

Madison Municipal Operations Energy Analysis and Scenario Comparison

A high-level energy and cost analysis was conducted to quantify energy management strategies identified to help the City of Madison achieve its Georgetown University Energy Prize (GUEP) reduction goal for municipal buildings from January 2015 through December 2016. The analysis includes all City buildings as well as street lights and water treatment and distribution facilities and applies a package of recommendations developed using utility data and energy use indexes, information gathered from department staff, and limited site visits conducted in March and June 2015. With this framework as a baseline, the filters of maximum energy savings, realistic implementation within the GUEP challenge timeframe, and package payback period were applied to support decision making. Three different target payback scenarios were run: 5, 7, and 10 years.

During the program plan development phase of the GUEP, a target reduction of 37 million kBtu by the end of 2016 was identified. Table 1 presents the three payback scenarios as they compare to this goal. In addition to the scenarios presented here, other activities are also currently underway as part of GUEP that will affect reduction outcomes and offer persistence beyond the GUEP challenge, including 1) the Facility and Energy Management Leadership Academy providing training to City facility staff about best practices and opportunities for efficiency improvements in City facilities, and 2) the City's existing operations and maintenance budgets for equipment upgrades.

Table 1. Scenarios and Estimated Savings Compared to GUEP Reduction Goal

<i>GUEP Reduction Goal</i>	<i>37,000,000 kBtu</i>		
<i>Scenario</i>	<i>kBtu saved</i>	<i>Simple Payback (years)</i>	<i>Savings as % of Goal</i>
5-year Payback	18,599,000	5	50%
7-year Payback	28,129,000	7	76%
10-year Payback	44,590,000	10	121%

The 5-year scenario (Table 2) focuses on interior lighting upgrades (linear fluorescent and HID replacements) and water distribution upgrades, including system optimization and controls, infrastructure upgrades, and an end user reduction program.

Table 2. 5-year Scenario: Estimated Cost and Savings by Recommendation

<i>Category</i>	<i>kWh saved</i>	<i>therms saved</i>	<i>kBtu saved</i>	<i>Total Savings (\$)</i>	<i>Total Cost (\$)</i>	<i>Simple Payback (years)</i>
Interior Lighting	1,755,200	0	5,989,000	\$179,800	\$1,014,500	6
Water Distribution	3,696,391	0	12,612,000	\$346,600	\$1,543,500	4
Total Package	5,451,591	0	18,601,000	\$526,400	\$2,558,000	5

As a mid-range scenario, the package that meets a 7-year payback threshold (Table 3) includes the interior lighting and water measures as well as HVAC improvements, controls optimization, and plug load strategies for select buildings.

Table 3. 7-year Scenario: Estimated Cost and Savings by Recommendation

<i>Category</i>	<i>kWh saved</i>	<i>therms saved</i>	<i>kBtu saved</i>	<i>Total Savings (\$)</i>	<i>Total Cost (\$)</i>	<i>Simple Payback (years)</i>
Interior Lighting	1,755,200	0	5,989,000	\$179,800	\$1,014,500	6
HVAC	162,300	32,500	3,804,000	\$39,800	\$752,900	19
Controls	430,200	33,600	4,828,000	\$73,200	\$923,200	13
Plug Load	264,100	0	901,000	\$31,500	\$308,800	10
Water Distribution	3,696,391	0	12,612,000	\$346,600	\$1,543,500	4
Total Package	6,308,191	66,100	28,134,000	\$670,900	\$4,542,900	7

The 10-year scenario is the only modeled option that enables the City to achieve its GUEP reduction goal entirely. This scenario includes all the measure from the 7-year scenario and incorporates expedited implementation of the City's existing plan to upgrade all of its street lights with LEDs.

Table 4. 10-year Scenario: Estimated Cost and Savings by Recommendation

<i>Category</i>	<i>kWh saved</i>	<i>therms saved</i>	<i>kBtu saved</i>	<i>Total Savings (\$)</i>	<i>Total Cost (\$)</i>	<i>Simple Payback (years)</i>
Interior Lighting	1,755,200	0	5,989,000	\$179,800	\$1,014,500	6
HVAC	162,300	32,500	3,804,000	\$39,800	\$752,900	19
Controls	430,200	33,600	4,828,000	\$73,200	\$923,200	13
Plug Load	264,100	0	901,000	\$31,500	\$308,800	10
Water Distribution	3,696,391	0	12,612,000	\$346,600	\$1,543,500	4
Street Lights	4,824,318	0	16,461,000	\$342,500	\$5,488,200	16
Total Package	11,132,509	66,100	44,595,000	\$1,013,400	\$10,031,100	10

The framework for the analysis provides a snapshot of City facilities by department, acknowledges efficiency efforts already underway, presents a utility analysis as a backdrop, and provides a first order quantification of applicable recommendations. The packages identified represent good energy management by combining both implementation scope and applicable buildings to balance shorter and longer term projects, helping to achieve an overall payback this is palatable and within an expected range.

Appendix - Scenario Summaries by Department

The 5-year scenario includes only those measure packages that have paybacks within 10 years, with some departments having much lower payback, which for an overall payback of 5 years.

Table A1. 5-year Scenario

Department	Cumulative Summary			
	Savings (\$)	Cost (\$)	Savings (kBTU)	Payback (yrs)
Engineering	\$0	\$0	0	0
Fire	\$2,000	\$14,200	81,000	7
Library	\$400	\$1,400	8,000	4
Metro Maintenance	\$25,400	\$80,000	911,000	3
Monona Terrace	\$0	\$0	0	0
Parks	\$11,700	\$65,700	196,000	6
Police	\$5,000	\$51,200	163,000	10
Senior Center	\$0	\$0	0	0
Streets	\$0	\$0	0	0
Traffic Engineering/ Parking	\$126,300	\$731,200	4,405,000	6
Water Utility	\$9,000	\$70,800	223,000	8
Total (Buildings)	\$179,800	\$1,014,500	5,987,000	6
Water Distribution	\$346,600	\$1,543,500	12,612,000	4
Grand Total	\$526,400	\$2,558,000	18,599,000	5

The 7-year scenario bundles in a few more measure packages, and while the payback by department is greater than 7 years, the overall payback is within this timeframe largely because of the water distribution opportunities. By combining longer-term paybacks with measure packages that have shorter paybacks, the City will be able to get closer to its reduction goal.

Table A2. 7-year Scenario

Department	Cumulative Summary			
	Savings (\$)	Cost (\$)	Savings (kBTU)	Payback (yrs)
Engineering	\$1,500	\$31,400	39,000	21
Fire	\$15,400	\$311,600	1,097,000	20
Library	\$13,300	\$89,900	441,000	7
Metro Maintenance	\$66,500	\$484,600	4,669,000	7
Monona Terrace	\$12,400	\$193,900	443,000	16
Parks	\$28,600	\$216,900	1,181,000	8

<i>Department</i>	<i>Cumulative Summary</i>			
	Savings (\$)	Cost (\$)	Savings (kBTU)	Payback (yrs)
Police	\$21,200	\$372,500	1,074,000	18
Senior Center	\$0	\$0	0	0
Streets	\$12,200	\$296,700	1,072,000	24
Traffic Engineering/ Parking	\$134,200	\$839,000	4,775,000	6
Water Utility	\$18,800	\$163,100	726,000	9
Total (Buildings)	\$324,100	\$2,999,600	15,517,000	9
Water Distribution	\$346,600	\$1,543,500	12,612,000	4
Grand Total	\$670,700	\$4,543,100	28,129,000	7

The 10-year scenario includes the 7-year bundle as well as street light upgrades, which are already underway but could be expedited to help the City achieve its reduction goal entirely. The departments with longer-term paybacks are again offset to some degree by the water distribution opportunities and upgrades to Fire, Library, and Traffic Engineering/Parking.

Table A3. 10-year Scenario

<i>Department</i>	<i>Cumulative Summary</i>			
	Savings (\$)	Cost (\$)	Savings (kBTU)	Payback (yrs)
Engineering	\$1,500	\$31,400	39,000	21
Fire	\$15,400	\$311,600	1,097,000	20
Library	\$13,300	\$89,900	441,000	7
Metro Maintenance	\$66,500	\$484,600	4,669,000	7
Monona Terrace	\$12,400	\$193,900	443,000	16
Parks	\$28,600	\$216,900	1,181,000	8
Police	\$21,200	\$372,500	1,074,000	18
Senior Center	\$0	\$0	0	0
Streets	\$12,200	\$296,700	1,072,000	24
Traffic Engineering/ Parking	\$134,200	\$839,000	4,775,000	6
Water Utility	\$18,800	\$163,100	726,000	9
Total (Buildings)	\$324,100	\$2,999,600	15,517,000	9
Water Distribution	\$346,600	\$1,543,500	12,612,000	4
Street Lights	\$342,500	\$5,488,200	16,461,000	16
Grand Total	\$1,013,200	\$10,031,300	44,590,000	10

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