

HIGH LEVEL BUSINESS CASE FOR AN EEMS SYSTEM

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Goals for High Level Business Case

1. Discuss ongoing energy consumption costs for the city government operations.
2. Develop projected energy costs for a “business as usual” scenario for 5 years including low, expected, and high forward price scenarios.
3. Estimate initial up-front cost estimates for an EEMS including licensing fees, installation costs, city staff resource requirements, and on-going maintenance costs.
4. Projected energy cost savings based on ranges observed in other EEMS implementations.

Drivers of ROI Analysis

Four main areas have the greatest impact on the costs and savings resulting from an EEMS installation:

Increase in administrative efficiency in analyzing, auditing and allocating costs to the different departments and agencies within the CoB.

Identification of additional energy efficiency projects based on analysis of KPIs associated with the different departments and buildings.

Reduction of on-going energy costs as a result of the energy efficiency upgrades. This constitutes a significant annual savings of energy and cost.

Monitor and maintain reduced levels of energy in buildings where energy efficiency projects have been completed.

Additional Factors that Impact ROI

- 1. Strategic Alignment** - The EEMS can construct a systematic process for aggregating, organizing and analyzing data. This includes providing solutions for data gaps, establishing KPIs and building benchmarks to help the City understand both excellence in energy efficiency and areas that need improvement.
- 2. Planning for Capital and Operational Expenditures** - Capital and operational planning will enable the City to generate concrete plans of action to optimize the energy and savings identified by the EEMS. These plans include the creation of multi-year energy efficiency plans with specific targets, budgets, and timelines that reconcile business-as-usual scenarios with optimization goals.
- 3. Implementation and Validation** - This will enable the City to track, monitor and review projects throughout their lifecycle, verify savings and match organizations with financing options and vendors for implementation.
- 4. Validation and Departmental/Building Allocation of Utility Billing**
 - Using data acquisition techniques, the EEMS can integrate utility bill data, usage data from building systems, meters, sub-meters and other assets, and reference or operational data, such as financials, which can be used as intensity factors and KPIs.

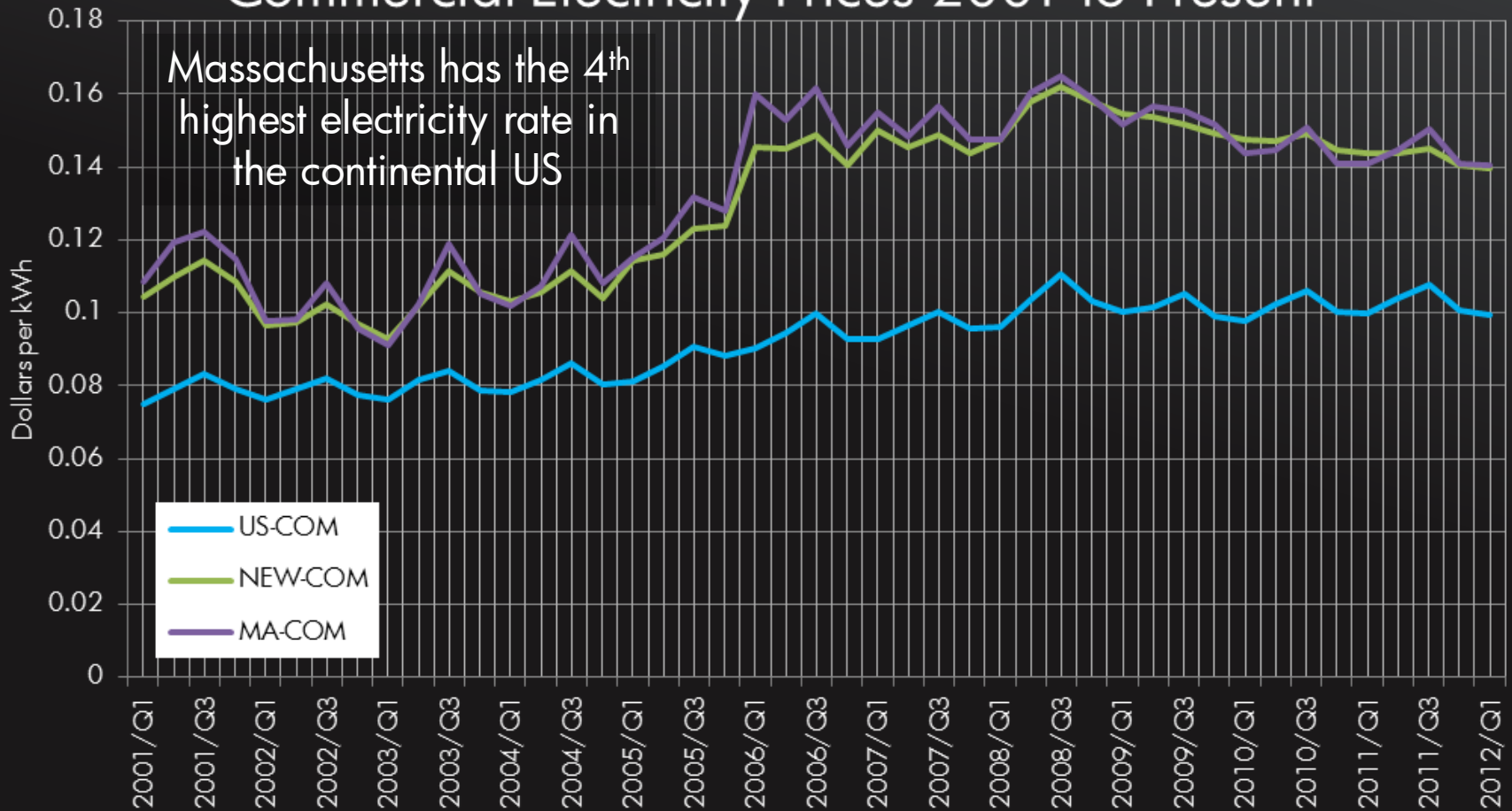
Energy Outlook

Electricity - Real average delivered electricity prices fall from 9.8 cents per kilowatt-hour in 2010 to as low as 9.2 cents per kilowatt-hour in 2019, as natural gas prices remain relatively low. Electricity prices in 2035 are 9.5 cents per kilowatt-hour (2010 dollars).

Natural Gas - With increased production, average annual wellhead prices for natural gas remain below \$5 per thousand cubic feet (2010 dollars) through 2023. After 2023, natural gas prices generally increase. Natural gas wellhead prices (in 2010 dollars) reach \$6.52 per thousand cubic feet in 2035, compared with \$6.48 per thousand cubic feet (2010 dollars).

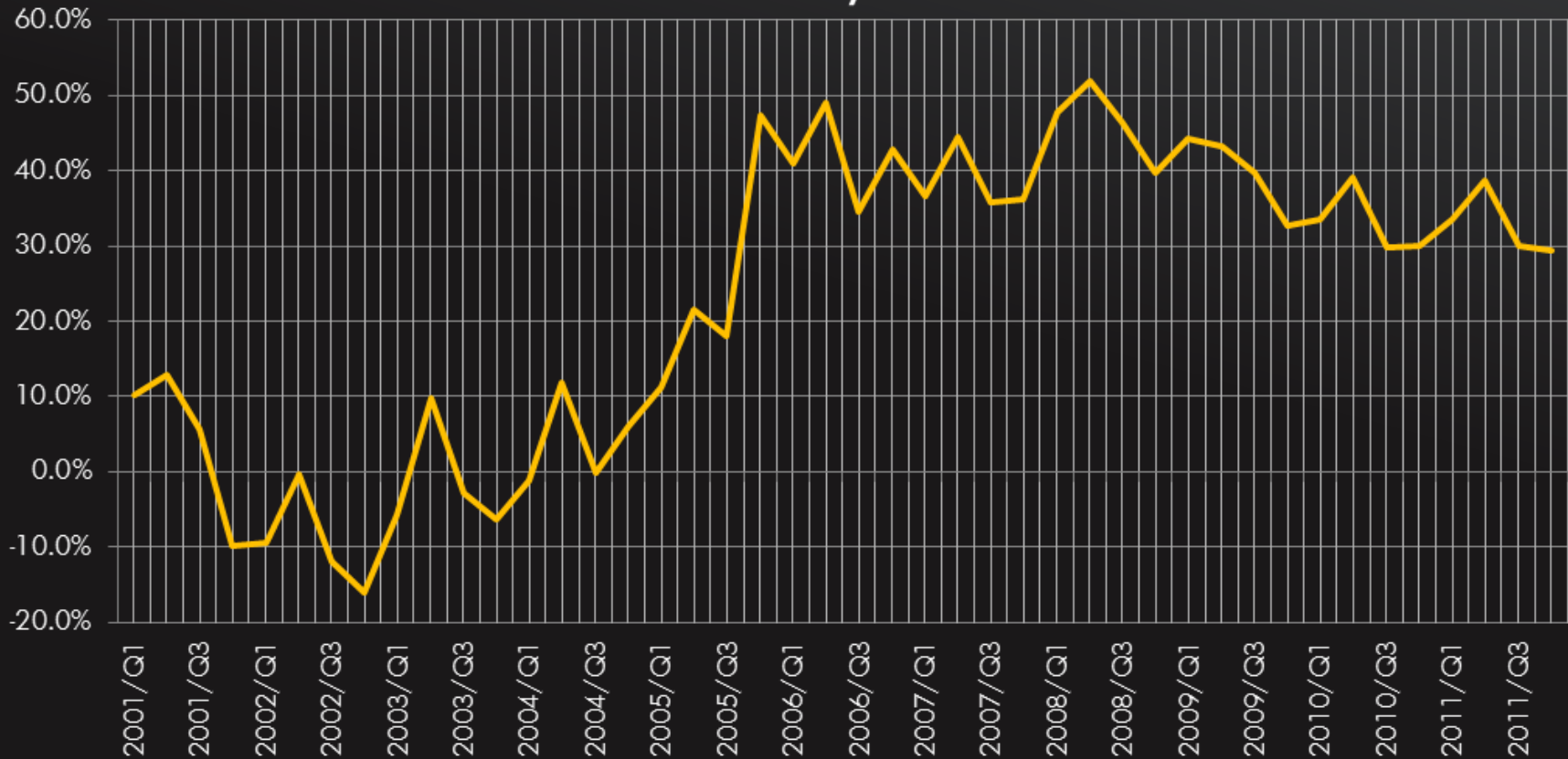
Electricity Costs

Commercial Electricity Prices 2001 to Present



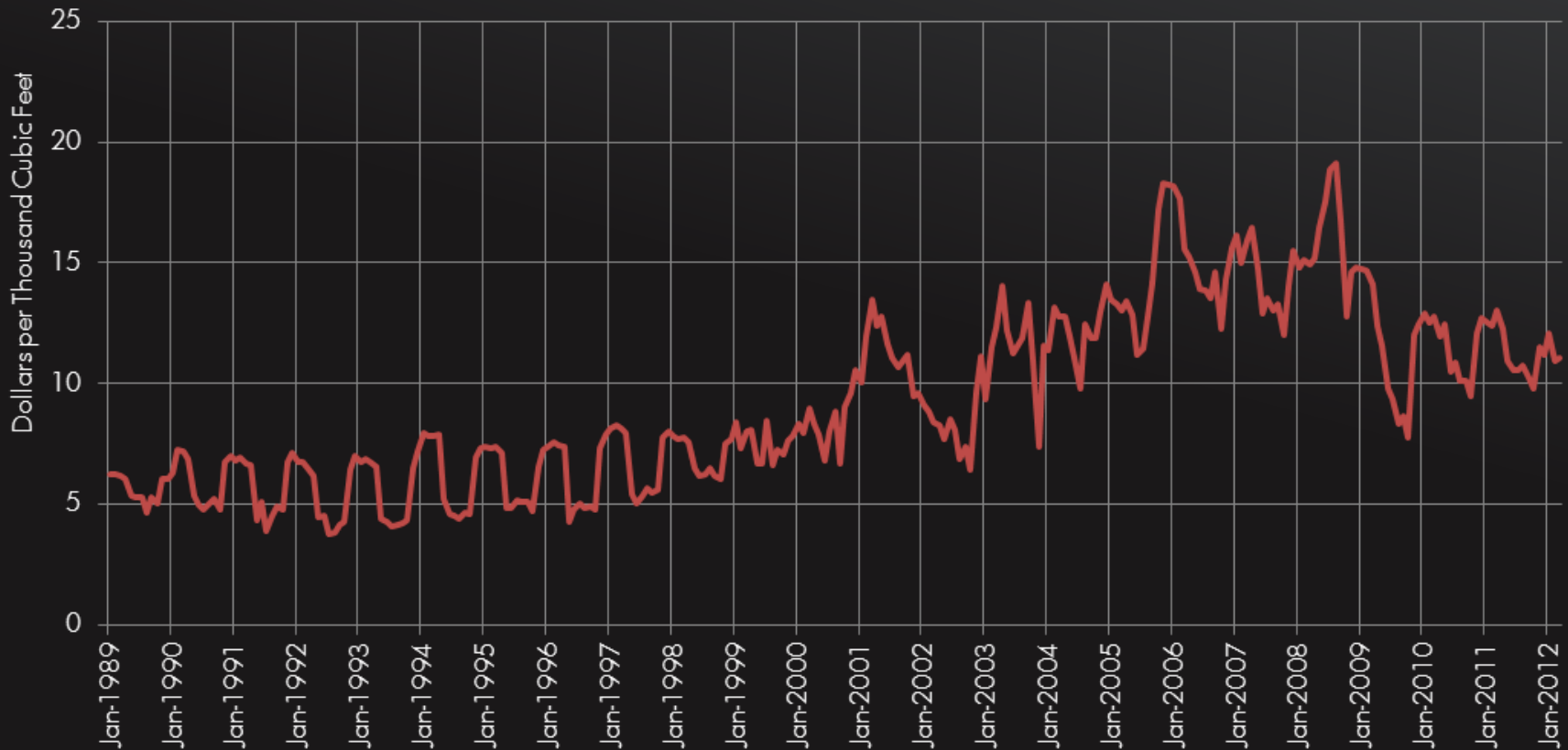
Electricity Costs

Massachusetts Percent Increase Over 2001/Q1 Electricity Prices



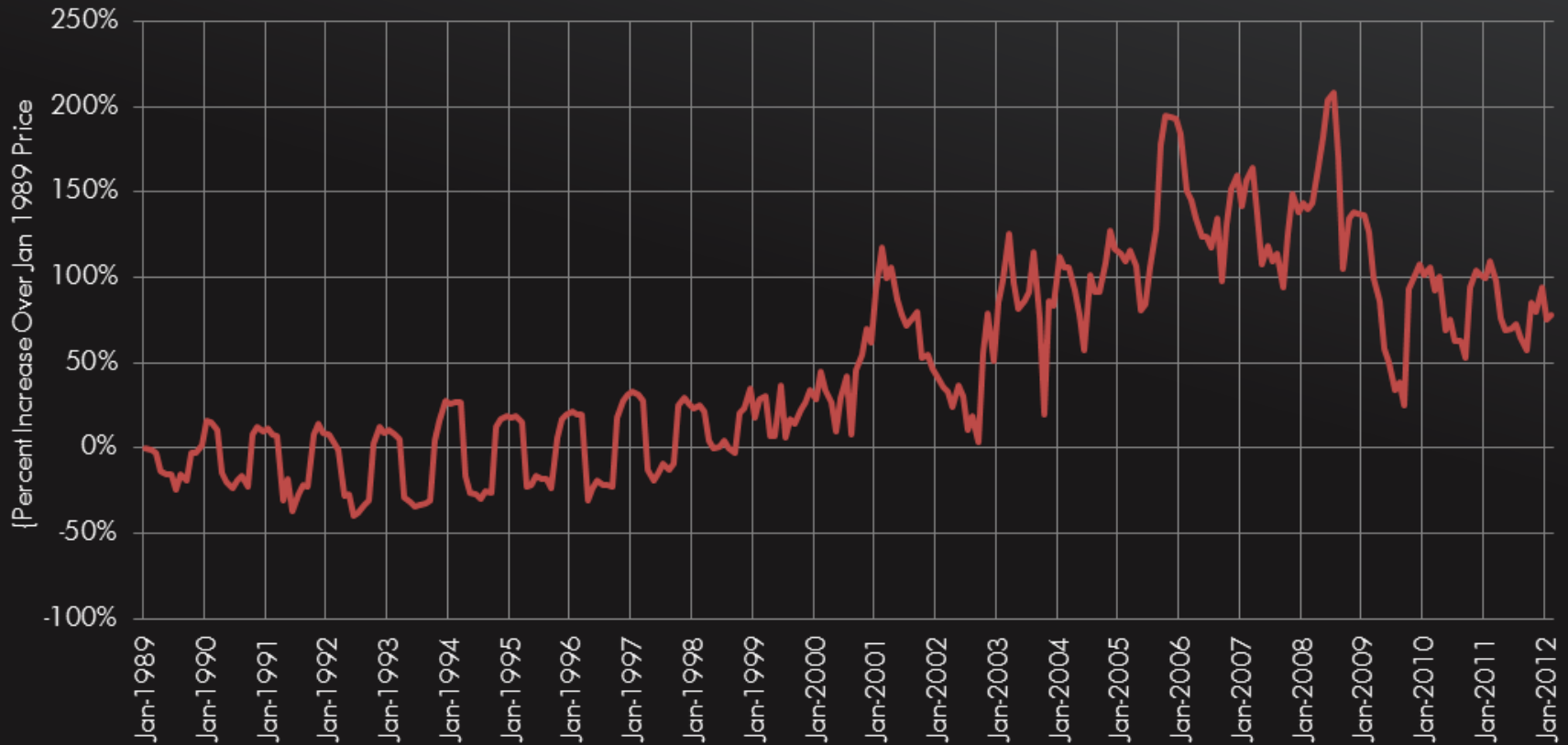
Natural Gas Costs

Massachusetts Price of Natural Gas Sold to Commercial Consumers 1989 to Present



Natural Gas Costs

Massachusetts Increase Over Jan-1989 Natural Gas Prices 1989 to Present



Five-Year Energy Cost Projections - Electricity

In order to determine energy costs in the near future, historical cost data was used to determine a low, middle and high projection for electricity.

Based on fluctuations in price since 2001, the lowest change represented a 23% increase; the third-quartile represented a 28.4% increase; the highest increase was 34.2%

Massachusetts Ten-Year Projected Electricity Prices

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Low	0.140	0.144	0.148	0.151	0.155	0.158	0.162	0.166	0.169	0.173
Middle	0.140	0.145	0.149	0.154	0.158	0.162	0.167	0.171	0.176	0.180
High	0.140	0.146	0.151	0.156	0.162	0.167	0.172	0.177	0.183	0.188

Based on the analysis, five-year low, middle and high electricity rates are respectively \$0.155, \$0.158 and \$0.162 per kWh



Five-Year Energy Cost Projections – Natural Gas

In order to determine energy costs in the near future, historical cost data was used to determine a low, middle and high projection for natural gas.

Based on fluctuations in price since 1998, the lowest change represented a 31.1% increase; the third-quartile represented a 97.7% increase; the highest increase was 207%

Massachusetts Ten-Year Projected Natural Gas Prices

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Low	6.210	6.424	6.639	6.853	7.068	7.282	7.496	7.711	7.925	8.140
Middle	6.210	6.884	7.559	8.233	8.908	9.582	10.256	10.931	11.605	12.280
High	6.210	7.644	9.079	10.513	11.948	13.382	14.816	16.251	17.685	19.120

Based on the analysis, five-year low, middle and high natural gas rates are respectively \$7.068, \$8.908 and \$11.948 per 1000 cubic feet



Energy Use of City Buildings vs. CBECS

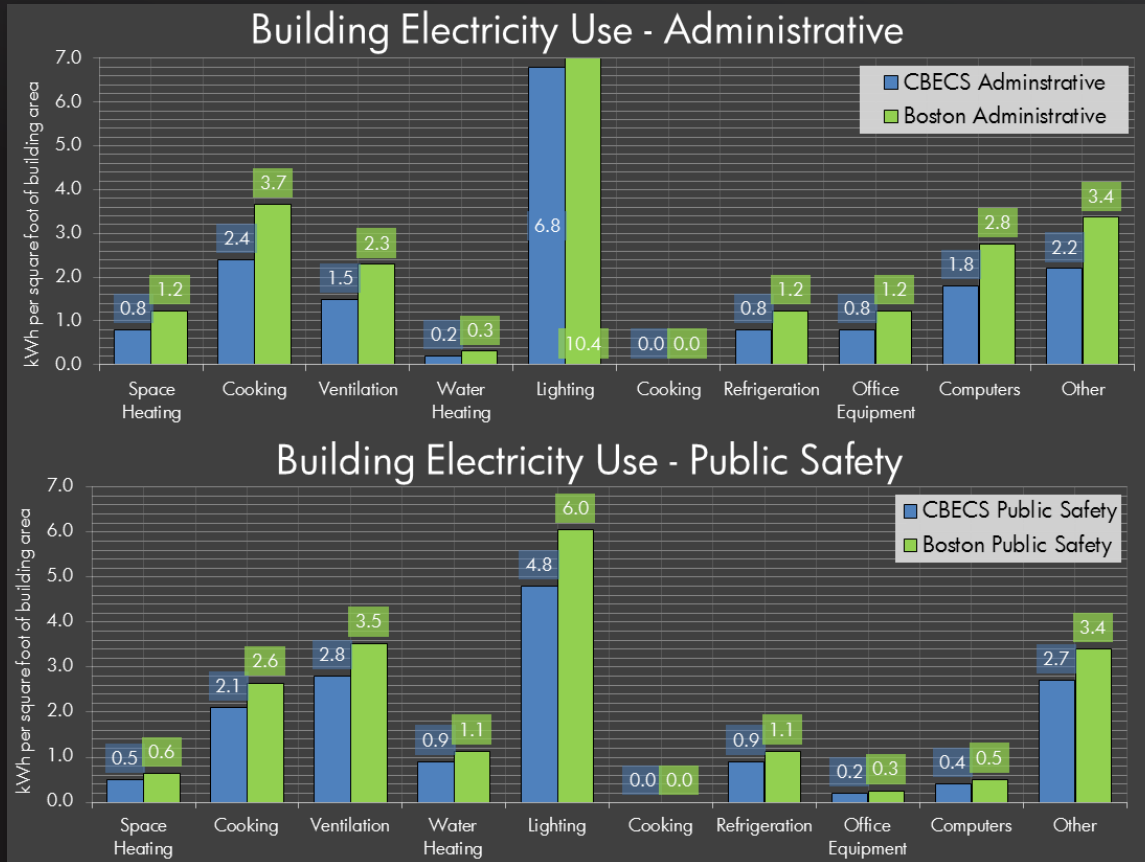


Figure 1: US Department of Energy building energy consumption data (aka CBECS) for US buildings compared to City of Boston data. Examples of two City of Boston building types' energy use intensity for different end uses compared to the CBECS data.

Electricity and natural gas usage data was used to determine the intensity in kWh/SF and CF/SF. These values were then compared to the CBECS energy consumption values. Finally, this variance was then used as a target energy reduction that would reduce the City facilities (on average) down to the CBECS average.

The analysis of the energy use of the City buildings' HVAC and electrical systems was consistently higher than that the CBECS data, indicating that generally there is a need to continue pursuing and implementing energy efficiency upgrade projects.

The average increase of energy use over the CBECS data ranged from 21% to 37%, meaning that on average the existing HVAC and lighting systems are consuming 21% to 37% more than comparable buildings in the CBECS data base.



Energy Reduction Proof-of-Concept

Base Line Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	12.4	11.2	12.6	13.9	26.5	16.7	26.2	22.1	42.8	18.4	13.0	12.4	228.2
Heat Reject.	0.0	0.0	0.0	0.2	1.4	1.2	2.0	0.0	0.0	0.5	0.1	0.0	11.2
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Space Heat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hot Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vent. Fans	51.1	46.5	52.0	49.7	51.7	26.3	27.2	27.2	49.7	51.4	49.7	51.1	533.5
Pumps & Aux.	19.5	17.7	19.8	19.0	19.7	11.9	12.3	12.3	19.0	19.6	19.0	19.5	209.3
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Misc. Equip.	18.6	17.5	20.9	18.5	20.1	2.6	2.7	2.7	18.5	19.4	18.5	18.6	178.3
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Area Lights	54.1	50.9	60.5	53.8	58.3	10.9	11.3	11.3	53.7	56.3	53.7	54.1	528.0
Total	155.7	143.8	165.8	155.0	177.8	69.6	82.2	77.3	186.9	165.6	153.9	155.8	1689.5

Before
1689.5

EEMs Implemented	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	5.1	4.6	5.1	5.4	11.0	7.1	13.4	10.2	20.4	6.8	5.2	4.9	99.2
Heat Reject.	0.0	0.0	0.0	0.1	0.8	0.7	1.0	0.0	0.0	0.3	0.1	0.0	6.5
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Space Heat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hot Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vent. Fans	42.5	38.6	43.2	41.3	43.0	21.8	22.6	22.6	41.3	42.7	41.3	42.5	443.1
Pumps & Aux.	8.7	7.9	8.8	7.8	7.5	3.6	4.4	4.2	7.4	7.3	8.3	8.5	84.3
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Misc. Equip.	18.6	17.5	20.9	18.5	20.1	2.6	2.7	2.7	18.5	19.4	18.5	18.6	178.3
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Area Lights	32.3	30.3	36.0	32.0	34.8	6.5	6.7	6.7	32.0	33.5	32.0	32.3	215.1
Total	107.0	98.9	114.0	105.1	117.1	42.2	51.3	47.4	121.6	109.9	105.3	106.7	1126.6

After
1126.6

Energy modeling of a prototypical school building before and after energy conservation measures.

ECMs represent typical energy reduction strategies used in schools.

Energy modeling indicates a 33% reduction in energy use from pre- to post-ECMs.

This validates magnitude of assumed reductions for ROI.



Units = (kWh x1000)

Overview of Energy Use/Billing Method

Total of 47 departments, 12 with utilities budget and gas/diesel budget, and 9 with just gas/diesel budget.

26 department do not have energy budgets and are budgeted and funded from a single line item.

Approximately 1 to 2 resources manage utility bills for each of the 12 departments.

Staying within the budget is the primary KPI, which is measured monthly. The budgets are set based on units and rates at the department level, not by building. Performance is measured monthly.

Electric kWh, natural gas therms and gallons of gasoline/diesel are also entered into Boston "About Results" performance system and converted to tons of greenhouse gas emissions.

Most departments track utilities bills and do some forecasting, mostly on averages.

Overview of Energy Use/Billing Method

The City gets a monthly report from HESS for the energy use for all 2864 meters. This includes the building electrical meters, traffic lights, etc. This is the data that gets rolled up into the City's master file.

The Office of Budget Management tracks the energy budgets on a monthly basis. The energy supply charges (from HESS) and distribution charges (from NSTAR) are sent to the departments for verification that the energy consumption and cost are valid. There will be correspondence back only if there is a discrepancy.

It was indicated that depending on the department size, the consumption and cost figures will have various levels of review diligence before they are approved or disapproved.

At the end of the billing cycle, a third-party vendor audits the consumption, cost, and rate data to ensure the billing is accurate.

Overview of City Energy Use/Billing Method

Customer Name	Affinity	Service Address	EDC Account Number	Bill Account Number	Previous Balance	Payments Applied	Balance Forward	Description	From Date	To Date	Bill Date	Metered (KWh)
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25690391013	559742/7194	\$69.29	\$69.29	\$0.00	Bill	05/03/2012	06/05/2012	06/07/2012	2149
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25693161017	559742/7100	\$55.29	\$55.29	\$0.00	Bill	05/03/2012	06/05/2012	06/13/2012	1320
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709691007	559742/8812	\$309.00	\$170.71	\$138.29	Bill	04/17/2012	05/15/2012	05/18/2012	3102
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709701004	559742/8849	\$176.51	\$99.71	\$76.80	Bill	04/17/2012	05/15/2012	05/18/2012	1798
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709711003	559742/8814	\$193.98	\$108.65	\$85.33	Bill	04/17/2012	05/15/2012	05/18/2012	1965
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709721002	559742/9329	\$151.98	\$84.97	\$67.01	Bill	04/17/2012	05/15/2012	05/18/2012	1544
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709731001	559742/9330	\$300.89	\$176.86	\$124.03	Bill	04/19/2012	05/17/2012	05/22/2012	2996
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709741000	559742/9331	\$242.30	\$136.08	\$106.22	Bill	04/17/2012	05/15/2012	05/18/2012	2439
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709751009	559742/8815	\$78.77	\$43.57	\$35.20	Bill	04/17/2012	05/15/2012	05/18/2012	800
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709761008	559742/8851	\$170.51	\$61.13	\$109.38	Bill	04/17/2012	05/16/2012	05/23/2012	2706
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709771007	559742/8817	\$93.90	\$52.47	\$41.43	Bill	04/17/2012	05/15/2012	05/18/2012	942
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709781006	559742/8818	\$148.00	\$81.34	\$66.66	Bill	04/17/2012	05/15/2012	05/18/2012	1593
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709791005	559742/8819	\$163.38	\$89.27	\$74.11	Bill	04/17/2012	05/15/2012	05/18/2012	56
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709801002	559742/8820	\$147.33	\$82.51	\$64.82	Bill	04/17/2012	05/15/2012	05/18/2012	1523
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709811001	559742/8813	\$208.91	\$123.27	\$85.64	Bill	04/17/2012	05/15/2012	05/18/2012	1660
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709821000	559742/8821	\$45.99	\$24.32	\$21.67	Bill	04/17/2012	05/16/2012	05/18/2012	576
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709831009	559742/8822	\$257.40	\$149.85	\$107.55	Bill	04/17/2012	05/16/2012	05/18/2012	2282
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709841008	559742/8823	\$107.16	\$58.60	\$48.56	Bill	04/17/2012	05/15/2012	05/18/2012	1137
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709851007	559742/8824	\$100.94	\$55.30	\$45.64	Bill	04/17/2012	05/15/2012	05/18/2012	1045
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709861006	559742/8825	\$212.66	\$117.80	\$94.86	Bill	04/17/2012	05/15/2012	05/18/2012	2423
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709881004	559742/8816	\$273.46	\$151.50	\$121.96	Bill	04/17/2012	05/16/2012	05/23/2012	3016
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709891003	559742/8826	\$242.82	\$143.91	\$98.91	Bill	04/18/2012	05/17/2012	05/21/2012	2509
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709901000	559742/8805	\$38.53	\$92.27	(\$53.74)	Bill	04/17/2012	05/16/2012	05/24/2012	2213
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709911009	559742/8806	\$92.35	\$125.11	(\$32.76)	Bill	04/18/2012	05/17/2012	05/21/2012	2296
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709921008	559742/8807	\$79.51	\$113.67	(\$34.16)	Bill	04/18/2012	05/17/2012	05/21/2012	1951
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709931007	559742/8808	\$101.64	\$60.35	\$41.29	Bill	04/18/2012	05/17/2012	05/21/2012	1051
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709941006	559742/8804	\$91.05	\$123.93	(\$32.88)	Bill	04/18/2012	05/17/2012	05/21/2012	2160
City of Boston 1	HESS-City of Boston	Boston City Hall Boston MA 02201	25709951005	559742/8810	\$22.82	\$12.65	\$10.17	Bill	04/17/2012	05/15/2012	05/18/2012	746

Monthly energy use and cost report from HESS for 2864 City meters



Overview of City Energy Use/Billing Process

ATTACHMENT "A"

Date: May 03, 2012

From: Sally D. Glora
City Auditor

Re: Electric Billing Usage Report
For Fiscal Month 09 Fiscal Year 2012

The City of Boston uses a Local Distributor and a Supplier for the delivery of electricity. The Local Distributor is NSTAR and the current Supplier is HESS Corporation. Each department responsible for managing electrical services is responsible for authorizing payment for electrical services.

The attached worksheets are the Billing/Usage Reports for electrical services supplied and billed for the fiscal month and fiscal year mentioned above. There are two worksheets: the NSTAR worksheet provides the detail for the Local Distribution Charges and usage (LDC) and a limited number of Supplier Charges and usage for accounts being transitioned to HESS; the HESS worksheet provides the detail for the Supplier Charges and usage. These worksheets provide detail for each account assigned to your Department, including Account Numbers, Location, Service Dates, Usage and Amounts Billed.

The following steps are required to authorize payment for electrical services:

- (1) Verify that the Accounts listed are appropriately assigned to your Department
- (2) Review usage and charges to determine each is reasonable and accurate
- (3) Approve/Dispute the charges for each Account (see below)
- (4) Return Billing/Usage Report to Auditing/Accounts Payable as authorization for payment (Email to: Hazel.McAfee@cityofboston.gov; Julie.Tippet@cityofboston.gov) within five (5) days of receipt.

Approve/Dispute Billing And Return Billing/Usage Reports to Auditing

To Approve/Dispute the charges go to the far right columns on the Billing/Usage Report. Columns headed 'Dispute' and 'Reasons'.

In the column headed 'Dispute' (1) enter 'N' (No – not disputed) if the Account is appropriately assigned to your Department and you authorize payment of the charges; (2) enter 'Y' (Yes – File Dispute).

1. Verification that the accounts listed are assigned to the appropriate department
2. Review of usage and charges to determine if they are reasonable and accurate
3. Approve or dispute the charges for each account
4. Return of billing/usage report to Auditing/Accounts Payable as authorization for payment
5. Email within five (5) days of receipt.



Overview of Energy Efficiency Planning

Facility	Projected kWh Savings	Incentives	Project Cost	Projected Annual Operational Cost Savings		5-Year Energy Cost Reduction
'12 City Hall Phase 3 - HVAC	1,625,674	\$263,752	\$376,789	\$243,851	2012	\$1,219,255
'12 City Hall Phase 4 - pmp, mtr, drv	56,632	\$51,655	\$73,794	\$8,500	2013	\$42,500
'12 City Hall Phase 5 - EMS	650,000	\$74,891	\$106,988	\$97,500	2013	\$487,500
City Hall - Lighting Upgrades 2nd	63,729	\$13,604	\$19,435	\$10,119	2012	\$50,595
City Hall - Lighting Upgrades 3rd	251,177	\$66,390	\$94,844	\$32,653	2012-14	\$163,265
City Hall - Lighting Upgrades 8th	27,290	\$4,974	\$7,931	\$3,302	2012	\$16,510
Total	2,674,502	\$475,266	\$679,781	\$395,925		\$1,979,625
Annual electricity usage	13,907,920					
Reduction in annual electricity usage	19.2%		Payback	1.7	years	

Facility	Projected kWh Savings	Incentives	Project Cost	Projected Annual Operational Cost Savings		5-Year Energy Cost Reduction
400 Frontage Road - Garage	31,283	\$9,385	\$30,085	\$4,067	2012	\$20,335
400 Frontage Road - Heavy Garage	45,525	\$11,381	\$40,065	\$6,829	2012-14	\$34,145
400 Frontage Road - Light Garage	24,691	\$6,173	\$26,939	\$3,704	2012-14	\$18,520
400 Frontage Road - EMS	375,000	\$93,750	\$90,000	\$80,000	2012	\$400,000
400 Frontage Road - HVAC system Equip	95,000	\$23,750	\$80,000	\$80,000	2012	\$400,000
400 Frontage Road - Ventilation System	110,000	\$27,500	\$95,000	\$80,000	2012	\$400,000
400 Frontage Road - Office Lighting	13,000	\$3,250	\$90,000	\$19,500	2012	\$97,500
Total	663,216	\$165,804	\$422,004	\$270,033		\$1,370,500
Annual electricity usage	3,044,160					
Reduction in annual electricity usage	21.8%		Payback	1.6	years	

Examples of the City's energy efficiency project planning and budgeting 

Drivers of ROI Analysis

Four main areas have the greatest impact on the costs and savings resulting from an EEMS installation:

Increase in administrative efficiency in analyzing, auditing and allocating costs to the different departments and agencies within the CoB.

Identification of additional energy efficiency projects based on analysis of KPIs associated with the different departments and buildings.

Reduction of on-going energy costs as a result of the energy efficiency upgrades. This constitutes a significant annual savings of energy and cost.

Monitor and maintain reduced levels of energy in buildings where energy efficiency projects have been completed.

Data for ROI Analysis

Energy Efficiency Projects¹

	Current Annual Energy Efficiency Projects ¹	Annual Energy Efficiency Projects After ECMs	Difference Between pre- and post-ECMs
Annual Project Cost ²	\$12,934,217	\$13,594,551	\$660,334
Annual Utility Incentives and Rebates ³	\$5,159,662	\$5,484,158	\$324,496
Annual Savings ⁵	\$2,852,167	\$3,481,030	\$628,862
Annual kWh Savings ⁶	35,935,806	43,841,684	7,905,877

¹data based on 2012-2014 proposed projects

²based on CoB data, project costs increase at a rate of 0.42:1 to energy efficiency gains.

³based on CoB data, utility incentives increase at a rate of 0.44:1 to energy efficiency gains.

⁴assume with ECMs 20% additional energy efficiency projects are identified and put in place

⁵\$0.0794/kWh was used for electricity rate

⁶assume low- and no-cost energy efficiency gains account for 10% of the annual kWh savings and have project costs 5% of capital projects



Overview of EEMS Delivery Types

SaaS Hosted

Service Type	SaaS Hosted Single-tenant hosting – subscription license model Deployment
Non recurring fee	\$75-\$100k; 5-years of historical data upload; 100 facilities; up to 10 participating business units, with designated personnel from each business unit trained in data input and management
Annual subscription costs	~\$100k include maintenance, support, computing infrastructure, software infrastructure, new product releases
Contract length	3, 5, 7 years
Additional training	\$1600/per day for 1 consultant

SaaS Cloud

Service Type	SaaS Cloud Multi-tenant hosting – subscription license model Deployment
Non recurring fee	\$75-\$100k; 5-years of historical data upload; 100 facilities; up to 10 participating business units, with designated personnel from each business unit trained in data input and management
Annual subscription costs	~\$75k include maintenance, support, computing infrastructure, software infrastructure, new product releases
Contract length	3, 5, 7 years
Additional training	\$1600/per day for 1 consultant

On Premise

Service Type	On-premise Client Deployment with Maintenance (client-side deployment – perpetual license model)
Non recurring fee	\$350-\$375k; 5-years of historical data upload; 100 facilities; up to 10 participating business units, with designated personnel from each business unit trained in data input and management
Annual subscription costs	~\$60k include maintenance, support, BUT NOT computing infrastructure and software new releases
Contract length	3, 5, 7 years
Additional training	\$1600/per day for 1 consultant



Data for ROI Analysis

Common to All EEMS Platforms (all ECM projects implemented)						
Benefit	Period					
	0	1	2	3	4	5
Annual Energy Efficiency Project Cost		-\$132,067	-\$132,067	-\$132,067	-\$132,067	-\$132,067
Annual Utility Incentives and Rebates		\$64,899	\$64,899	\$64,899	\$64,899	\$64,899
Annual Savings		\$0	\$157,216	\$314,431	\$471,647	\$628,862

Common to All EEMS Platforms (only low/no cost ECM projects implemented)						
Benefit	Period					
	0	1	2	3	4	5
Annual Energy Efficiency Project Cost		-\$6,603	-\$6,603	-\$6,603	-\$6,603	-\$6,603
Annual Utility Incentives and Rebates		\$6,490	\$6,490	\$6,490	\$6,490	\$6,490
Annual Savings		\$0	\$15,722	\$31,443	\$47,165	\$62,886

Two scenarios were developed for the ROI analysis:

1. Annual costs and savings for implementation of all ECM projects identified by the use of the EEMS
2. Annual costs and savings for implementation of only low/no cost ECM projects identified by the use of the EEMS



Data for ROI Analysis

SaaS Hosted (first cost and annual fee)						
	Period					
	0	1	2	3	4	5
One-Time Cost	-\$100,000					
Annual Fees		-\$100,000	-\$100,000	-\$100,000	-\$100,000	-\$100,000

SaaS Cloud (first cost and annual fee)						
	0	1	2	3	4	5
One-Time Cost	-\$100,000					
Annual Fees		-\$75,000	-\$75,000	-\$75,000	-\$75,000	-\$75,000

On Premise (first cost and annual fee)						
	0	1	2	3	4	5
One-Time Cost	-\$375,000					
Annual Fees		-\$60,000	-\$60,000	-\$60,000	-\$60,000	-\$60,000

Each EEMS delivery platform has different first costs and annual fees that have an impact on the ROI.



Summary of ROI Analysis

All ECMs implemented

SaaS Hosted (all ECM projects implemented)						
Period	0	1	2	3	4	5
EEMS One-Time Cost	-\$100,000					
EEMS Annual Fees		-\$95,238	-\$90,703	-\$86,384	-\$82,270	-\$78,353
Annual Energy Efficiency Project Cost		-\$125,778	-\$119,788	-\$114,084	-\$108,652	-\$103,478
Annual Utility Incentives and Rebates		\$61,809	\$58,866	\$56,062	\$53,393	\$50,850
Annual Energy Savings		\$0	\$142,599	\$271,617	\$388,025	\$492,730
Total Discounted Costs		-\$221,016	-\$210,491	-\$200,468	-\$190,922	-\$181,830
Total Discounted Savings		\$61,809	\$201,465	\$327,680	\$441,418	\$543,580
Total discounted benefit flow		-\$159,207	-\$9,027	\$127,212	\$250,496	\$361,750
Total cumulative discounted benefit flow		-\$259,207	-\$268,234	-\$141,022	\$109,474	\$471,224
ROI		19%	50%	81%	112%	143%

SaaS Cloud (all ECM projects implemented)						
Period	0	1	2	3	4	5
EEMS One-Time Cost	-\$100,000					
EEMS Annual Fees		-\$71,429	-\$68,027	-\$64,788	-\$61,703	-\$58,764
Annual Energy Efficiency Project Cost		-\$125,778	-\$119,788	-\$114,084	-\$108,652	-\$103,478
Annual Utility Incentives and Rebates		\$61,809	\$58,866	\$56,062	\$53,393	\$50,850
Annual Energy Savings		\$0	\$142,599	\$271,617	\$388,025	\$492,730
Discounted Costs		-\$197,206	-\$187,816	-\$178,872	-\$170,354	-\$162,242
Discounted Savings		\$61,809	\$201,465	\$327,680	\$441,418	\$543,580
Total discounted benefit flow		-\$135,398	\$13,649	\$148,808	\$271,063	\$381,338
Total cumulative discounted benefit flow		-\$235,398	-\$221,749	-\$72,941	\$198,122	\$579,461
ROI		21%	54%	89%	124%	158%

On Premise (all ECM projects implemented)						
Period	0	1	2	3	4	5
EEMS One-Time Cost	-\$375,000					
EEMS Annual Fees		-\$57,143	-\$54,422	-\$51,830	-\$49,362	-\$47,012
Annual Energy Efficiency Project Cost		-\$125,778	-\$119,788	-\$114,084	-\$108,652	-\$103,478
Annual Utility Incentives and Rebates		\$61,809	\$58,866	\$56,062	\$53,393	\$50,850
Annual Energy Savings		\$0	\$142,599	\$271,617	\$388,025	\$492,730
Discounted Costs		-\$182,921	-\$174,210	-\$165,915	-\$158,014	-\$150,489
Discounted Savings		\$61,809	\$201,465	\$327,680	\$441,418	\$543,580
Total discounted benefit flow		-\$121,112	\$27,254	\$161,765	\$283,404	\$393,091
Total cumulative discounted benefit flow		-\$496,112	-\$468,857	-\$307,092	-\$23,688	\$369,403
ROI		11%	36%	66%	98%	131%

SaaS Hosted model has the second-best ROI, with a payback occurring in the fourth year of use.

SaaS Cloud delivery method has the fastest ROI and will pay for itself in the fourth year of use.

On-Premise model has the lowest ROI and will pay for itself in the fifth year of operation.



Summary of ROI Analysis

Only low/no cost ECMs implemented

SaaS Hosted (only low/no cost ECM projects implemented)

Period	0	1	2	3	4	5
EEMS One-Time Cost	-\$100,000					
EEMS Annual Fees		-\$95,238	-\$90,703	-\$86,384	-\$82,270	-\$78,353
Annual Energy Efficiency Project Cost		-\$6,289	-\$5,989	-\$5,704	-\$5,433	-\$5,174
Annual Utility Incentives and Rebates		\$6,181	\$5,887	\$5,606	\$5,339	\$5,085
Annual Energy Savings		\$0	\$14,260	\$27,162	\$38,802	\$49,273
Total Discounted Costs		-\$101,527	-\$96,692	-\$92,088	-\$87,703	-\$83,527
Total Discounted Savings		\$6,181	\$20,146	\$32,768	\$44,142	\$54,358
Total discounted benefit flow		-\$95,346	-\$76,546	-\$59,320	-\$43,561	-\$29,168
Total cumulative discounted benefit flow		-\$195,346	-\$271,892	-\$331,212	-\$374,773	-\$403,942
ROI		3%	9%	15%	22%	28%

SaaS Hosted model has the second-best five-year ROI

SaaS Cloud (only low/no cost ECM projects implemented)

Period	0	1	2	3	4	5
EEMS One-Time Cost	-\$100,000					
EEMS Annual Fees		-\$71,429	-\$68,027	-\$64,788	-\$61,703	-\$58,764
Annual Energy Efficiency Project Cost		-\$6,289	-\$5,989	-\$5,704	-\$5,433	-\$5,174
Annual Utility Incentives and Rebates		\$6,181	\$5,887	\$5,606	\$5,339	\$5,085
Annual Energy Savings		\$0	\$14,260	\$27,162	\$38,802	\$49,273
Discounted Costs		-\$77,717	-\$74,017	-\$70,492	-\$67,135	-\$63,938
Discounted Savings		\$6,181	\$20,146	\$32,768	\$44,142	\$54,358
Total discounted benefit flow		-\$71,537	-\$53,870	-\$37,724	-\$22,994	-\$9,580
Total cumulative discounted benefit flow		-\$171,537	-\$225,407	-\$263,131	-\$286,124	-\$295,705
ROI		3%	10%	18%	27%	35%

SaaS Cloud delivery method best five-year ROI

On Premise (only low/no cost ECM projects implemented)

Period	0	1	2	3	4	5
EEMS One-Time Cost	-\$375,000					
EEMS Annual Fees		-\$57,143	-\$54,422	-\$51,830	-\$49,362	-\$47,012
Annual Energy Efficiency Project Cost		-\$6,289	-\$5,989	-\$5,704	-\$5,433	-\$5,174
Annual Utility Incentives and Rebates		\$6,181	\$5,887	\$5,606	\$5,339	\$5,085
Annual Energy Savings		\$0	\$14,260	\$27,162	\$38,802	\$49,273
Discounted Costs		-\$63,432	-\$60,411	-\$57,534	-\$54,795	-\$52,185
Discounted Savings		\$6,181	\$20,146	\$32,768	\$44,142	\$54,358
Total discounted benefit flow		-\$57,251	-\$40,265	-\$24,766	-\$10,653	\$2,173
Total cumulative discounted benefit flow		-\$432,251	-\$472,516	-\$497,282	-\$507,935	-\$505,762
ROI		1%	5%	11%	17%	24%

On-Premise model has the lowest five-year ROI



Conclusions and Recommendations

Based on the analyses, investing in an EEMS will result in **on-going savings**, both from **energy consumption**, and from an **increase in administrative efficiency** in analyzing, auditing and allocating costs to the different departments and agencies within the CoB.

With the dashboarding and analytics capability that is inherent in most EEMS systems, it will be **simpler and less time consuming to assess, develop, budget, implement and track energy efficiency projects.**

This will also lead to the ability to **identify energy efficiency projects that might not be discovered using traditional methods.**

The quicker these types of projects can be brought on line, the quicker the City will save money.