations
- City-specific details (stand-alone chapters)
  - Energy profile for buildings, fleet, street lights, distributed energy
  - Summary of policies
  - Detailed recommendations
- Process for progress tracking
- Appendices with major assumptions

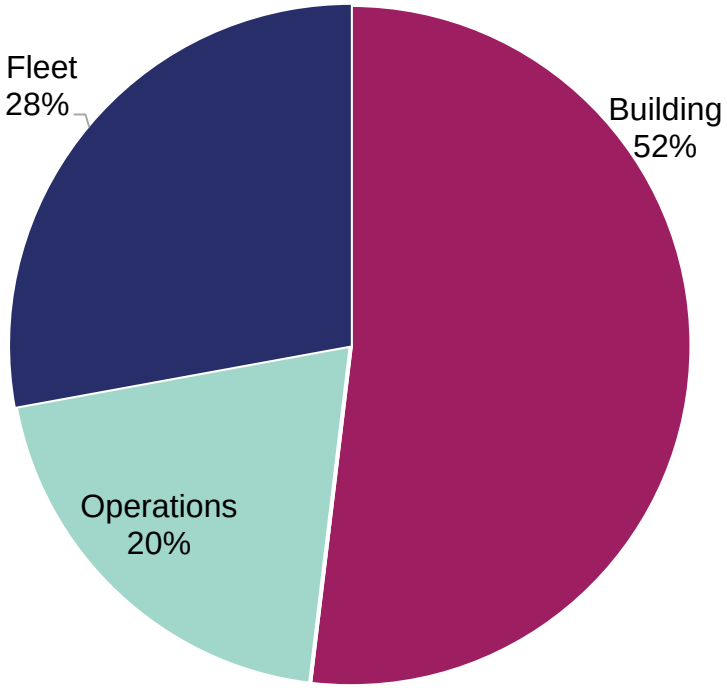
Energy profile update

Inventory elements

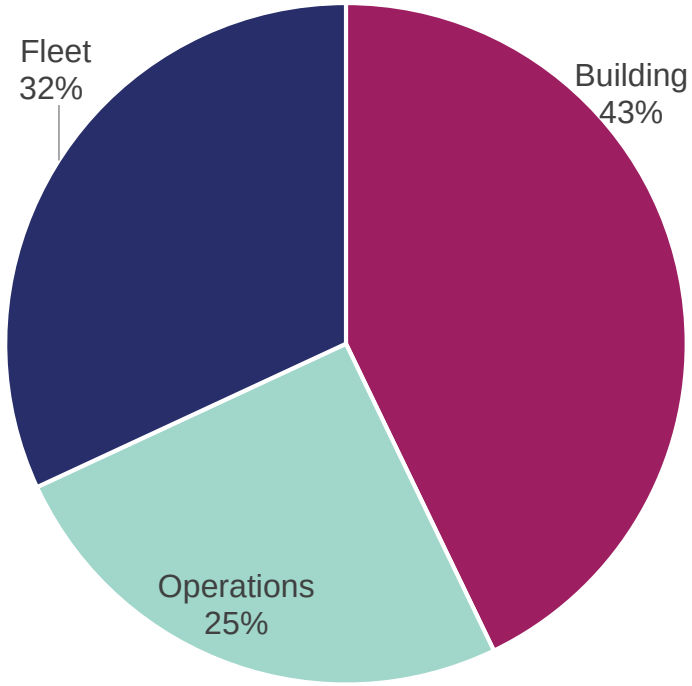
Buildings	Operations	Fleet
City Hall / Opera House Fire Department Library Senior Center Public Safety Youth Center Stoughton EMS Chamber Of Commerce Public Works Stoughton Utilities	Wastewater Treatment Center	*Details below*

Energy and GHG Inventory

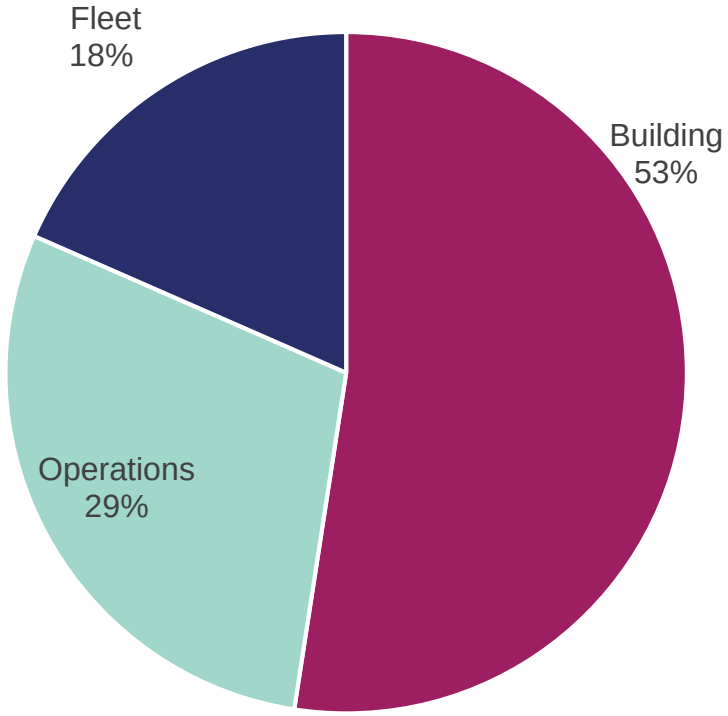
2018 Consumption (kBtu)



2018 Costs ($)



2018 Total carbon (CO2e)



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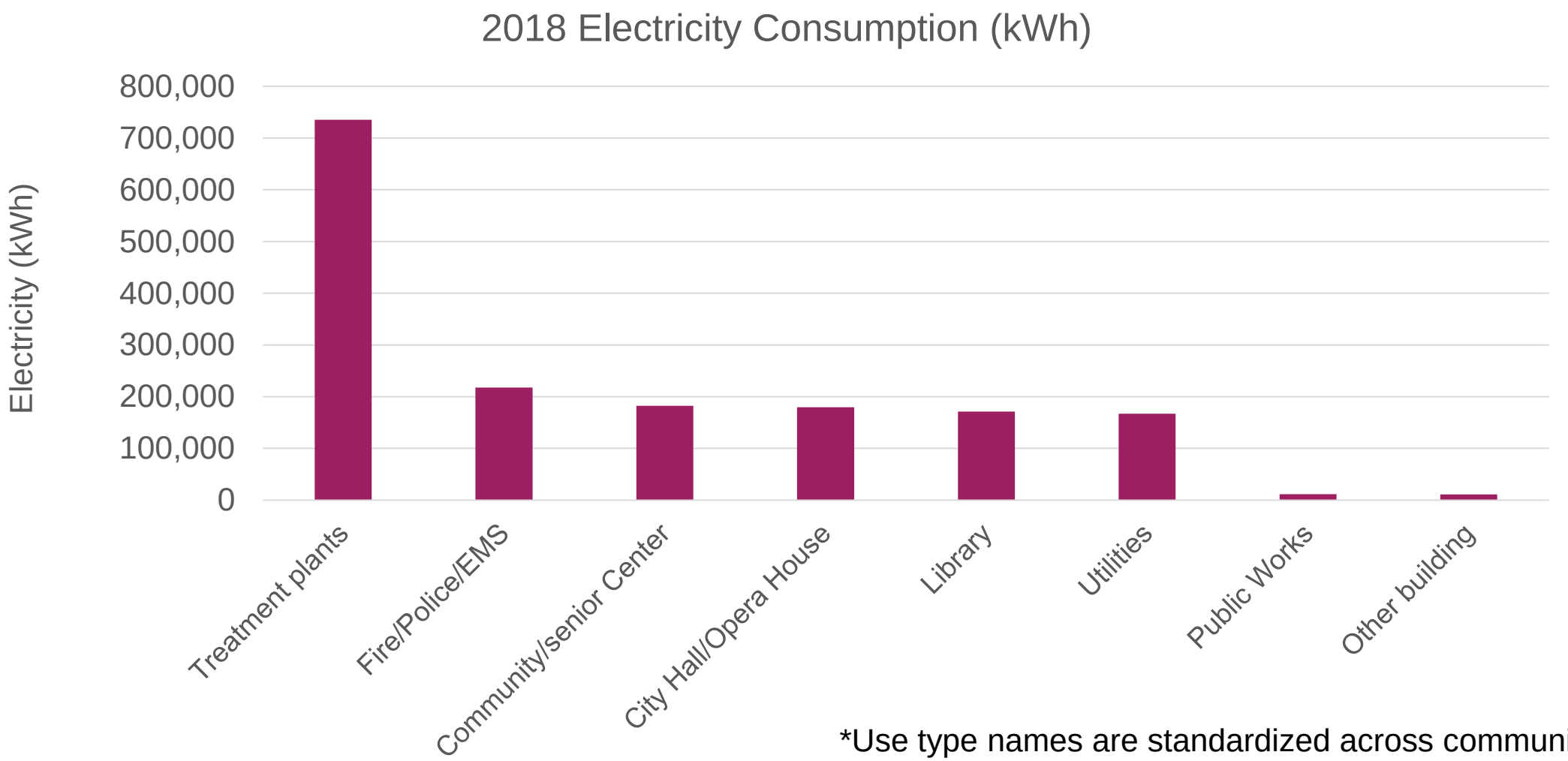
Energy consumption by use type*



*Use type names are standardized across communities

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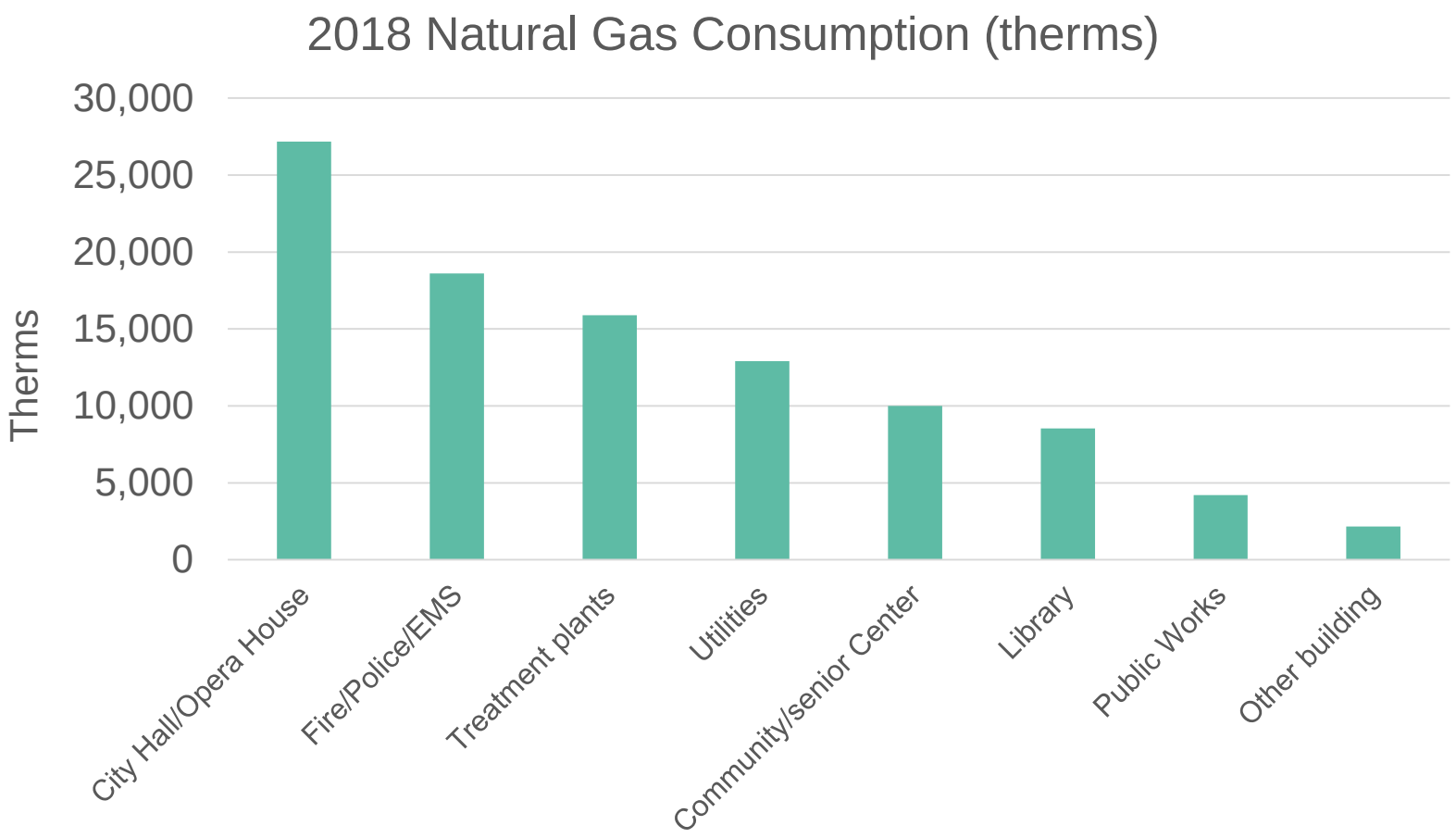
Energy consumption by use type



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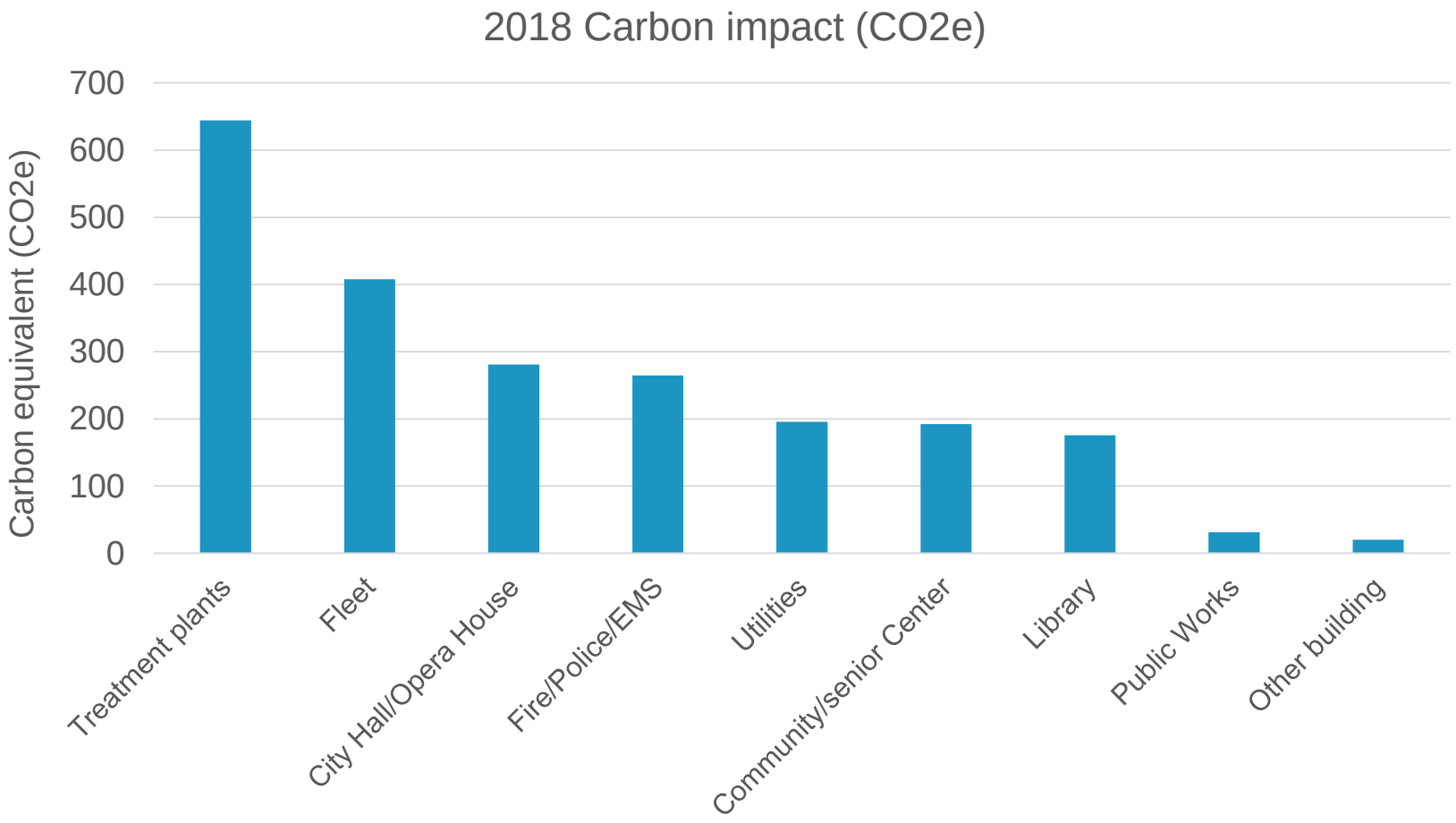
Carbon impact of energy by use type



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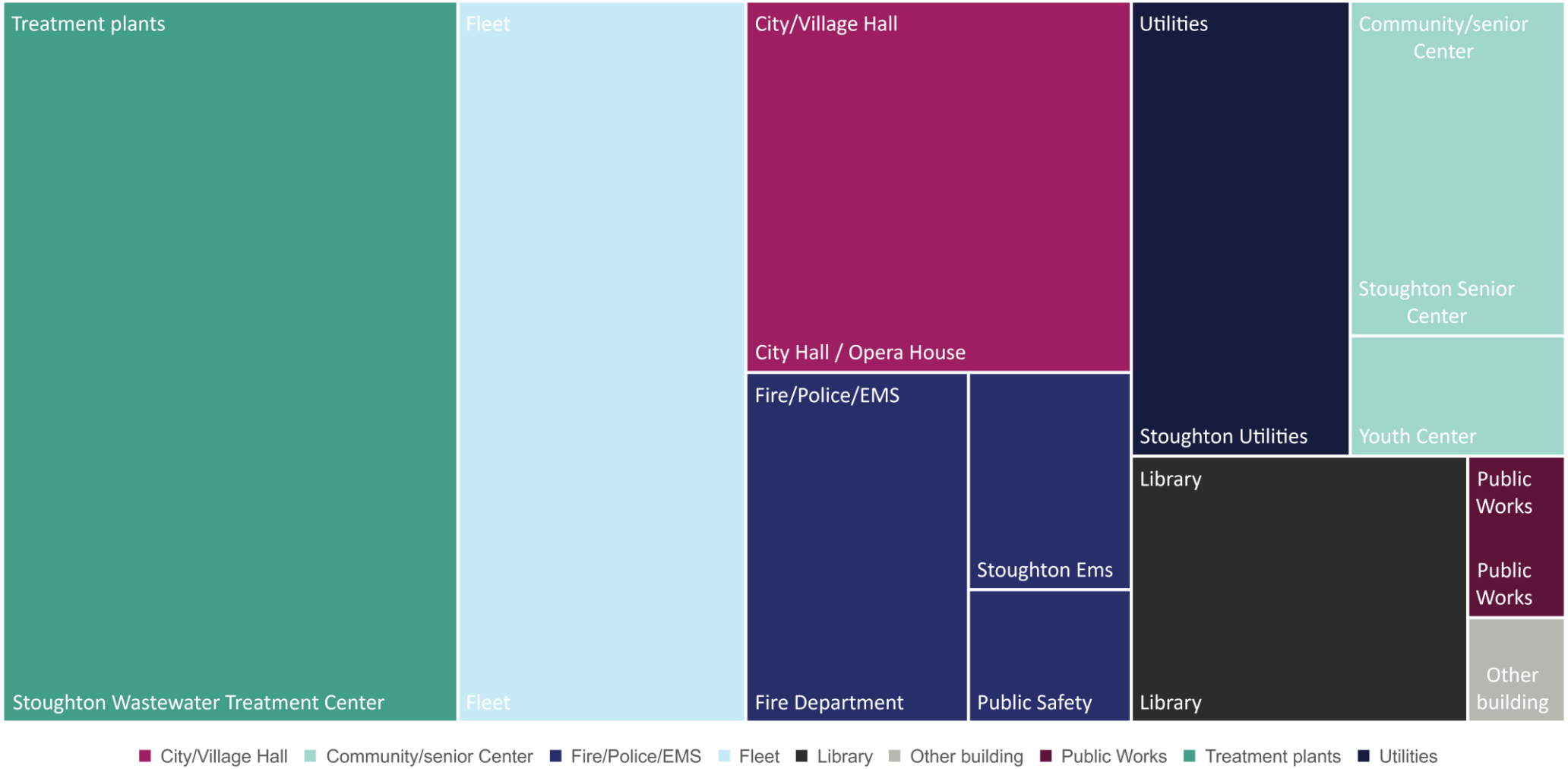
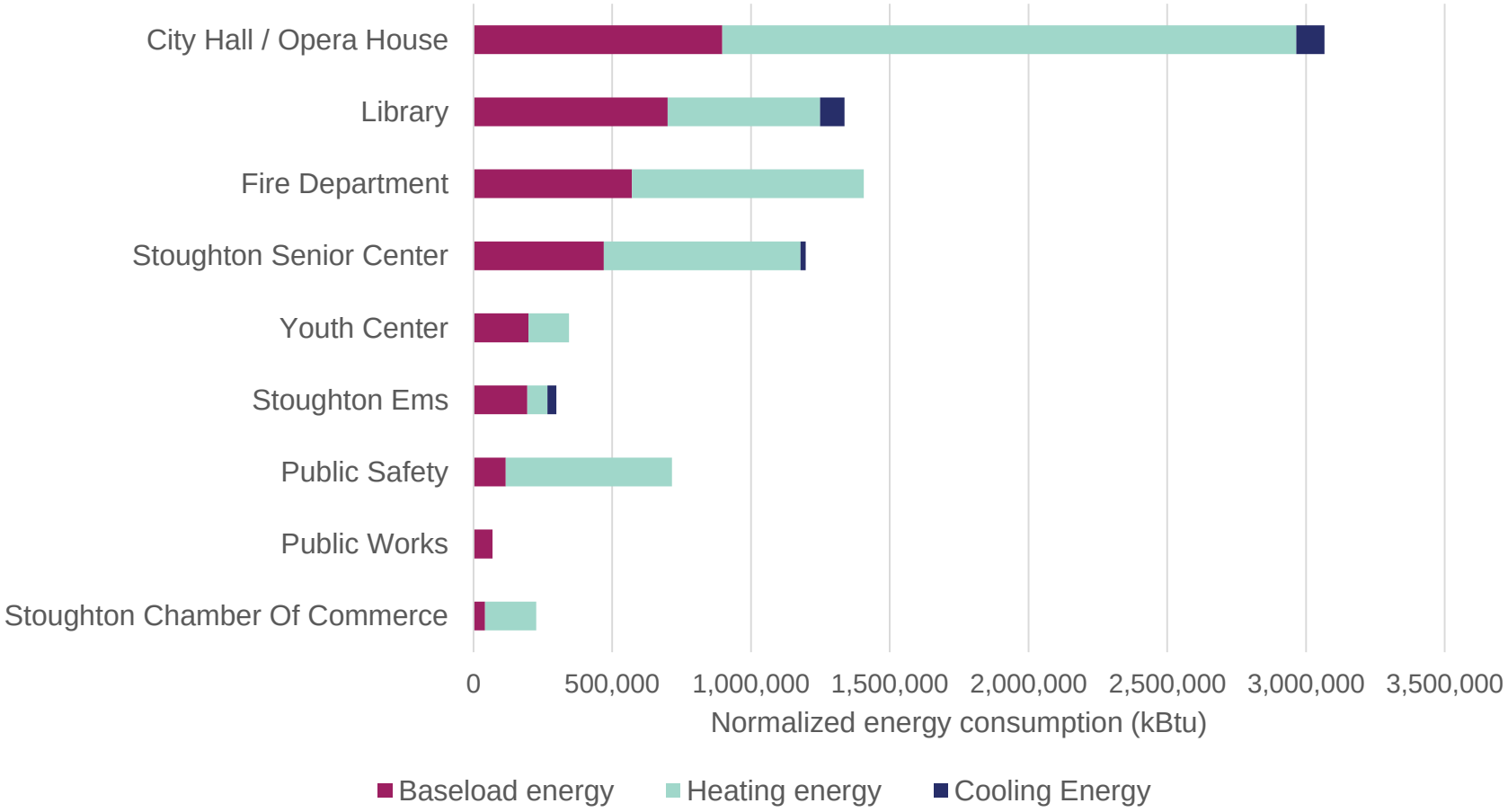
Carbon impact of energy



2018 data

Breakdown by heating, cooling, and baseload



2018 data

Building efficiency

Building efficiency analysis process

Stoughton buildings visited:
- Senior Center
- Fire Department
- Opera House

Select two or three buildings

Conduct high-level walk-through

Identify opportunities

Calculate energy and cost savings

Share opportunities from other communities

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Prioritizing energy upgrades

FIRST COSTS AND ENERGY SAVINGS POTENTIAL

OCCUPANT COMFORT, HEALTH, SAFETY

MAINTENANCE

EQUIPMENT END-OF-LIFE REPLACEMENT OPPORTUNITIES

CARBON REDUCTION

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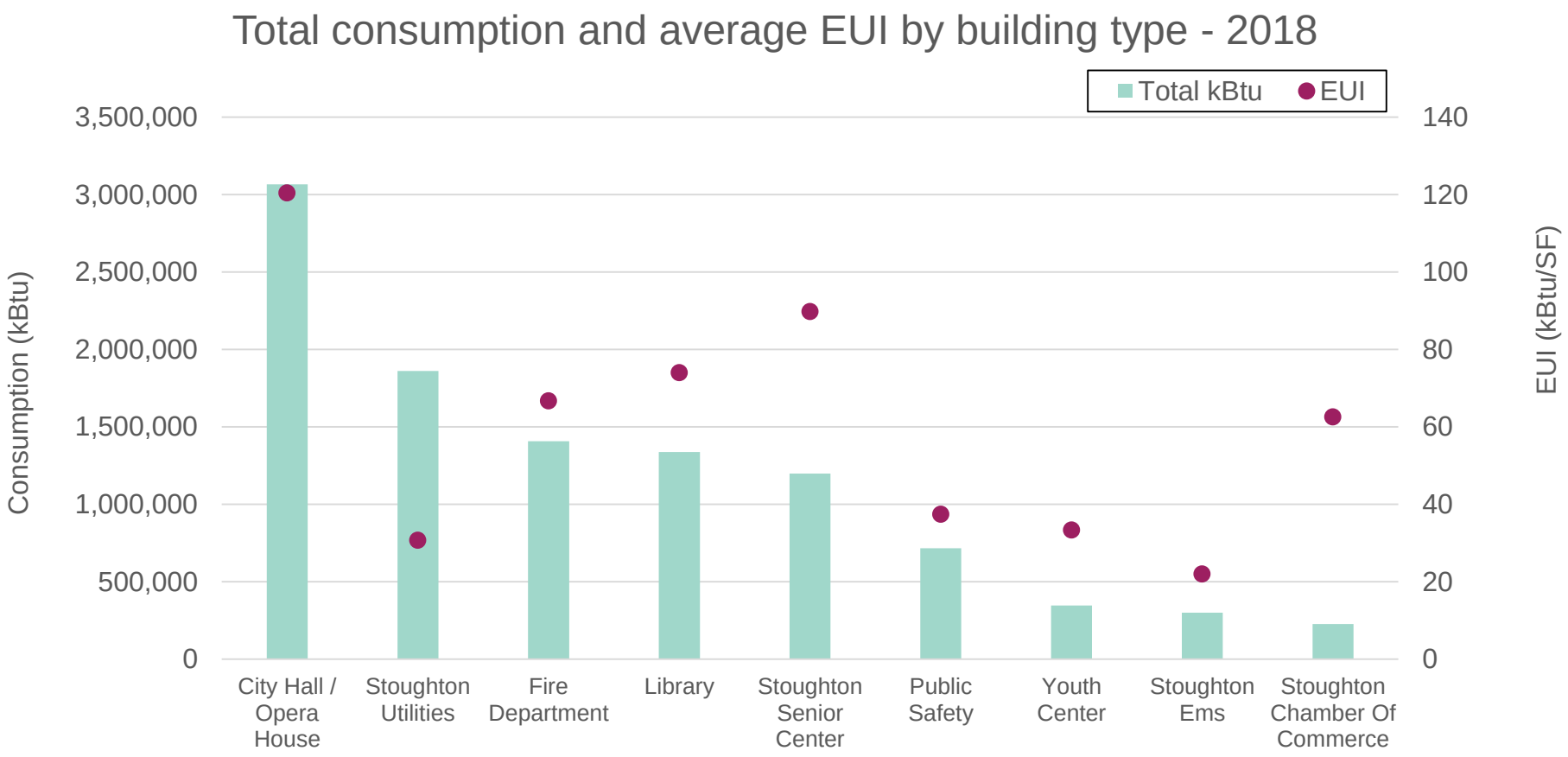
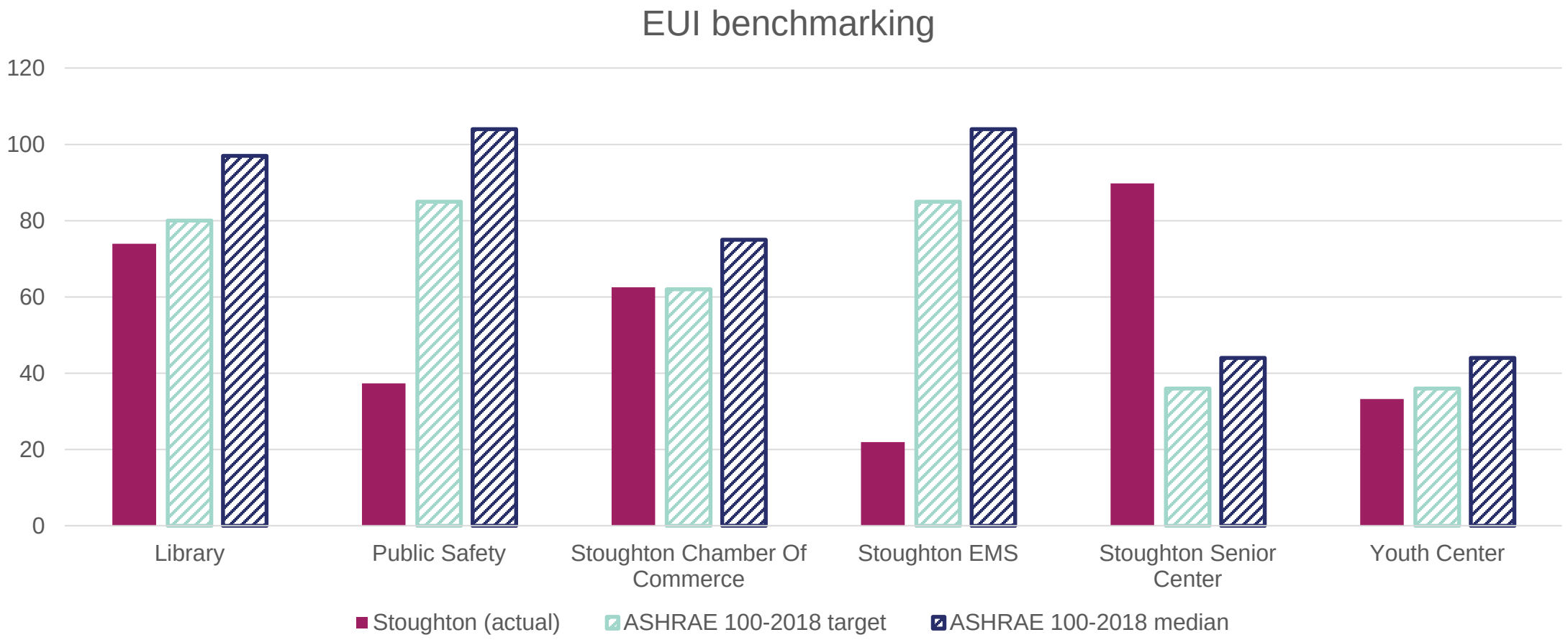
Building energy summary



Benchmarking



Low-hanging fruit opportunities we explored

Measure	Senior Center	Fire Department	Opera House
LED lighting retrofit – interior	✓	✓	✓
LED lighting retrofit – exterior			
Lighting controls – occupancy/vacancy		✓	
Lighting controls – daylighting		✓	
Lighting controls – exterior timeclock	✓		✓
Lighting controls – garage	✓		
RTU upgrade (at end of service)	✓		✓
Split system AC (IT room)			
Summer boilers			
Demand controlled ventilation	✓		✓
Boiler hot water reset	✓		
AHU supply air reset	✓	✓	
Computer power management			
ENERGY STAR appliances	✓	✓	

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Senior Center

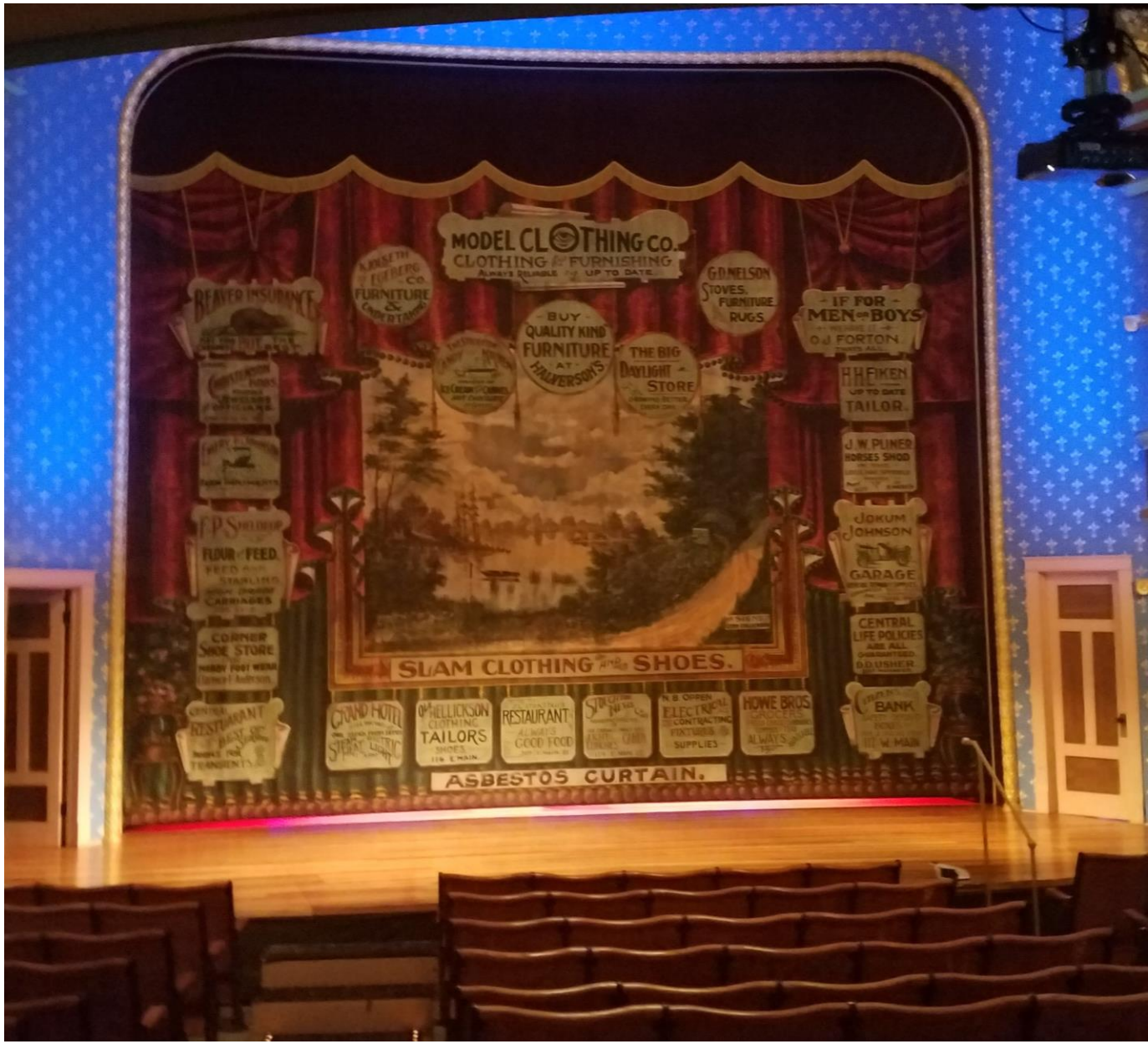
- Summary
  - Boilers rebuilt and AHU replaced recently
  - LED upgrades on-going as lights fail – roughly 33% complete
  - Roof may require replacement soon
- Opportunities
  - Demand control ventilation (DCV) could be effective given variable occupancy
  - LEDs and occupancy sensors in garage an easy change, but possibly minimal savings
  - When replacing the roof, consider implementing solar or building solar-ready

Fire Department

- Summary
  - Energy recovery ventilation implemented
  - Plans to retrofit lighting with LEDs
- Opportunities
  - Garage has significant daylighting controls potential
  - Air handling unit (AHU) supply air reset is simple to implement

Opera House

- Summary
  - Future renovations expected for former city hall spaces
  - Any proposed modifications need to consider space and lighting aesthetics
  - On-going thermal comfort issues
- Opportunities
  - Significant savings potential with LED retrofit, but will require careful design
  - Several options for improving HVAC efficiency while addressing thermal comfort issues



Estimated savings – Senior Center

Measure	Annual kWh savings	Annual therm savings	Incremental capital cost	Simple payback (years)
LED lighting retrofit – interior	30,530	-680	11,230	3.8
Demand controlled ventilation	13,470	7,030	90	0.5
Boiler hot water reset	0	1,070	1,220	1.9
AHU supply air reset	1,630	180	100	0.3
Total	**45,680**	**7,590**	**12,690**	

Estimated savings – Fire Department

Measure	Annual kWh savings	Annual therm savings	Incremental capital cost	Simple payback (years)
LED lighting retrofit – interior	29,710	-660	10,930	3.8
Lighting controls – occupancy/vacancy	4,000	-90	2,200	5.7
Lighting controls – daylighting	7,600	-170	3,940	5.4
AHU supply air reset	2,580	280	100	0.2
Total	**43,940**	**-640**	**17,200**	

Estimated savings – Opera House

Measure	Annual kWh savings	Annual therm savings	Incremental capital cost	Simple payback (years)
LED lighting retrofit – interior	29,170	-650	10,730	3.8
Demand controlled ventilation	25,740	13,410	170	0.5
Total	**54,910**	**12,765**	**10,907**	

NOTE:

- Initial estimates based on square footage and building type
- For a building this unique, we will refine our analysis with additional modeling in the coming weeks

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Recommendations for Energy Efficiency

Lighting

- LED retrofit
- Occupancy/vacancy controls
- Daylighting

HVAC

- Demand controlled ventilation
- Boiler reset
- AHU supply air reset

Other

- ENERGY STAR Appliances

Building efficiency analysis – next steps

- Finalize/fine-tune initial analysis
- Continue to model additional measures and improve savings estimates for Opera House
- Apply other municipality analyses to Stoughton buildings

Fleet analysis

Fleet Analysis

- Characterized vehicles into 6 types
  - Separated diesel & gasoline vehicles
- Used city-specific data and secondary data to estimate current costs & carbon footprints
- Estimated carbon footprint & costs if alternatives adopted where possible

Key Vehicle Types

Category	Vehicles Included
Police Vehicles	Police department SUVs, motorcycles, pickups, vans, cars
Pickups	Pickups, heavy-duty cargo vans, Jeeps
Heavy Duty	Large pickups (e.g. F550 & F750); plows, dumps, refuse vehicles, cargo trucks, etc.
Emergency Vehicles	Firetrucks, ambulances, fire department SUVs & pickups
Light Duty	Cars, SUVs, vans
Other	Construction equipment, outdoor power equipment, small street cleaning equipment, ATVs

Alternatives by Vehicle Type

Vehicle type	Near-term alternative	Example Manufacturer
Light duty	Full electric or PHEV	• Car: many • SUV PHEV: many • Van PHEV: Chrysler Pacific • Transit Van: Electric Ford Transit
Police vehicles	Hybrid electric or full electric	• Ford Interceptor SUV hybrid • Police Responder Hybrid Sedan • Motorcycle: ZERO Motorcycles
Pickups	Hybrid electric or PHEV	• F150: PHEV retrofit by XL Fleet • Larger (including cargo vans): Hybrid retrofit by XL Fleet • Jeeps: Hybrid options
Heavy-duty vehicles	CNG	• Freightliner • Kenworth • Ford retrofits by qualified vehicle modifier
Emergency vehicles	*no widespread alternative*	N/A
Other	*no widespread alternatives*	N/A

Stoughton: Fleet Profile

		Energy Use (MMBtu)		Carbon (Tons)		Fuel Cost ($)	
Department	Number of Vehicles	Current	Alternative	Current	Alternative	Current	Alternative
Police	11	1,650	**1,020**	112	**70**	33,120	**20,060**
Light Duty	1	23	**10**	2	**1**	465	**230**
Emergency Vehicles	10	570	**570**	41	**41**	9,850	**9,850**
Heavy Duty	29	1,120	**1,180**	89	**69**	23,975	**22,675**
Pickups	26	910	**545**	62	**43**	18,260	**11,370**
Other	17	1,380	**1,380**	102	**102**	28,685	**28,685**

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Police Vehicles – lifetime savings

	Lifetime	Incremental Vehicle Cost	Annual Cost Savings	Lifetime Savings	Payback Period	Lifetime Carbon Reduction
Hybrid Patrol SUV	8	3,500	1,640	10,200	1.2	41%
Hybrid Patrol Sedan	8	3,500	2,170	14,560	1	55%
Electric Motorcycle	8	390	825	8,600	.4	35%

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Light Duty – lifetime savings

	Lifetime	Incremental Vehicle Cost[1]	Annual Cost Savings	Lifetime Savings[3]	Payback Period (years)	Lifetime Carbon Reduction
Passenger Vehicle	15	8,600	350[2]	-$3,700	24	43%
Plug-in Hybrid SUV	15	9,000	430	-$3,000	20	18%
Plug-in Hybrid Van	15	9,000	240	-$5,650	37	35%

As miles driven per vehicle increases, savings will increase & payback will decrease

1. *Another option is to lease the vehicle – this creates the ability for the federal tax credit to be worked into the agreement and would subsequently lower the incremental vehicle cost.*
2. *Accounts for a $0.0128/mile decrease in annual maintenance costs*
3. *The cost of a charger is $500 which decreases lifetime savings by about 500*

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Pickups – lifetime savings

	Lifetime	Incremental Vehicle Cost	Annual Cost Savings	Lifetime Savings	Payback Period	Lifetime Carbon Reduction
F150 Plug-in Hybrid[1]	15	20,000	565	-12,160	35	22%
F250 + Hybrid	15	9,000	370	-3,875	24	21%

As miles driven per vehicle increases, savings will increase & payback will decrease

1. New hybrid and electric pick-up trucks planned for release in coming years

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Heavy Duty – lifetime savings

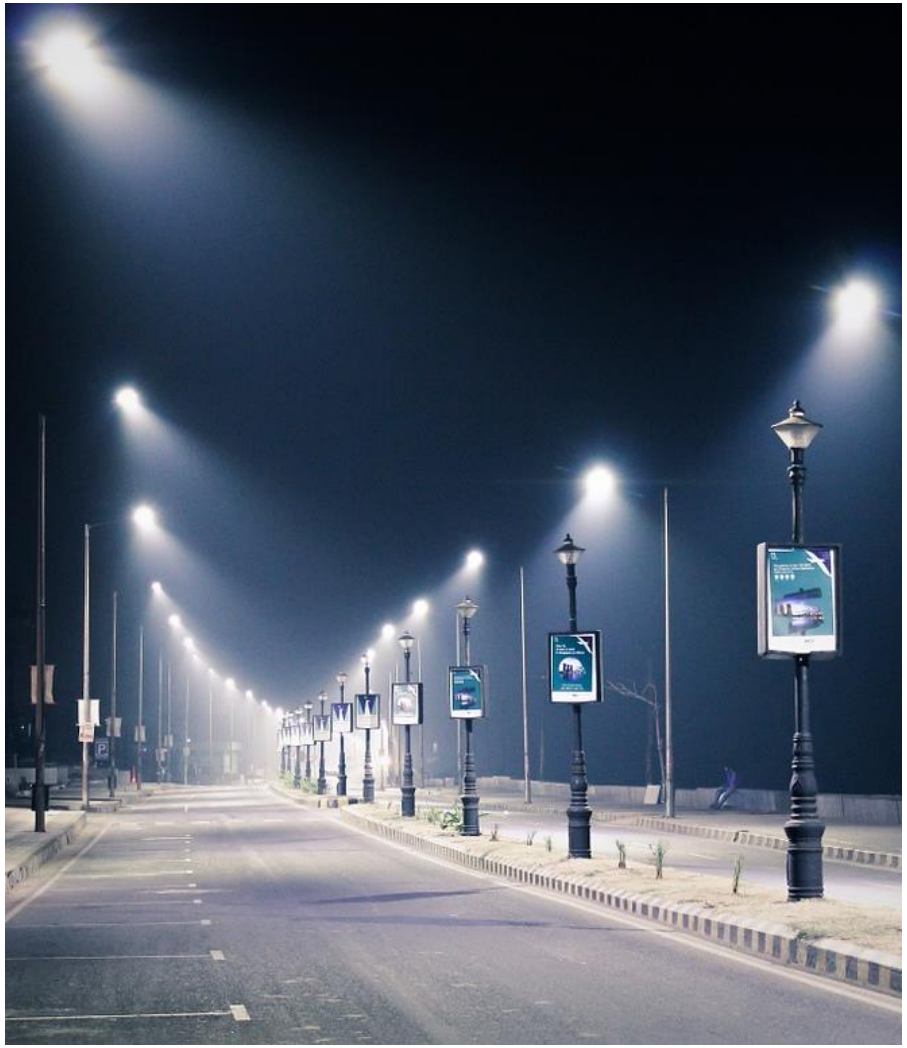
	Lifetime	Incremental Vehicle Cost	Annual Cost Savings	Lifetime Savings	Payback Period	Lifetime Carbon Reduction
Low Upfront Cost	12	10,000	299	-6,500	33	21.6%
Medium Upfront Cost	12	35,000	299	-31,500	117	21.6%
High Upfront Cost	12	50,000	299	-46,500	167	21.6%

Street lighting analysis

Street lighting analysis

- Common technologies: High pressure sodium (HPS), Metal Halide (MH) and LED

- Benefits of upgrading to LED
  - Lower maintenance costs
  - Improved lighting quality (color rendition)
  - Improve perception of safety
  - Reduced light pollution (better glare control)



Street lighting analysis process

All Lights:

- Review existing lighting data & remove LED lights (45% of utility lights)
- Calculate pre- and post- energy consumption
- **If City-Owned:**
- Estimate difference in upfront and ongoing labor and equipment costs
- Determine Focus on Energy rebate availability
- Calculate cost-savings and payback

Upfront Lighting Costs

- LED costs are decreasing quickly – historical costs are often not reflective of current costs

- Two upfront costs estimated in this analysis:

  High upfront fixture cost: Focus on Energy Technical Resource Manual

  Low upfront fixture cost: Estimated from conversations with WI cities implementing LED streetlight upgrades

Stoughton: Streetlight Profile

	Utility Owned
Number of Lights	419
kWh Saved	294,295
Carbon Saved (tons)	224
Dollars Saved	$604,010

***Have not analyzed city-owned streetlights as unsure about lighting type*

Solar analysis

Solar Opportunity Analysis – Process

1. High-level survey of solar potential for all facilities

1. Roof size/available land
2. Review of historical electric consumption
3. Initial system size, production, and cost estimates
4. Recommendation of 2-4 facilities with good solar potential

2. Individual meetings

1. Review recommendations
2. City feedback on site potential
3. Identification of facilities for additional analysis

3. Remote site reviews

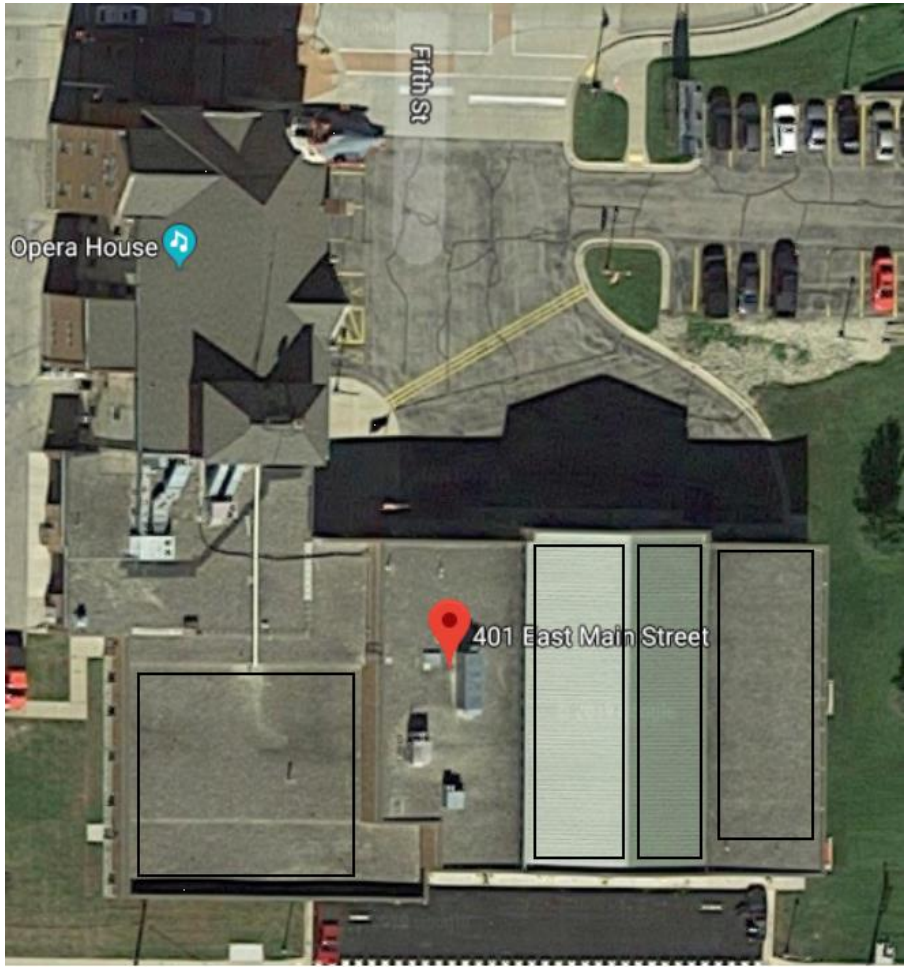
1. Detailed roof measurements
2. Identification of roof penetrations and other obstructions
3. Potential array layout
4. System modeling (NREL System Advisor Model)
5. Update cost, capacity, and production estimates

Stoughton – Opportunity Summary

Facility	Capacity (kW DC)	Production (kWh)	Electricity Offset	Net Cost
Fire Station	98.6	119,704	95%	$115,394
WWTP	24.5	33,942	5%	$28,667
Library	19.5	27,338	16%	$22,860

Stoughton

Fire Station – 401 E Main St.	
Energy Profile	
Annual electric consumption:	126,517 kWh
Potential array capacity	98.6 kW DC
Annual production (est.)	119,704 kWh
Share of consumption offset	95%
Financial Performance	
Total system cost (est.)	$192,323
Potential rebate	$76,929
Net cost	$115,394
Payback year	8



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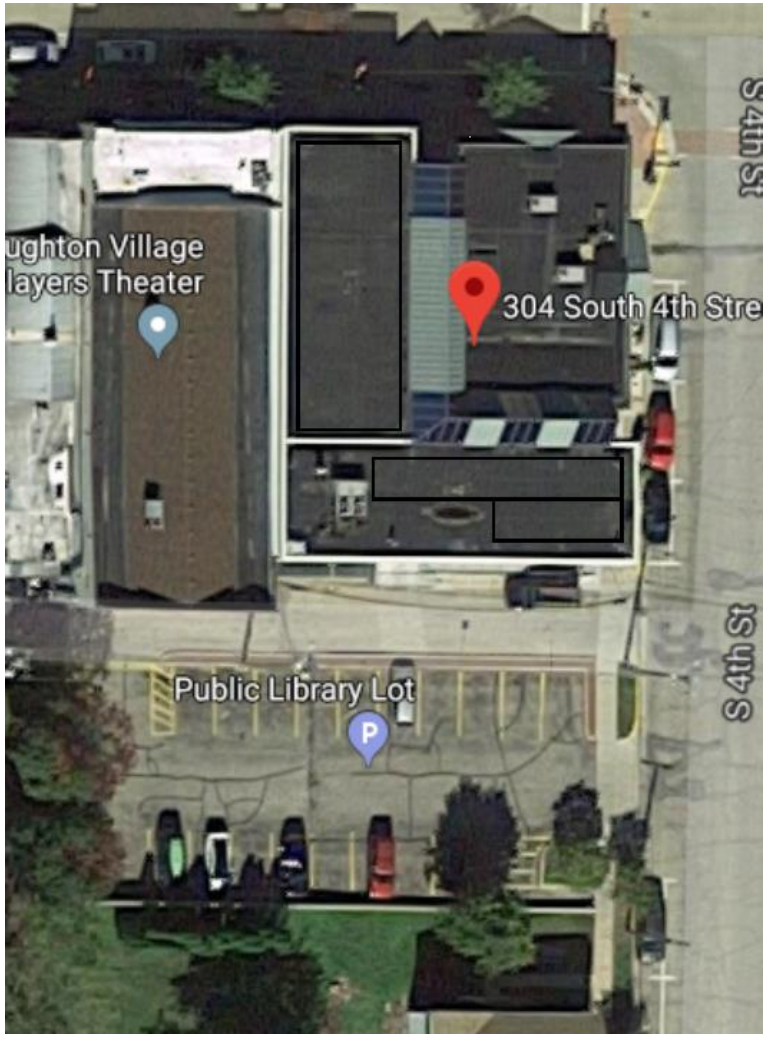
Library – 304 S 4th St.	
Energy Profile	
Annual electric consumption:	171,240 kWh
Potential array capacity	19.5 kW DC
Annual production (est.)	27,338 kWh
Share of consumption offset	16%
Financial Performance	
Total system cost (est.)	$38,101
Potential rebate	$15,240
Net cost	$22,861
Payback year	7



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WWTP – 700 Mandt Pkwy	
Energy Profile	
Annual electric consumption:	735,329 kWh
Potential array capacity	24.5 kW DC
Annual production (est.)	33,942 kWh
Share of consumption offset	5%
Financial Performance	
Total system cost (est.)	$47,779
Potential rebate	$19,112
Net cost	$28,667
Payback year	7

Stoughton – Opportunity Summary

Municipal Renewable Energy Opportunity	Kilowatt hours (kWh)
Current	
Municipal Gross Electricity Consumption	1,800,148
Net-metered solar production	124,585
Export-metered solar production	0
Other renewable electricity	1,130,400
Total renewable electricity	1,254,985
Percent renewable electricity	69.7%
Opportunity	
Annual additional solar production	180,984
Total renewable electricity	1,435,969
Electric efficiency improvement	TBD
Percent renewable electricity	79.8%

Solar Analysis – Trends

- **Limited number of opportunities to fully offset a facility's electricity use**
  - Fire stations
  - Public works buildings
  - Libraries.
- **Identify ground-mounted array opportunities**
  - Wells
  - Wastewater treatment plants
- **Consider both total production and offset opportunity**
  - Effect on municipal energy goals
  - Financial performance of the project
- **Key factors affecting financial performance**
  - Value per kWh
  - Discount rate
  - Inflation assumption
  - Rebate amount available
- **Most payback periods > 10 years (as modeled)**

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Solar Analysis – Site Prioritization and Sizing

Determine objective for PV installation at each site

- Offset maximum percentage of current site consumption?
- Offset maximum percentage of current municipal consumption?
- Develop all sites with PV potential?
- Visual confirmation of municipality's commitment to clean energy?
- Optimize financial performance?

Identify non-energy factors affecting potential PV installations

- Impact on neighboring properties
- Development plans for neighboring properties
- Repair and replacement plans for building

Evaluate 'right' size for each site

- Do siting issues further limit array potential?
- How do utility rate capacity limitations affect financial performance?
- How much capital is the municipality able to allocate to the project?
- Do grant/rebate opportunities and amounts affect the right size for the project?

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Initial recommendations

Overall impact of energy investments

	Carbon	Cost	Recommendation
Total Current	2,212	358,350	-
Fleet	-42	-13,075	Convert police fleet
Street Lighting	-224	-32,375	LED conversion
Building Efficiency	-215	-27,730	Implement efficiency measures on Fire Station, Opera House and Senior Center
Solar	-138	-19,910	Installation on Fire Station, WWTP, Library
New Total	**1,593**	**265,270**	-

Initial recommendations

Building Efficiency

- LED lighting upgrades
- HVAC upgrades
- Consider net-zero new construction policy

Fleet

- Upgrades police vehicles to hybrid
- Develop a tracking system to understand fuel purchases by vehicle

Street lighting

- Upgrade to LED

Solar

- Maximize solar potential at fire station. Initiate scalable solar investment at WWTP.

Policies and Processes

- Benchmark energy data, verify savings and create goals
- Develop internal policies to address operational efficiencies

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