Team 2030 – Case Proposal

Case Name: Electri-City - Energy Management in Public Buildings

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Executive Summary

On behalf of the City Energy Management Office, we are pleased to present the Energy Efficiency Action Plan in application for the Mayor's Special Projects Budget. The Energy Efficiency Action Plan was crafted in response to the City's commitment to the Better Buildings Challenge requiring a 20% reduction in energy use over ten years.

The Energy Efficiency Action Plan is intended to restructure the City's existing framework for energy management using funding from the Special Projects Budget. Energy efficiency has yet to become fully-integrated in the City's management and decision making processes. This has limited the ability of the Energy Management Office to effectively implement cost-saving energy efficiency measures in the City's building portfolio.

The Energy Efficiency Action Plan aims to improve knowledge about the City's building stock and promote a culture of energy efficiency in order to achieve the voluntary goals established by the Better Buildings Challenge. We are confident that this program can be easily implemented and will achieve significant and enduring energy savings. The Energy Efficiency Action Plan includes six overarching themes necessary to ensure continued energy savings. These include:

1. Making a strong, visible, and public commitment to energy efficiency
2. Redefining energy management office roles and fostering interdepartmental communication
3. Better understanding and optimizing the City's current building portfolio
4. Facilitating energy efficiency project discovery, prioritization, and financing
5. Encouraging behavioral change among city employees
6. Holding us accountable through communication of progress and results.

Tackling each of these areas using the methods included in the Energy Efficiency Action Plan will create a strong incentive for employees to engage in energy efficiency and will help finance future building retrofits. We estimate that implementing the Energy Efficiency Action Plan will result in annual energy savings of at least $700,000, equivalent to a 14% reduction in the energy used by the City's buildings (excluding the pumping station).

To implement the Energy Efficiency Action Plan, the EMO requests a funding increase of $8 million through the 2014 Special Projects Budget, which is within the maximum allowable yearly increase of $9.2 million (see ***Appendix 7*** for budget-related data).

We are hopeful that you will approve our proposal for the Special Projects Budget to help distinguish our city as a national leader in energy efficiency.

Introduction

As a Municipal Partner of the Better Buildings Challenge (BBC), the City has committed to a 20% reduction in energy use. The Energy Management Office (EMO) believes targeted efforts to increase energy efficiency in the City's buildings represent a significant opportunity to help achieve this goal. Covering six overarching themes, the Energy Efficiency Action Plan ("Action Plan") offers a comprehensive, cross-functional approach to reducing energy use in City buildings. We believe this approach is scalable to fit the population and building inventory size in any mid-size city, and is easily replicable across cities. Furthermore, our options include a significant degree of flexibility that allows for program expansion over time, or for some individual components to be implemented independent of others.

I. Making a Strong, Visible, and Public Commitment to Energy Efficiency

The Mayor has committed to a voluntary 20% reduction in city energy consumption over the next ten years. We commend the Mayor for his leadership and vision for a modern, efficient City. However, while setting an energy efficiency target is important, the impact of this action diminishes over time without strong institutions in place for implementing, managing, and tracking program progress (ACEEE, 2013). To establish energy efficiency as a priority and improve public awareness of the BBC, we recommend that the Mayor publicly issue an executive order initiating the Action Plan. Issuing the executive order will establish the Mayor's vision for the city and re-emphasize his commitment to energy efficiency and sustainability. Furthermore, we ask the Mayor to advocate that the City Council incorporate the Action Plan and BBC commitment into the City's General Plan. Doing so will help cement energy efficiency as one of the City's core priorities, instead of a side project pursued by just one department. This approach has proven successful in other cities like Portland, Oregon (City of Portland, 2014). The Mayor should accompany the executive order with a press release and a publicity campaign to generate public interest and awareness. The Mayor should also announce the Action Plan as a key component of his next State of the City speech.

II. Redefining Roles and Fostering Interdepartmental Communication

Our goal is to achieve a more holistic approach to city energy management. However, at present, the EMO staff does not have clearly defined roles within the office, and the current organizational structure is not sufficient to meet the demands of the Action Plan. Another issue is that the EMO does not communicate with other critical stakeholders within the City's organizational structure. This limits the EMO's ability to leverage and collaborate with key stakeholders in other departments. Energy efficiency is by nature a crosscutting, multidisciplinary endeavor, and the EMO cannot be siloed into one department within the City organizational structure.

A. Empowering the Energy Management Office

We propose that the Mayor elevate the EMO to a branch of the Mayor's Executive Office. Research has shown that organizational efforts to improve energy efficiency are more successful when led from a position close to the top executive (Martin et al., 2012). In this new role, the

Energy Management Director would report directly to the Mayor's Chief of Staff on the progress of all efficiency-related projects and initiatives. The Director would continue to oversee a limited staff tasked with coordinating efficiency programs through City government. The new structure would afford the department with the authority and flexibility needed to cut across siloed City departments. Furthermore, elevating the EMO to a branch of the Mayor's Executive Office would further publicly commit the Mayor to pursuing the Action Plan.

B. Redefining the Energy Management Office's Roles and Responsibilities

The EMO currently has six full-time employees responsible for a wide variety of activities related to city energy management (see ***Appendix 2***). To improve organizational efficiency within the Department, the Action Plan creates structured roles with specific responsibilities for each EMO staff member. Implementing these roles will require the Energy Management Director to realign job descriptions and clarify responsibilities for his existing staff. The newly created roles within the EMO are:

1. EMS Managers (two employees)
2. Energy-Facilities Liaison (one employee)
3. Behavioral and Educational Programs Manager (one employee)
4. Energy Efficiency Project Managers (two employees)

See ***Appendix 5*** for full job descriptions of EMO staff responsibilities.

C. Rethinking the Facilities-Energy Nexus

The Facilities Department is responsible for safe and reliable operation and maintenance of the 150 city-owned buildings. In this capacity, Facilities staff regularly report to contact points at individual departments to discuss building operation and maintenance. However, Facilities staff are not attentive to energy efficiency and are focused on keeping old equipment operating as long as possible, regardless of the implications for energy consumption. Equipment and operating decisions are made without input from the EMO, and poorly operated buildings can produce significant additional costs (Mills et al, 2004).

To resolve this issue, we propose that the Energy-Facilities Liaison be integrated into existing communication channels between Facilities and City departmental staff, and be responsible for identifying energy efficiency opportunities during these discussions. The Energy-Facilities Liaison will participate in meetings between (1) Facilities management staff and representatives of individual departments, and (2) Facilities management staff and the Facilities Managing Director.

The presence of the Energy-Facilities Liaison at meetings between Facilities management staff and departmental representatives will enable the EMO to develop a better sense of the day-to-day challenges faced by facilities management. Furthermore, by attending these meetings, the Energy-Facilities Liaison will be able to better understand technical, occupant comfort, and productivity issues through communication with departmental representatives. We recommend the Energy-Facilities Liaison meet with each agency representative and their respective facility

manager(s) four times per year. Given that the average mid-sized city has approximately 25 city departments (City of Pittsburgh, 2014; City of Buffalo, 2014; City of Virginia Beach, 2014; City of Burlington, 2014; City of North Las Vegas, 2014), we estimate that this represents a total of approximately two meetings per week for the Energy-Facilities Liaison. In addition, including the Energy-Facilities Liaison at meetings between facilities managers and the Facilities Managing Director will help the Energy-Facilities Liaison better understand the high-level issues impacting the day-to-day decisions of Facilities managers.

III. Understanding and Optimizing the City's Current Building Portfolio

Currently, the City has limited information on energy consumption within its buildings and the operational efficiency of building systems. Part of the reason for this lack of knowledge is that utility meters may cover multiple buildings or subdivide single buildings. In addition, Facilities staff are focused primarily on operation and maintenance for safety concerns and on minimizing costs. To address these issues, we propose a comprehensive approach that includes: (1) retrocommissioning ("RCx") of selected buildings to identify building inefficiencies and optimize operations and (2) the installation of an EMS across the City's building portfolio to provide insight into building operations and allow for baselining, benchmarking, and tracking of energy consumption.

A. Jumpstarting Energy Savings through Building Retrocommissioning

To jumpstart the City's energy savings commitment, we propose the City undertake RCx for a portion of its building stock. RCx is the process by which building systems are evaluated to measure their performance, identify system defects, and modify building operation to improve overall performance and efficiency. RCx is among the most cost-effective efficiency upgrades a building can make and should be the first step in any integrated building efficiency upgrade plan (ENERGY STAR, 2007). A majority of projects achieve simple payback periods of less than three years, with larger buildings typically achieving quicker paybacks (ENERGY STAR, 2007; Mills et al., 2004). We recommend the City begin by retrocommissioning buildings that are publicly owned, staff-occupied, require a significant amount of heating and cooling, or contribute significantly to the City's energy use[1]. Based on the breakdown of the City's building ownership, we project this subset represents 106 buildings and roughly 2.2 million square feet. Based on RCx estimates, we estimate a total project cost of $762,000 and annual savings of $733,000. Including one-time non-energy impact savings[2], we estimate a payback period of 0.35 years for this investment. We estimate savings of roughly 38 million kBtus per year, or approximately 14% of total building energy usage, excluding the pumping station (see ***Appendix 12*** for data and calculations).

[1] This would include the following building types: municipal buildings, warehouses, animal shelters, police stations, fire stations, libraries, community centers, pools, airport buildings and the pump station.
[2] Non-energy impacts include one-time cost savings such as savings from reduced maintenance or prolonged equipment life.

B. Tracking Consumption through an Energy Management System

The savings from RCx can be maintained through the installation of a comprehensive EMS. The EMS will be used for monitoring-based commissioning, in which the EMS continuously tracks critical building systems to identify problems as they occur. Under the current framework, city officials are limited in their capacity to monitor building energy use and trends. As discussed above, utility bills do not accurately convey building energy information, and the utility company is unable to provide additional information on the building(s) that each meter account belongs to. This lack of data in building energy use is a major impediment to enhanced energy management. In addition to improving building information, installing an EMS opens the door to behavioral energy programs, such as *Beat the Peak!*, an inter-building energy reduction competition (see Section 5.D). As discussed above, pairing RCx with a comprehensive EMS will help savings persist over time and maintain the highest level of efficiency in building systems.

As part of the EMS implementation, we propose the installation of electricity and gas meters at a subset of buildings across the city, based on the type of building and energy requirements. For example, buildings that are occupied by personnel and have gas and electric needs (such as municipal buildings, libraries, and community centers), will have gas and electric meters installed. Conversely, buildings serving a single purpose with limited utility needs, such as parking garages, will only have one meter (in this case for electricity due to lighting). Additionally, buildings that are heated and cooled will be equipped with sub-meters to measure the HVAC and air handling systems, as these are likely culprits of energy system deficiencies and are essential to maintaining tenant comfort (ENERGY STAR, 2007). Collectively, these monitors will feed information to a central server and data will be read and interpreted using software provided by the EMS vendor. We project the cost of this system to be approximately $7.1 million (see ***Appendix 13*** for cost breakdown) and include meters in 135 buildings. This system will allow for future flexibility, since additional meters, controls and new energy technologies can be easily integrated.

Data from the EMS will be used to baseline energy building use beginning in 2015, after the EMS is installed (see ***Appendix 1*** for project timeline). These baselines will be updated annually for distribution in the communication campaign and the inter-building energy competition (beginning in 2015 after the EMS is installed).

The EMO would issue an RFP for retrocommissioning and for the EMS once it has secured funds from the Mayor's Special Projects Fund, or roughly halfway through year one of the Action Plan. The RCx process would take place during the first half of year two, concurrent with the EMS installation. One EMS Manager will be responsible for coordinating the RCx RFP, while the other EMS Manager will be responsible for coordinating the EMS RFP.

C. Establishing Comparative Reference Points through Benchmarking

To help assess and analyze the data provided by the new EMS, we suggest that (1) the City invest in a subscription to an online energy management software platform, such as WegoWise, and (2) begin using ENERGY STAR Portfolio Manager. Utilization of these software platforms will allow the City to systematically track and monitor the performance of its buildings, and to

benchmark them against one another as well as other similar buildings across the country. The additional investment in a more sophisticated platform is necessary because it provides benefits like long-term tracking of savings from energy efficiency retrofits and improved project prioritization**.** This investment is minor relative to the EMS and retrocommissioning projects, and we estimate a total annual cost of $9,720 to include all 135 buildings receiving EMS upgrades (see ***Appendix 13***). Additional buildings could easily be added at an affordable cost of $6 per building per month.

To complement these software packages, we also suggest the city work with local education groups to help complete a city-wide inventory of building characteristics. For example the EMO will reach out to students from local universities to assist in collecting building information as part of an independent study or for class credit.

IV. Facilitating Project Discovery, Prioritization, and Financing

A. Strengthening Criteria for the Capital Improvement Budget

At present, the primary source of funding for City departments to upgrade their facilities is through the Capital Improvement Budget. Upgrades to these facilities offer significant opportunities for energy efficiency improvements. However, the Capital Improvement Budget does not specify energy efficiency as a criterion for evaluating applications. To resolve this problem, we propose that energy efficiency is made a criterion of the Capital Improvement Budget and that future applications require an analysis of the project's implications for energy consumption. Energy Efficiency Project Managers will assist City departments with this analysis during the application process.

Similarly, the Capital Improvement Budget application criteria should be amended to cover procurement of office equipment. While most procurement is governed by city procurement policies, in some cases itemized purchases are funded through the Capital Improvement Budget in conjunction with other capital projects. Therefore, we also recommend the incorporation of a green standard for purchases as part of the Capital Improvement Budget application criteria (see ***Appendix 14***).

Recognizing that the Facilities improvement team does not have experience in evaluating energy efficiency projects, we recommend that the Energy Efficiency Project Managers be involved in the review of Capital Improvement Budget applications. Instituting these requirements will elevate the importance of energy efficiency and bring critical energy efficiency expertise to the capital budgeting process.

B. Recovering Energy Savings for Reinvestment

Many projects specifically intended to improve energy efficiency are highly involved and capital-intensive. At present, city agencies interested in these projects must apply to the Capital Improvement Budget for financing. However, efficiency projects must meet a large number of unrelated criteria and compete against other, more general applications. We believe projects devoted to efficiency deserve their own source of capital. In order to fast-track energy efficiency

projects, we propose the institution of the Energy Reinvestment Fund, a "revolving door" fund with the sole purpose of financing energy savings projects and programs.

Initial capital for the Energy Reinvestment Fund will be generated from the retrocommissioning savings discussed above. This fund will be used to finance energy efficiency upgrades and the EMO's behavioral education programs (discussed in more detail below). In turn, energy savings from these investments and programs will revolve back into the fund to continue the next round of investments (see ***Appendix 6***). The EMS Managers will measure the success of these investments using the EMS software and online energy management program, which will help the EMO accurately recuperate savings back into the fund. The purpose of this fund is to target high return energy efficient investments and provide an internal funding source for the City. The Energy Efficiency Project Managers will help identify energy efficiency projects and oversee the application and approval process for the Energy Reinvestment Fund. The Energy Reinvestment Fund will be added as a subsection under the Capital Improvement Budget.

C. Sustaining Continual Discovery of Efficiency Projects

The ability to continually identify new opportunities for efficiency is one of the most critical components of any energy program. To encourage new energy efficiency projects, we recommend a two-pronged program. First, the EMS Managers will utilize EMS data to identify cost-saving opportunities – the "top-down" approach. Second, the EMO will incentivize a "bottom-up" approach through its Energy Ideas Incentive program, in which city staff are encouraged to come forward with new project proposals.

Identifying and Financing Energy Efficiency Investments: The Top-Down Approach

The final retrocommissioning report will help prioritize a preliminary round of investments. Once implemented, the EMS and benchmarking software will provide further insight into optimal, cost-effective energy efficiency investments. The Energy Efficiency Project Managers will prioritize these investments using the same metrics that the Facilities improvement team uses to evaluate capital improvement projects. Such criteria typically include net present value, return on investment, internal rate of return, and/or simple payback period. While high return, low cost energy investments will be the first priority, Project Managers will take into consideration the possibility of bundling energy efficient investments. Bundling is a useful tool to mix investments of different financial attractiveness that might not make sense independently but do when implemented together because of pooled capital costs (Kerstetter, 2012).To finance these projects, the EMO will rely primarily on funding from the Energy Reinvestment Fund, but will also investigate opportunities to leverage funding from the Capital Improvement Budget and from outside sources (see ***Appendix 15***).

Instituting the Efficiency Ideas Incentive Program: The Bottom-Up Approach

Currently, city employees are not encouraged or incentivized to bring energy related issues to management, resulting in lost opportunities for energy efficiency investments. However, employees working in city buildings are one of the most important sources of feedback about building operations, as they interact with the buildings on a daily basis.

Boosting employee participation to achieve energy efficiency goals has proven to be a low-cost, extremely effective method for identifying energy efficiency opportunities (Carbon Trust, 2013; Carrico and Riemer, 2011). For example, 3M's Annual Energy Recognition Program, which encourages employees to develop ideas to cut energy consumption, has resulted in 1,900 employee-inspired projects, a 22% improvement in total energy efficiency, and $100 million in savings over a five-year period (U.S. DOE, 2010). To increase employee engagement in achieving efficiency, we propose the creation of the Efficiency Ideas Incentive Program to recognize and reward viable employee-proposed energy efficiency projects.

The Efficiency Ideas Incentive Program will offer employees who propose an energy efficiency project that is approved and implemented a cash reward based on the anticipated project savings. Interested employees can apply directly to the program, which will connect the employee(s) with one of the Energy Efficiency Project Managers. The Energy Efficiency Projects Managers will evaluate and rank submissions based on projected energy savings, costs of implementation, timeline, and fit within the broader context of the building's systems. Upon completion of the employee's project, he or she will be awarded a one-time cash payment equal to 5% of the expected first-year savings, up to a maximum of $5,000.[3] This incentive will be funded by the Energy Reinvestment Fund. Each department's Energy Champion (discussed in detail below) will be responsible for encouraging participation among city staff, and ideas will be submitted via pre-designed application forms to the EMO's Project Managers[4].

V. Encouraging Behavioral Change among City Employees

Occupant behavior is a major determinant of energy use in buildings, and behavior change is a fast, low-cost and high-impact way of reducing energy consumption (Carbon Trust, 2013; Levine et al., 2007). For example, several studies show that energy costs can be reduced by up to 20% simply through implementing basic behavioral changes at very low cost (Ucci et al., 2014; Lopez et al., 2012; Carrico and Riemer, 2011)[5]. Based on the significant potential for savings through behavioral changes we propose the implementation of a comprehensive behavioral improvement program focused on feedback, training and peer education, and incentives. Incorporating each of these components into the behavioral program will boost program success and unleash significant energy savings (Barbu et al., 2013).

A. Training Energy Champions

During year one of the Action Plan, the Behavioral and Educational Program Manager will recruit volunteers to serve as Energy Champions within his or her department. Each Energy Champion will receive energy efficiency training from the Behavioral and Educational Program Manager. Energy Champions will serve as the connection between the EMO and individual

[3] Incentives will be based off the expected savings as calculating real savings for individual proposals once all other behavioral programs are implemented will be extremely difficult, if not impossible.
[4] To avoid a conflict of interest, the EMO staff will not be eligible for this program.
[5] Household studies show reduction can range from 0 to 15% (Abrahamse et al., 2005) to 20% (Lopes et al., 2012; Gynther et al., 2012), while office building studies show reductions can range from 4 to 7% (Carrico and Reimer, 2011), to 10% (Carbon Trust, 2013) or even 20% (Ucci et al., 2012).

departments. Each Energy Champion's duties will include: (1) sending monthly energy consumption reports to staff within his or her department; (2) providing examples of energy efficient behavior and comparative feedback; and (3) serving as the department's point of contact to the EMO for any questions or concerns related to energy efficiency.

B. Educating Employees on Energy Efficiency

We propose the development of an annual information campaign to educate employees on energy efficiency. This program will heighten employee awareness of environmental issues associated with their energy use, help them change their everyday behavior surrounding energy, keep them informed on progress towards the Mayor's 20% goal, and invite them to participate in the Energy Ideas Incentive Program. Development and management of the information campaign will be undertaken by the Behavioral and Educational Program Manager with assistance from the Energy Champions. Information will be distributed to employees through signage and posters in offices, announcements at staff meetings, the monthly feedback emails (see Section 5.C), and postcards delivered to mailboxes. The EMO will develop the content of the campaign and hold a competition among students from local universities to design the campaign's branding. This strategy will minimize design costs while increasing awareness of the Action Plan.

C. Providing Feedback and Comparative Energy Consumption

Feedback has been successfully used to promote energy efficient behavior, with some feedback interventions alone achieving up to 7% reductions in energy use (Carrico and Riemer, 2011). In particular, comparative feedback, in which individuals are compared to their peers, has proven to result in even greater energy savings (UK Gov., 2012; Ucci et al., 2014). Based on these findings, we propose the creation of tailored building-to-building comparative feedback, *Beat the Peak!* – an inter-building energy competition, and employee incentives as a strategy to encourage the adoption of energy efficient behavior among city employees.

Buildings occupants will receive monthly energy consumption reports distributed by the Energy Champions containing simple, easily understood graphs summarizing their building's energy consumption during the previous month, equivalent GHG emissions[6], and a comparison to other buildings. Energy Champions will also post the information in common areas in their departments. These postings will include motivational images or phrases when goals are achieved or surpassed, which have been shown to effectively encourage improved behavior (Carrico and Riemer, 2011).

D. Implementing the "Beat the Peak!" Inter-Building Energy Competitions

In order to maximize savings we recommend that, in addition to the use of comparative feedback, an inter-building competition, titled *Beat the Peak!* take place for three months each summer.[7] The winning building will be chosen based on the largest percent reduction in energy

[6] Information on GHG emissions will be presented through comparable emissions, such as emissions in equivalent car miles traveled per year.

[7] PECI's 2013 Kilowatt Cup competition in Portland, OR had three floors of their headquarter offices compete against each other to reduce energy use; reductions of 19, 18, and 13% in each of the three floors were achieved

use over the previous year's summer baseline. The competition will occur during the summer so as to have the largest impact on energy savings (energy demand tends to peak during the summer). Incentives to the winning building will be provided in the form of a formal celebration with the Mayor in attendance and one additional day of paid time off in the following year[8], both of which will be funded by energy savings from the Energy Reinvestment Fund. Presence of local media at the celebrations would foster a sense of accomplishment among employees and would help communicate results to the general public. We recognize that if a building undergoes an energy retrofit during or in the year preceding the competition, the energy savings calculations from behavioral programs could be affected. Therefore, the estimated savings from retrofits will be accounted for in order to keep competitions fair.

VI. Communicating Program Results and Involving the Public

A. Generating an Annual Progress Report

The disclosure of progress towards the BBC goal through an Annual City Building Energy Report ("Annual Report") is the most effective way to clearly communicate results both internally and to the general public. Translating building energy consumption into a report format will be relatively seamless using the EMS and the tools provided by WegoWise and ENERGY STAR Portfolio Manager. Through the utilization of these software tools, the City can provide quantitative evidence of the progress towards the BBC goal. The creation of an Annual Report is a low-cost mechanism to hold city agencies accountable and ensure the success of the Action Plan.

B. Maintain an Education and Outreach Website

The City is making a major investment to increase the energy efficiency of its building portfolio and should keep the public abreast of their progress. The BBC goal calls for city-wide energy reduction and this goal will be difficult to achieve without involving community members. One of the most effective means of bringing the City's effort to the forefront of public discussion is through the creation of a city-operated web portal. This website, titled *City Energy Portal*, will serve a dual purpose of 1) communicating city-run energy efficiency initiatives and progress; and 2) encouraging community members to become involved in energy efficiency initiatives.

The City could effectively publicize internal energy efficiency goals and actions by making the BBC goal and the Action Plan prominent components on the *City Energy Portal* website. This would clearly demonstrate to citizens both the City's energy-saving goals and also actions being taken to meet these goals. The *City Energy Portal* will also serve as a cost-effective means of distributing the Annual Report to community members interested in tracking the City's progress towards their stated goal. Bridging internal efforts to city-wide initiatives will be key in helping the City achieve their 20% energy reduction goal. The *City Energy Portal* can be leveraged to

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(Merrick, 2013). The Watts To Water competition awards the most efficient buildings in the Denver metro area; the competition has 137 registered buildings (*wattstowater.com*). Other competitions include Arlington's Green Games, Chicago's Green Office Challenge, and Louisville Kilowatt Crackdown among many others (*energystar.gov*).

[8] Assuming an average of 30 employees per building and an average salary of $43,000 per year, this would only cost the City $5,160 (http://hamptonroads.com/newsdata/salaries/city/portsmouth). Other city estimates were very close to this.

educate and engage community members in energy efficiency opportunities. The city of Portland, Oregon uses their *Climate Action Now!* website to provide helpful tips to residents to reduce transportation and home energy use (Portland Climate Action Now, 2014). Our City could use a similar approach to provide community members with easy-to-understand steps to reduce personal energy use. The *City Energy Portal* will represent an add-on to the existing city website and a collaborative effort between the EMO and the City's Information Technology Department.

Conclusion

The City needs a new outlook on energy management to meet its commitment to a 20% energy reduction goal. We believe the Energy Efficiency Action Plan outlined above will realign incentives, restructure operations, improve building knowledge, and establish the culture of energy efficiency that the City seeks. Our recommendations will not only help the City meet this challenge, but will set in place the framework to drive continued energy and cost savings long into the future. We are confident that by awarding us funding through the Special Projects Budget, the Mayor will propel our City to the forefront of energy efficiency and sustainability.

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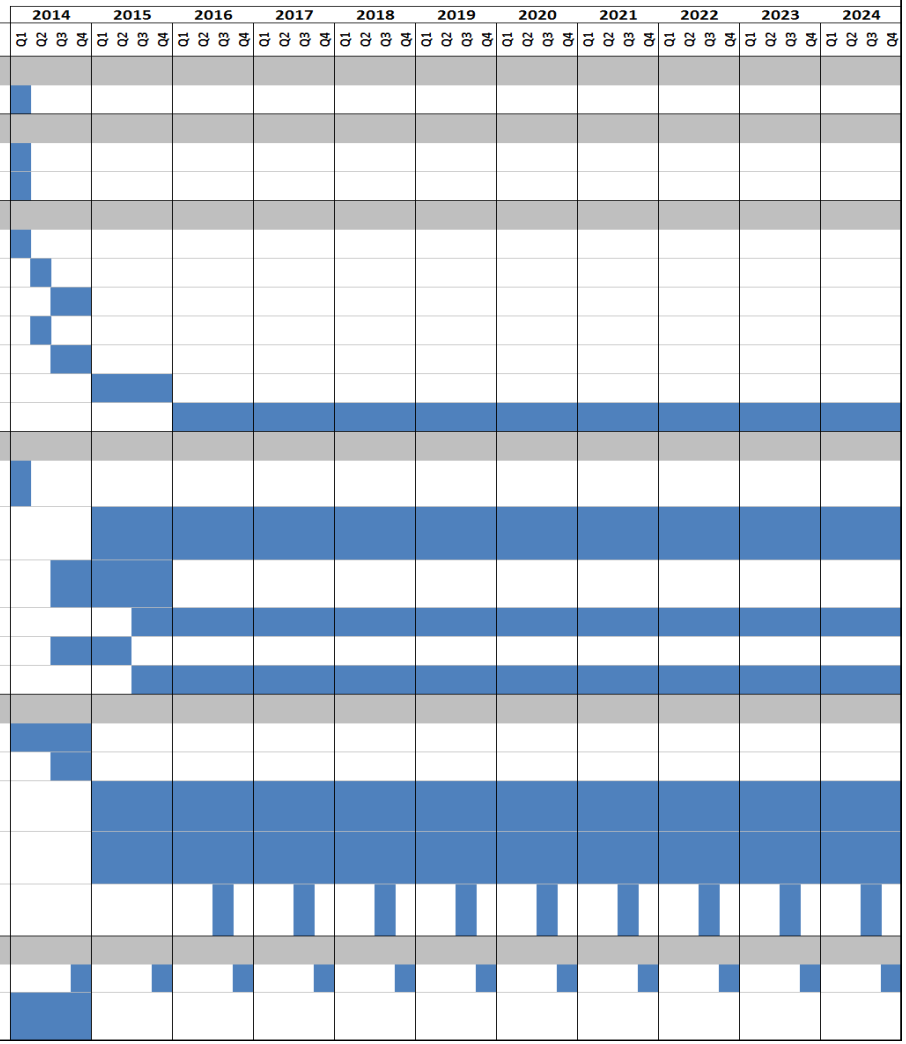
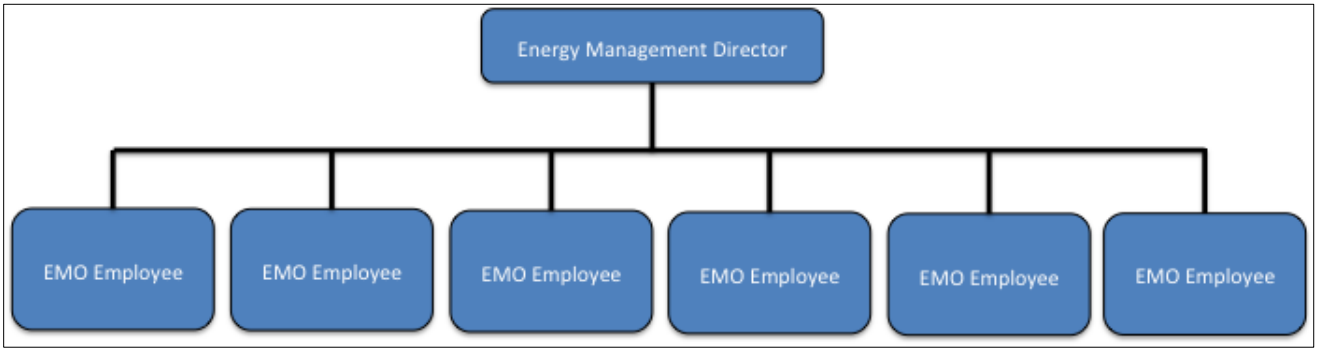
Appendix 1 – Timeline

Energy Action Plan
Program Timeline, 2014 - 2024

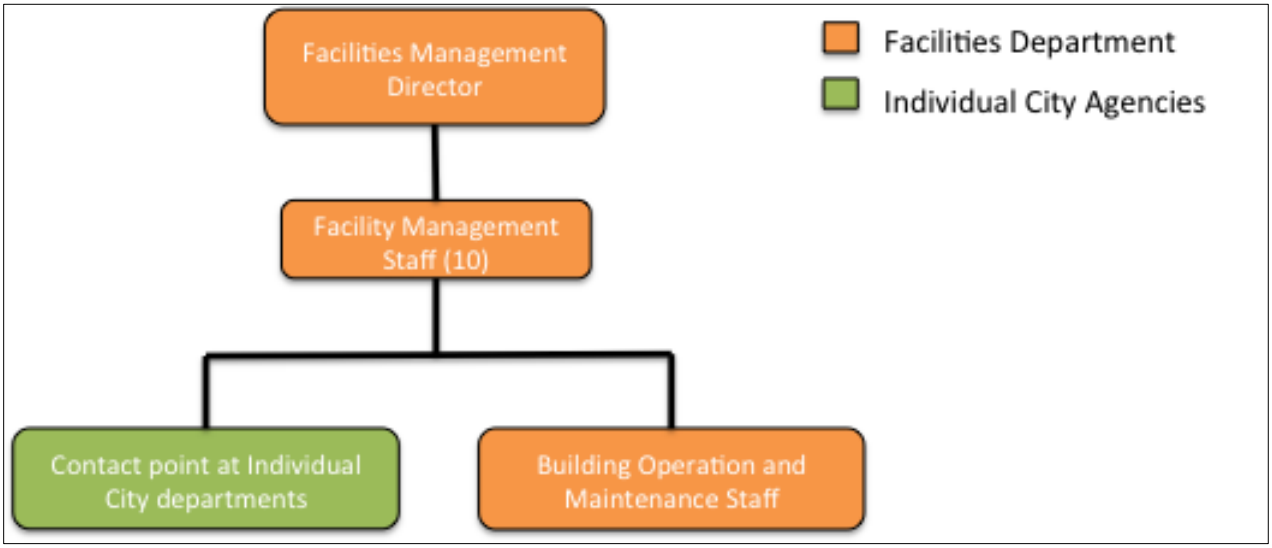
GOAL #	TASKS	RESPONSIBLE PARTY
1	**Public Commitment to Energy Efficiency**	
1.1	Issue Executive Order	Mayor's Office
2	**Redefining Roles & Fostering Communication**	
2.1	Elevate EMO to Mayor's Office	Mayor's Office and EMO Director
2.2	Redefine EMO staff roles	EMO Director and staff
3	**Understanding and Optimizing Buildings**	
3.1	Approval of Action Plan/SPB application	Mayor's office
3.2	Retrocommissioning planning & RFP process	EMS Managers, Project Managers
3.3	Retrocommissioning Project Execution	EMS Managers, Contractors
3.4	EMS planning & RFP Process	EMS Managers, Project Managers
3.5	EMS installation	Contractors
3.6	Establish longterm consumption baseline	EMS Managers
3.7	Use WegoWise for ongoing consumption tracking	EMS Managers
4	**Project Financing, Discovery, and Prioritization**	
4.1	Amend Capital Improvement Budget criteria	Mayor's Office, City Council, EMO Director
4.2	Accumulate capital for Energy Reinvestment Fund from retrocommissioning	Project Managers
4.3	Energy Reinvestment Fund (ERF) development and budgeting	EMO Director, Project Managers
4.4	Energy Reinvestment Fund opens to applications	EMO Director, Project Managers
4.5	Energy Ideas Incentive program development	EMO Director, Project Managers
4.6	Energy Ideas Incentive opens for applications	Project Managers
5	**Behavioral Programs**	
5.1	Program development (information and training)	Behavioral Program Managers
5.2	Train department Energy Champions	Behavioral Program Managers
5.3	Implementation of information campaign	Behavioral Program Managers, Energy Champions
5.4	Monthly energy consumption reports and feedback	Behavioral Program Managers, EMS Managers, Green Champions
5.5	Implement yearly inter-building competition	Behavioral Program Managers, Energy Champions
6	**Communicating progress to the public**	
6.1	Generate Annual Progress Report	EMO at large
6.2	Development of energy disclosure website	EMO Director, Behavioral Program Managers



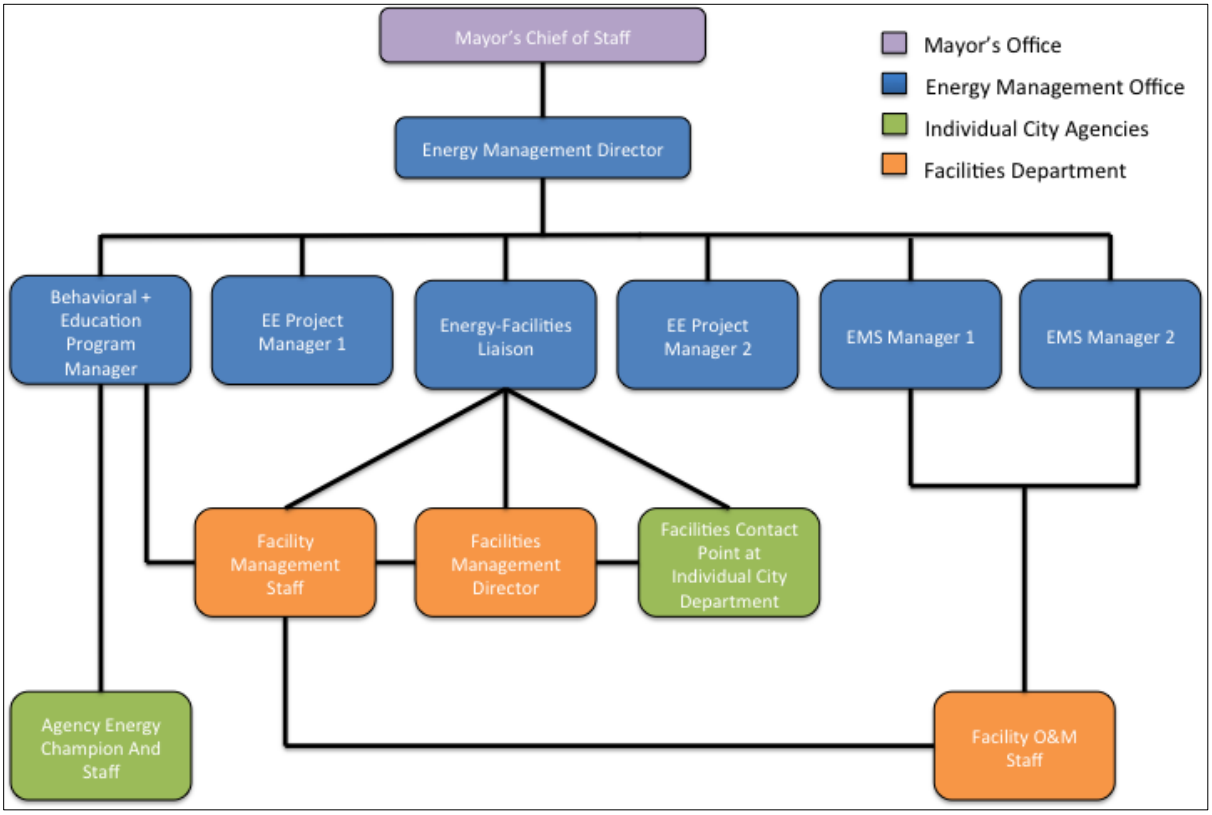
Appendix 2 - Existing Department Organizational Chart



Appendix 3 - Existing Facilities Organizational Chart



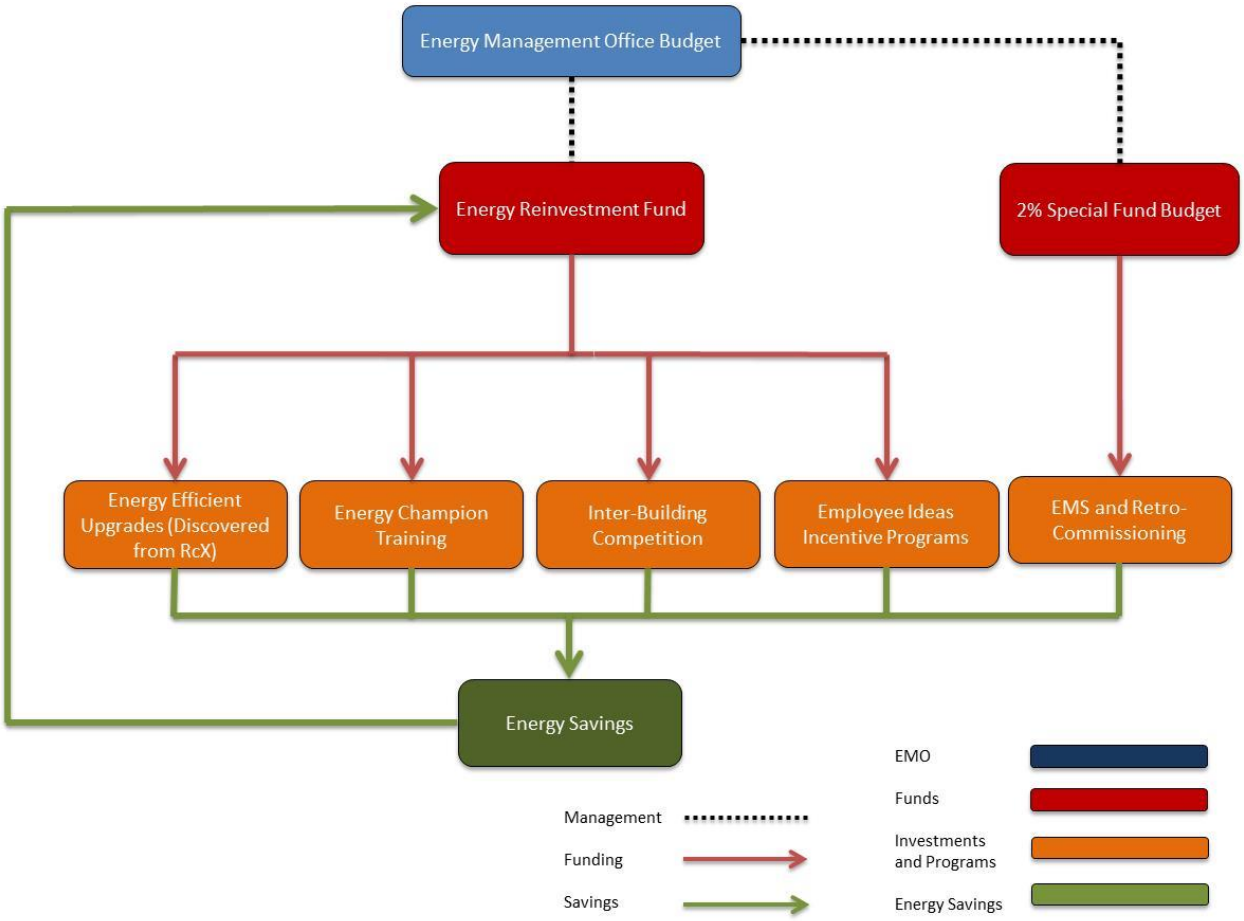
Appendix 4 - Flowchart of Proposed City Organizational Structure



Appendix 5 - EMO Staff Job Descriptions

EMS Managers	**Two full-time employees**
1. Coordination of the RFP process and installation for the city's new EMS in conjunction with Project Managers; 2. Coordination of the RFP process for RCx; 3. Ongoing upkeep of EMS in conjunction with Facilities Department O&M staff; **4.** Compilation and analysis of energy consumption for city buildings, in conjunction with the Behavioral and Educational Program Manager;	
Energy-Facilities Liaison	**One full-time employee**
1. Attend all meetings between the facilities managers and the Facilities Management Director; 2. Coordinate quarterly meetings with each department head and corresponding facilities manager; 3. Collaborate with Behavioral and Education Program Manager on ongoing education and training programs for ten facilities management staff and other O&M staff; 4. Offer support and guidance to City departments who express interest in applying for the Energy Reinvestment Fund.	
Behavioral and Educational Program Manager	**One full-time employee**
1. Design and implement Behavioral Energy Challenge; 2. Train Energy Champions within each City department; 3. Design and implement educational sessions on efficiency for ten facilities management staff and other O&M staff; 4. Coordinate with EMS Managers to generate and distribute monthly consumption reports for each building.	
Energy Efficiency Project Managers	**Two full-time employees**
1. Collaborate with EMS Managers to identify viable efficiency-related projects and develop project proposals; 2. Review and approve/reject project proposals submitted by city employees through the Energy Ideas Incentive program; 3. Review and approve/reject project proposals submitted by city buildings (either one department or multiple departments.	
Director	**One full-time employee**
1. Budget planning for efficiency budget and Energy Reinvestment Fund 2. Report to the Mayor on energy efficiency initiatives 3. Manage EMO staff 4. Oversee annual report 5. Provide strategic vision for EMO	

Appendix 6 - Finance Flowchart



Appendix 7 - Effective Steps for Energy Efficiency in the Workplace

Source: Tweed, 2012.

Appendix 8 - Midsize City Population and Budget Data

City Name	State	Population (2010 Census)	Annual Operating Budget (adopted 2013)	Estimated EMO Budget (2% AOB)	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**	

Appendix 9 - Estimated Average Square Footage for Local Government-Owned Buildings by Building Type (CBECS)

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

Appendix 10 - Estimated Average Square Footage for Local Gov't-Owned Buildings by City

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	10.0	(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**	**21.0**	

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

Appendix 11 - Estimated Square Footage and Energy Use by Building Type

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	145.0	6	9.0	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	0.0	N/A		Assume yards are simply open spaces with no facilities on site
Park	11%	488,906	N/A	N/A	0.0	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. Energry Information Administration, 2013)	
Police Station	6%	266,676	15.3	18	88.0	23,459,465	(U.S. Department of Energy, 2003)	Assumed local government owned fire/police
Cemetery	6%	266,676	10.0	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	94.0	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	Unit Site Energy: considered fully enclosed parking with 24/7 ventilation

							Agency, 2007)	
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	310.0	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	13.0	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	88.0	3,909,911	(U.S. Department of Energy, 2003)	Assumed local government owned Fire/police
Pump Station	1%	44,446	N/A	1	0.0	1,143,329,908		Calculation Based on documents provided wherein buildings are 13% of total city energy use and pump station is 57%

Appendix 12 - Retrocommissioning Costs and Savings Estimates

Building Type	Estimated Total Square Footage by Building Type	Implement RCx	Total RCx Costs	One Time-NEI Savings[9]	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[10]		
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)

[9] Non-energy savings are one-time non-energy related savings, such as savings from decreased maintenance and prolonged equipment lifetime
[10] Cost estimates adjusted for inflation from 2003 to 2013 using the Bureau of Labor Statistics CPI Inflation Calculator (http://data.bls.gov/cgi-bin/cpicalc.pl).

Appendix 13 - Total Estimated Costs of Intervention Measures

System Component	Count	Cost	Total Cost	Source(s)	Notes
EMS Installation[11]					
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[12]					
WegoWise Membership	135	$72 per building per year	$9,720	(Wegowise, 2013)	
Retrocommissioning (RCx)[13]					
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[14]	$5 per person	$22,500	(Carrico and Riemer, 2011)	
Training	4,500 employees[15]	$6 per person	$27,000	(Carrico and Riemer, 2011)	
TOTAL			**$7,898,041**		

[11] Electric meters installed in all buildings (excludes yards and parks); natural gas installed in all (excludes yards and parks) but parking facilities (assumed only electricity for lighting). Sub-meters installed in all buildings with natural gas master meters (assumed those buildings have HVAC and air handling systems).
[12] Benchmarking software purchased for all buildings with at least an electricity-based EMS installed.
[13] Retrocommissioning undertaken on all buildings except for: cemeteries, parking facilities, and yards/parks
[14] Average number of government employees for several American mid-size cities with populations between 200,000 and 400,000 (U.S. Census Bureau, 2011).
[15] Average number of government employees for several American mid-size cities with populations between 200,000 and 400,000 (U.S. Census Bureau, 2011).

Appendix 14 - Green Standards for the Capital Improvement Budget

Type of Procurement	Requirements
Computers, Laptops, monitors and other computer related hardware	Must be EPEAT Certified
Office Appliances	Must be EnergyStar Certified
New Office Leases	Must sign Green Leases (Sample)
New Building Construction and/or Major Reconstruction	Must be at least LEED Silver or Equivalent and energy tracked using ENERGY STAR portfolio

Source: portlandoregon.gov

Appendix 15 - Outside Funding Opportunities

Type of Financing	Project Type	Funding Amount	Term	Interest Rate	More Info
On-Bill Financing	Energy Efficiency Investments Only	Low to Moderate (less than $250,000)	Up to 10 Years	0%	Dependent on utility company
Municipal or Project Lease	Large Equipment Lease	High, Flexible	Up to 15 Years	Low Tax-Exempt Rate	Can be tax-exempted, dependent on local regulations
Municipal Bonds	Flexible	Large (Millions)	Up to 20+ years	Low Tax-Exempt Rate	May require taxpayer approval
State Energy Efficient Financing	Flexible	Moderate to Large	Up to 20 years	Low	Dependent if state offers special financing programs for cities
State/Federal Grants	Energy Efficient Investments	Low to High	None	None	State/Federal Grants that may exist for city energy efficient investments. Such as the American Recovery and Reinvestment Act of 2009.

Sources: The Energy Network, 2013; EPA, 2004; Zobler and Hatcher, 2003.

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