Team 2030

Electri-city: Energy Management in Public Buildings

Recommendations

1. Make A Strong Commitment

- Issue public announcement with publicity campaign
- Integrate Action Plan into the City's General Plan

Establish energy efficiency as a priority and improve public awareness

2. Restructure Energy Management

- Mayor's Office
  - Energy Office
    - Behavior
    - EMS Mgrs
    - Project Mgrs
    - Facilities

Empower the Energy Management Office by redefining roles and fostering inter-departmental communication

3. Harness Data to Discover Savings

- Retrocommission buildings
- Install energy management system
- Begin benchmarking and baselining

14% Savings
=
$730,000 per year

Find low-hanging fruit, maintain savings over time, and find building candidates for deep retrofits

4. Incentivize and Fund Projects

- Amend Capital Improvement Budget
- Create revolving door fund
  - Top-down project discovery
  - Bottom-up project discovery incentive

Facilitate energy efficiency project discovery, prioritization, and financing

5. Create a Culture of Energy Efficiency

- Energy Champions
- Educate employees
- Provide comparative feedback
- Inter-building energy competition

Encourage behavioral change among city employees

6. Communicate Results and Engage the Public

- Annual Progress Report
- City Energy Portal website

Hold agencies accountable, communicate progress, and engage community members in energy efficiency

A Replicable Program

- Straightforward
- Robust
- Flexible
- Demonstrated

Our recommendations have a track record of success and set the framework for continued savings

Thank You!

Questions?

Team 2030

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Appendices

City Size and Budget Data

City Name	State	Population (2010 Census)	Annual Operating Budget (adopted 2013)	Estimated EMO Budget	Annual Capital Budget (adopted 2013)	Source(s)
Pittsburgh	PA	306,211	$469,513,815	$9,390,276	$52,431,600	(City of Pittsburgh, 2013)
Ashville	NC	85,712	$82,733,613	$1,654,672	$7,600,000	(City of Asheville, 2013)
Burlington	VT	42,282	$64,041,052	$1,280,821	$4,605,956	(City of Burlington, 2013)
Virginia Beach	VA	447,021	$1,768,806,714	$35,376,134	$274,950,286	(City of Virginia Beach, 2013)
Cambridge	MA	106,471	$54,107,840	$1,082,157	N/A	(City of Cambridge, 2013)
Saint Paul	MN	285,068	$508,507,770	$10,170,155	$38,208,000	(City of Saint Paul, 2014)
Plano	TX	259,841	$424,746,828	$8,494,937	$88,115,900	(City of Plano, 2013)
Buffalo	NY	261,310	$377,166,000	$7,543,320	$53,572,000	(City of Buffalo, 2013)
Jersey City	NJ	247,597	$485,576,000	$9,711,520	$1,340,900	(City of Jersey City, 2013)
Orlando	FL	238,300	$354,293,000	$7,085,860	$3,661,000	(City of Orlando, 2013)
Norfolk	VA	242,803	$977,292,418	$19,545,848	$92,830,300	(City of Norfolk, VA)
Durham	NC	228,330	$376,545,543	$7,530,911	$70,923,875	(City of Durham, 2014)
Glendale	AZ	226,721	$347,725,000	$6,954,500	$106,200,000	(City of Glendale, 2013)
Baton Rouge	LA	229,493	$291,963,000	$5,839,260	$91,701,592	(City of Baton Rouge, 2013)
North Las Vegas	NV	216,961	$123,288,556	$2,465,771	$125,341,200	(City of North Las Vegas, 2013)
Richmond	VA	204,214	$780,953,451	$15,619,069	$95,842,698	(City of Richmond, 2013)
Hartford	CT	124,775	$538,791,625	$10,775,833	$140,754,755	(City of Hartford, 2013)
New Haven	CT	129,779	$497,454,609	$9,949,092	$62,955,279	(City of New Haven, 2013)
Pasadena	CA	137,122	$215,658,000	$4,313,160	$88,485,000	(City of Pasadena, 2013)
AVERAGES		**211,580**	**$459,956,044**	**$9,199,121**	**$77,751,130**	

Building Area Estimates

Building Type (Group: Subgroup)	Sample Size	Average Square Footage
Non-refrigerated warehouse		
Non-refrigerated warehouse	5	28,360
Office		
Government office	49	49,555
Public assembly		
Entertainment/culture	10	237,640
Library	19	25,308
Other public assembly	2	771,000
Recreation	27	30,291
Social/meeting	15	37,453
Public order and safety		
Fire station/police station	33	15,271

Source: U.S. Energy Information Administration, 2003

City-Owned Property Estimates

City	Square Footage City Property	Population (2010 Census)	Square Feet City Property per Capita	Source(s)
Virginia Beach, VA	3,700,000	437,994	8.4	(City of Virginia Beach, 2014)
Columbus, OH	2,500,000	787,033	3.2	(City of Columbus, 2013)
Seattle, WA	10,000,000	608,660	16.4	(City of Seattle, 2013)
Denver, CO	6,000,000	600,158	10	(City of Denver, 2013)
Minneapolis, MN	21,300,000	382,578	55.7	(City of Minneapolis, 2013)
Cambridge, MA	3,398,259	105,162	32.3	(City of Cambridge, 2014)
Averages	**7,816,377**	**486,931**	**21**	

Average Square Feet City Property per Capita	21
Average Population Size (from City Data)	211,580
Estimated Square Footage of City-Owned Property	4,444,596

Building Size and Energy Estimates

Building Type	Proportion	Estimated Total Building Type Square Footage	Average Square Footage (10^3)	Estimated Number of Buildings	Average EUI (kBtu/ft^2/year)	Estimated Energy Use (1000 kBtu/year)	Source	Notes
Parking Structure	17%	755,581	145	6	9	6,764,036	(Reed Construction, 2013b; San Francisco Public Utilities Commission, 2012; U.S. Environmental Protection Agency, 2007)	Unit Site Energy; considered unenclosed parking (i.e. open parking structure)
Municipal Building	15%	666,689	49.6	14	85.8	57,168,612	(U.S. Department of Energy, 2003)	Assumed local government owned office buildings
Yard	13%	577,797	N/A	N/A	0	N/A		Assume yards are simply open spaces with no facilities on site
Park	11%	488,906	N/A	N/A	0	N/A		Assume parks are simply open spaces with no facilities on site
Warehouse	9%	400,014	28.4	15	49.4	19,752,672	(U.S. Department of Energy, 2003)	Assumed local government owned non-refrigerated warehouse
Animal Shelter	7%	311,122	21.3	15	157.3	48,951,741	(City of Chicago, 2014; Group, 2011; Metro Energy Solutions, 2007; New England Trane, 2010; San Francisco Public Utilities Commission, 2012; Steven Winter Associates, 2010; U.S. Energy Information Administration, 2013)	
Police Station	6%	266,676	15.3	18	88	23,459,465	(U.S. Department of Energy, 2003)	Assumed local government owned fire/police
Cemetery	6%	266,676	10	27	132.9	35,451,147	(Nashua Regional Planning Commission, 2010; Reed Construction, 2013a; The Corporation of the Town of Tillsonburg, 2013)	
Library	5%	222,230	25.3	9	94	20,891,822	(U.S. Department of Energy, 2003)	Assumed local government owned libraries
Garage	3%	133,338	68.8	2	22.5	3,004,493	(San Francisco Public Utilities Commission, 2012; U.S. Energy Information Administration, 1992; U.S. Environmental Protection Agency, 2007)	Unit Site Energy: considered fully enclosed parking with 24/7 ventilation
Community Center	2%	88,892	98.1	1	81.7	7,258,914	(U.S. Department of Energy, 2003)	Assumed local government owned non-library public assembly buildings
Pool	2%	88,892	5.4	17	310	27,556,493	(City of Pittsburgh Department of City Planning, 2014; City of Seattle, 2013; San Francisco Public Utilities Commission, 2012)	Pools tend to include the facilities in which they are located; the Seattle number is very close to the San Francisco number
Airport	2%	88,892	13	7	74.1	6,590,147	(Lau, Stromgren, & Green, 2010; Parker, Cropper, & Shao, 2011)	Commercial service airport
Fire Station	1%	44,446	15.3	3	88	3,909,911	(U.S. Department of Energy, 2003)	Assumed local government owned Fire/police
Pump Station	1%	44,446	N/A	1	0	1,143,329,908		Calculation Based on documents provided wherein buildings are 13% of total city energy use and pump station is 57%

Retrocommissioning Estimates

Building Type	Estimated Total Square Footage by Building Type	Implement RCx	Total RCx Costs	One Time-NEI Savings	Recurring Annual Savings
Parking Structure	755,581	No	-	-	-
Municipal Building	666,689	Yes	$228,608	$152,405	$220,141
Yard	577,797	No	-	-	-
Park	488,906	No	-	-	-
Warehouse	400,014	Yes	$137,165	$91,443	$132,084
Animal Shelter	311,122	Yes	$106,684	$71,122	$102,732
Police Station	266,676	Yes	$91,443	$60,962	$88,056
Cemetery	266,676	No	-	-	-
Library	222,230	Yes	$76,203	$50,802	$73,380
Garage	133,338	No	-	-	-
Community Center	88,892	Yes	$30,481	$20,321	$29,352
Pool	88,892	Yes	$30,481	$20,321	$29,352
Airport	88,892	Yes	$30,481	$20,321	$29,352
Fire Station	44,446	Yes	$15,241	$10,160	$14,676
Pump Station	44,446	Yes	$15,241	$10,160	$14,676
	TOTALS		**$762,026**	**$508,017**	**$733,803**

RCx Costs and Savings per Square Foot - LBL Study		
Metric	***Cost***	
Cost - Excluding NEIs (conservative, higher cost)	0.3429	$2013/sqft
Savings - Standardized US Energy Price	0.3302	$2013/sqft
Savings - One-time Non-Energy Impact	0.2286	$2013/sqft
Energy Savings per year	17	kBtu/sqft

Adapted from: (Mills et al., 2004)

Cost Estimates

System Component	Count	Cost	Total Cost	Source(s)	Notes
EMS Installation					
Electricity Master Meter	135	$9,717 per meter	$1,311,795	(Motegi, Watson, & Mckane)	Assumed uniform meter prices, same configuration cost per building; Adjusted all costs for inflation
Electricity Sub-meter	127		$1,234,059		
Natural Gas Master Meter	127		$1,234,059		
Natural Gas Sub-meter	127		$1,234,059		
Software	1	$59,040	$59,040		
Server	1	$15,683	$15,683		
Configuration per Building	135	$14,760	$1,992,600		
Benchmarking Software					
WegoWise Membership	135	$72 per building per year	$9,720	(Wegowise, 2013)	
Retrocommissioning (RCx)					
RCx of Specified Buildings by Square Foot	2,222,298	$0.3429 per square foot	$762,026	(Mills et al., 2004)	Used costs excluding non-energy impacts (higher costs and thus more conservative)
Behavioral Programs					
Feedback	4,500 employees	$5 per person	$22,500	(Carrico and Riemer, 2011)	
Training	4,500 employees	$6 per person	$27,000	(Carrico and Riemer, 2011)	
TOTAL			**$7,898,041**		

Identifying Inefficient Buildings

Tracking Retrofits

Effect of Boiler Upgrade (June 11, 2009)

Back to list of all upgrades

Heating energy in Btu per square foot (conditioned)

Show Raw Data | Bookmark This Report

Date Range	Full-Year Sum
Jun 09 - May 10	7.36
Jun 08 - May 09	12.2

Before: Old A.O. Smith ~68% efficient boiler, uninsulated basement

After: New Slant/Finn 84% efficient boiler, basement ceiling insulated with foam

Cost: $23,000.00

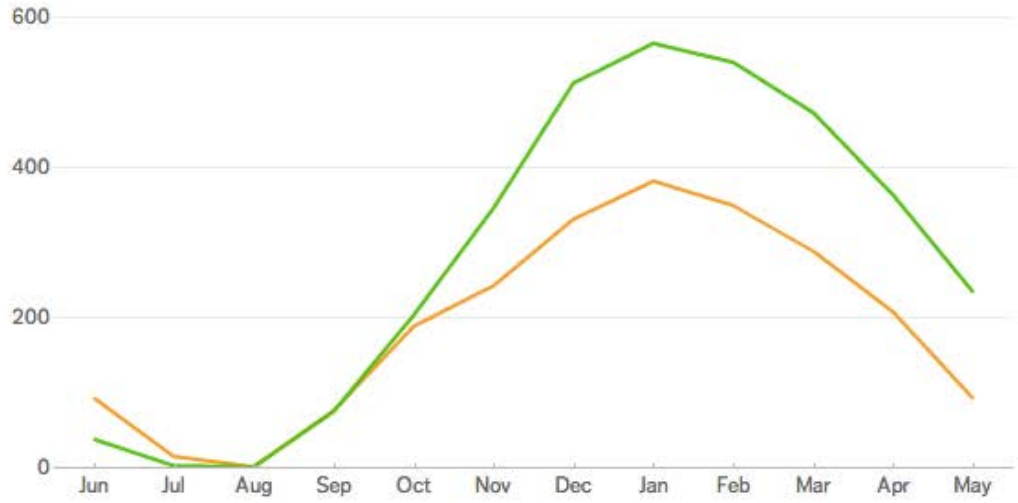
Expected Savings: **22%**

Actual Savings: **40%** (5 Btu/conditioned sqft/HDD)

Detailed Data per Month

Click a square to show or hide an item on the graph

Click & drag to zoom in



Benchmarking Buildings

← Oct | Nov 2013 | Dec →

Water

BETTER THAN AVERAGE

Entire building - Gallons / bedroom / day

8% better than similar bldgs

76	Actual
83	Similar

29% worse than efficient bldgs

76	Actual
59	Efficient

View meter-level data

Electric

WORSE THAN AVERAGE

Common areas - kWh / 1k sqft / day

33% worse than similar bldgs

16	Actual
12	Similar

103% worse than efficient bldgs

16	Actual
7.9	Efficient

View meter-level data

Gas

POOR

Entire building - Btu / sqft / day

54% worse than similar bldgs

317	Actual
206	Similar

102% worse than efficient bldgs

317	Actual
157	Efficient

View meter-level data