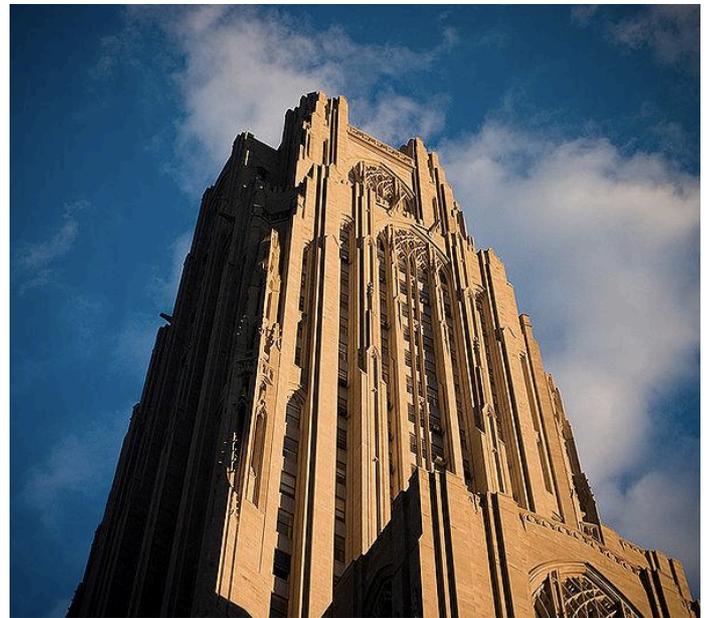




University of
Pittsburgh



Graduate School of Public and
International School 2014 Capstone Project

The Inventory of City Facilities



+ Introduction

In 2014, Mayor William Peduto established the Department of Innovation and Performance to transform the City of Pittsburgh into a world-class city. One of the ways in which the Department is working to put Pittsburgh on the map is through its recent energy benchmarking and disclosure initiative. It involves promoting energy efficiency in the existing building sector and helps prioritize poorly performing facilities for immediate improvement. Also, it identifies best practices that can be replicated, either within a building or across a portfolio of buildings. Nine cities across the United States are already implementing these initiatives, and the City of Pittsburgh could soon be next.

Energy benchmarking has many benefits. In the short-term, benchmarking increases the general awareness of energy efficiency among building occupants and managers by providing objective, reliable information on energy use. On a more long-term basis, benchmarking can substantially reduce greenhouse gas emissions and provide benefits to the local economy. For example, a benchmarking and disclosure policy has the potential to motivate investment in existing buildings and create jobs in the energy management, benchmarking, auditing, and retrofit industries. It establishes reference points for measuring and rewarding good performance. Examples from cities where policies are in place, such as Minneapolis, show increased demand for energy services and growth in energy management companies.

The City of Pittsburgh has engaged the University of Pittsburgh's Graduate School of International Affairs to assist with the beginning stages of this initiative. This includes completing a database consolidation project of publically owned buildings and researching best practices for benchmarking energy usage. The following report summarizes this data and lessons learned from early adopters that might prove valuable to the City of Pittsburgh.

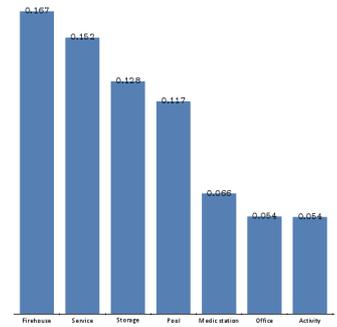
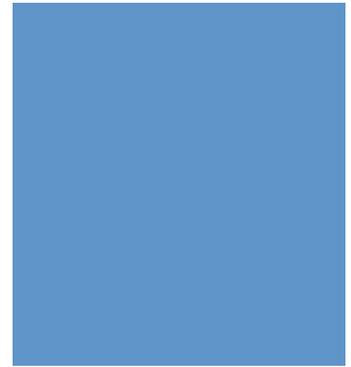
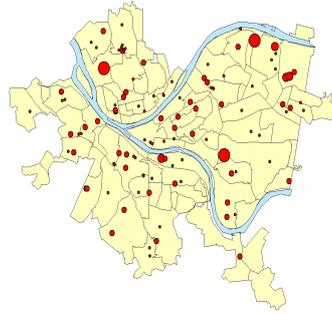
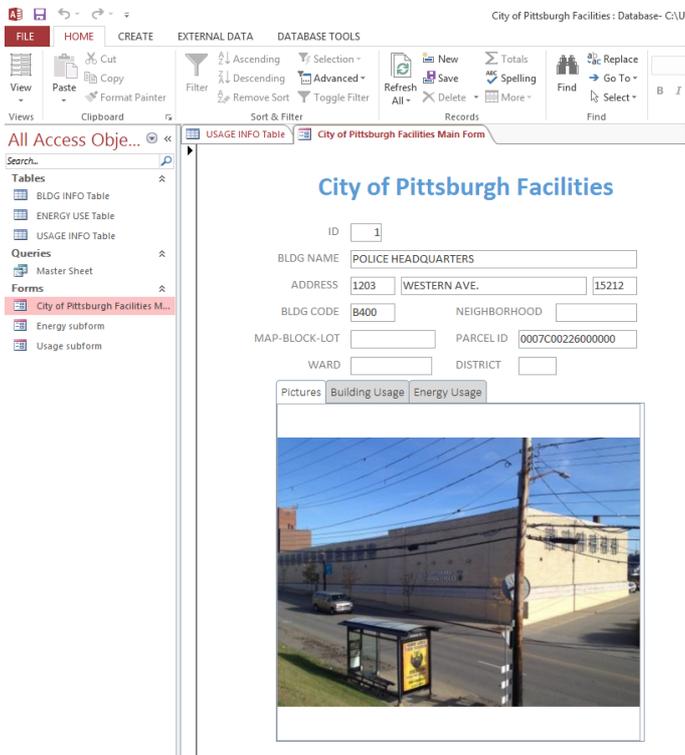


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The benchmarking is based on research on the energy disclosure and management of other cities. It also gives analysis and recommendations on energy management tools and strategies.

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The Access database is very user-friendly and can export excel sheets for different purpose easily. This database can serve as a framework to inventory all city owned properties. Allows user to search, edit, and export excel sheets from the database.

Code Book -----12

The code book includes explanation for each variable used in the database, explains the data source, missing data, and responsible working group.

GIS Map Layout-----16

The GIS map comes with its file geodatabase. It's saved with relative path and can be added to the city's GIS map. The data in the Access database is jointed to the map file, and energy usage is symbolized with graduated points.

+ Benchmarking Report

Building Characteristics

This City of Pittsburgh currently uses the Environmental Protection Agency’s (EPA) ENERGY Star Portfolio Manager for reporting energy usage. All nine cities that currently have energy benchmarking and disclosure ordinances use this software. It is an online energy benchmarking tool to help monitor, measure, rate and optimize energy use, and to identify which buildings in a portfolio are under-performing by establishing energy use baselines and tracking energy and water use, as well as greenhouse gas emissions.

Overall, energy data is available for 258 buildings, or 84% of the City’s 1.69 million square feet of property. Energy information is tracked for most or all firehouses, medic stations, pools, senior centers, and office buildings. This data is reported in terms of Energy Use Intensity (EUI) which is simply the amount of energy used per one square foot of floor space. Some categories don’t have much energy information available, such as storage space, concession stands, and activity buildings. It may be that these areas don’t use electricity or heat, but further investigation is necessary to ensure energy use is not being overlooked. The tables below provides a more detailed breakdown of EUI by building type.

Building type	Available Energy Data by Building Type						Projected EUI			
	Total normalized EUI	Total buildings	Buildings not included	Total square feet (SF)	SF not included	% SF with no energy data	Building type	Total norm. EUI	SF not included	Estimated total
Firehouse	4,046	26	1	228,353	2,684	1.2%	Firehouse	4,046	2,684	4,094
Storage	3,111	15	13	45,175	42,773	94.7%	Storage	3,111	42,773	58,513
Pool	2,841	34	17	181,399	24,887	13.7%	Pool	2,841	24,887	3,292
Medic station	1,610	10	1	66,616	3,520	5.3%	Medic station	1,610	3,520	1,699
Office	1,306	21	8	481,596	2,159	0.4%	Office	1,306	2,159	1,312
Activity	1,299	16	10	92,667	58,653	63.3%	Activity	1,299	58,653	3,539
Concession	1,194	27	25	13,036	9,642	74.0%	Concession	1,194	9,642	4,585
Senior	1,105	11	1	148,465	16,804	11.3%	Senior	1,105	16,804	1,246
Recreation	922	6	1	56,605	5,256	9.3%	Rec	922	5,256	1,017
Restrooms	863	18	14	15,026	5,753	38.3%	Restrooms	863	5,753	1,398
Police station	828	8	4	101,804	41,190	40.5%	Police station	828	41,190	1,390
Police	521	2	0	124,646	0	0.0%	Police	521	0	521
Police unit	286	3	1	10,981	24	0.2%	Police unit	286	24	287
Utility	212	23	20	8,856	3,531	39.9%	Utility	212	3,531	353
Training	154	4	3	41,920	19,572	46.7%	Training	154	19,572	290
Gym	110	1	0	9,774	0	0.0%	Gym	110	0	110
Community	73	2	0	10,475	0	0.0%	Community	73	0	73
Picnic shelter	40	26	25	14,744	13,207	89.6%	Picnic shelter	40	13,207	381
Salt dome	35	5	2	40,220	16,088	40.0%	Salt dome	35	16,088	58
TOTAL	20,555	258	146	1,692,358	265,743	15.7%	TOTAL	20,555	265,743	84,157

Notice that there is still 265,753 square feet that is unaccounted for. In an attempt to capture the true potential energy use of City of Pittsburgh buildings, we developed a formula to project the average EUI/square foot to the square footage not currently tracked in Portfolio Manager. By this measure, storage space would account for 58,500 annual EUI—a measure almost certainly inflated by the fact that only 5% of 45,000 square feet of storage space is currently tracked in Portfolio Manager. Some of this space may in fact not be hooked up to electricity or heat, but it would be worth checking out these storage facilities to see if these buildings are indeed using a lot of energy.

Performance-based Conservation

To determine the appropriate measures for benchmarking publically owned buildings in the City of Pittsburgh, we reviewed a number of cities that have also committed to benchmarking energy consumption, including U.S. cities such as Boston, New York, Minneapolis, Chicago, and D.C., as well as the international cities Toronto and Melbourne. All of these cities propose goals to substantially reduce greenhouse gas emissions in the long-run (e.g. an 80% reduction by 2015), the means by which they will achieve this remain vague. The only city that actually provides for a meaningful implementation plan to reduce energy consumption is the City of Toronto. In their 2014 Energy Conservation Plan they develop a methodology called “performance-based conservation.”¹ This data-driven approach classifies buildings by use type (e.g. administrative offices, police stations, fire stations, public works facilities) and then benchmarks to the best performing buildings within each classification.

This makes sense because each building classification inherently has very different energy use intensity and as a result, cannot be held to the same standards. More importantly, they require different strategies and solutions to reduce energy consumption. Another benefit of performance-based conservation is the ability to clearly see the best and worst performing building within each use class. The City of Toronto currently benchmarks to the top-quartile performing building for each classification. Because this approach yields tangible results in energy consumption in the short-term that will greatly influence greenhouse gas emissions in the long-term, we recommend the City of Pittsburgh adopt a similar methodology moving forward.

Analysis

The following analysis provides the recommended benchmarks for the City of Pittsburgh using the City of Toronto’s performance-based methodology.

The first step for the City of Pittsburgh is to benchmark the data of every type of government-owned buildings and compare their energy usage to figure out the energy efficient buildings. This involves creating a meaningful use classification and then setting energy performance targets for each class. We have attempted to create these classifications in conjunction with the database construction element of this project. However, this is just a starting point. We believe that the Department Heads know their buildings best and recommend that they fact-check these use classifications with a representative from Innovation and Performance who will be implementing this program prior to the full rollout of the program.



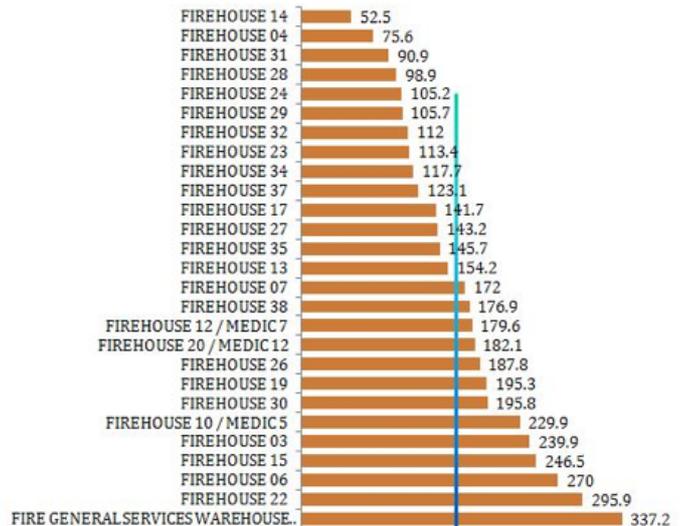
Also, the City must decide on an initial benchmark, or target, and the timeframe



In our analysis, we benchmark to the top-quartile of energy performers. On the right is an example of what this might look like, using City of Pittsburgh Firehouses.

The average EUI of Fire Department buildings is 162. Firehouse 14 performs the best, as it is 17,262 square feet but only cost \$7,582 for 2013. The poorest performer in terms of EUI is the Fire Service General Warehouse. It has very limited space of 1,072 square feet but a relatively large \$16,800 annual energy cost. The reason for this building's performance could be that the building is for general services, which requires long operating hours every week and possibly more machines and equipment to maintain services and operating for all the firehouses located in Pittsburgh area. It is also important to note that the buildings Firehouse 10, 12 and 20 also include Medical Centers. Therefore, their EUI data could be over-estimated.

Measured EUI, Firehouses



The energy data on office buildings is also very varied. The EUI varies widely, most likely because the buildings themselves are so different. Although all these spaces are marked "Office" as the primary use, some are Parks buildings, others are Public Works, and another is a police investigations center. Possibly only one building, the City-County Building, qualifies as a true office. Heth Run Garage has the lowest EUI, but probably isn't an actual office, as it cost only \$231 to heat the 2,000 square foot space in 2013. Frick Park Biddle Building and McKinley Park Office are both categorized as parks administration buildings, but still only cost \$4-\$5,000 to run annually despite a square footage of 1,500-2,000.

In contrast, the City-County Building cost \$423,240 to heat and cool according to Portfolio Manager.

To reiterate, this is why we highly recommend developing these use classifications internally. The goal is to identify high-potential buildings and estimate overall conservation potential. In addition, energy-saving measurement should be customized to each building type and included in individual reports, like energy assessment reports and building-level audit reports. The measures can be categorized as behavioral, operational or retrofit/capital in the implementing projects. Savings potential, suggested timelines



Firehouse 24



+ Program Design and Management

This section details some of the logistical issues the City of Pittsburgh must consider prior to full implementation of this benchmarking initiative.

❖ Data Access and Reporting

In order to keep the database up to date, we recommend that it be housed within the Department of Innovation and Performance with limited access, rather than on a shared drive. Only one or two individuals should be able to edit the database.

❖ Outreach and Stakeholder Engagement

Representatives from the City of Pittsburgh were interviewed and are generally eager to be included as part of this process. As noted earlier, they play an integral role, along with the experts from Innovation and Performance to fact check use classifications and champion behavioral modifications that will lead to energy conservation

❖ Staffing Levels

The City of Boston interviewed a number of cities before implementing their program and determined that a full-time staff person specifically dedicated to the program is essential for its ongoing success. While it is clear that the Department of Innovation and Performance should house this staff person, it is not certain whether the Department currently has the appropriate level of staffing capacity to fully implement. Of course, this is an assessment the Department must make based on the knowledge of its current workload and future initiatives. To assist with this decision, we identify the following responsibilities needed to carry out this program effectively and classify them into three broad categories:

- 1. Data entry, distribution and maintenance, and analysis**
 - Quarterly entry into Portfolio Manager
 - Distribution of output to Department Heads
 - Updating and processing requests for updates in database
 - Setting benchmarks
- 2. Identifying energy-saving strategies and managing projects**
 - Small, but impactful improvements
 - Capital projects
 - Training and behavioral/cultural modifications
- 3. Reporting**
 - Developing annual reports to track progress

All of these duties have very different skillsets. The City may decide for an equivalent of a full-time staff person, for example a team, or committee, of current employees and new employees.



+ Next Steps

❖ Benchmarking Water Usage and Indoor Air Quality

Not all cities who have enacted energy benchmarking and disclosure ordinances are benchmarking water usage, but there are a handful of cities in the northeast that are, including New York and Philadelphia.^{1,1} It is our understanding that City currently has an agreement with the Pittsburgh Water and Sewer Authority that provides for an allotment of a certain amount of water usage, so it is unclear whether or not there would be any significant monetary gain for the City by reducing water consumptions as there would be for reducing energy consumption. At the same time, with the appropriate staffing infrastructure in place, recording and subsequently benchmarking water usage may not pose a significant burden to the existing activities of the Department. It is also worth noting that the Portfolio Manager that the City is already using has the capability for recording water bills. This is something the City may want to consider as a possible Phase II once the Department has overcome the learning curve of the energy initiative. It is recommended that the City establish the same performance-based conservation benchmarks as in the case of energy benchmarks that were adapted from the Toronto Report.

Another interesting idea is to eventually benchmark indoor air quality. We were unable to find any U.S. cities that currently do this, so the City of Pittsburgh could be the first. Indoor air quality is extremely important from a public health standpoint because it is a known factor of respiratory illnesses and especially impacts those with asthma or other pre-existing respiratory conditions.¹ Obviously the City strives to create a healthy and productive work environment for their employees and customers, but the problem with indoor air quality is that testing can be very expensive with little to no financial returns. The City would either have to pay a consultant or hire staff to test all of their buildings and then develop an appropriate remediation plan. Therefore, we recommend that the City hold off on benchmarking indoor air quality on all buildings and just focus on the most highly trafficked ones, at least until the larger initiative of energy reduction begins to yield some tangible financial returns that the City could then use to finance these lower-yielding projects.

❖ Retrofitting Street Lights

While street lighting is a little beyond the scope of this project because they are not public buildings per se, they are publically owned infrastructure and we believe they are worth exploring. Not only are a lot of other cities doing it, but also the potential returns are great.

The City of Seattle conducted a number of pilot studies and estimated that the payback time is a mere 7.7 years, decreasing energy consumption between 48 to 62 percent, saving the City \$2.4 million each year in energy and maintenance cost.¹ Similarly, San Francisco is also undertaking a large-scale conversion project, converting 18,500 city-owned streetlights to LED. Like Seattle, San Francisco estimates a reduction in energy consumption by approximately 50 percent.¹ However, because these are city-owned and not utility-owned streetlights, there are even more savings to be had. We mention this because the potential returns are great and could perhaps even fund future initiatives in the Department of Innovation and Performance.

+ Summary of Findings

- ❖ **ENERGY Star Portfolio Manager is the industry standard for aggregating and reporting energy data from utility bills to a uniform and comparable energy usage intensity (EUI)**
- ❖ **Performance-based conservation is the preferred approach to identifying top performers and aggressively remediating or disposing low performing buildings**
- ❖ **Ensuring accurate, representational data and building the appropriate level of capacity before implementing**
- ❖ **Focus on high-impact projects that yield positive returns to potentially finance and support Departmental, energy conservation initiatives**

Reference

¹ [http://www1.toronto.ca/City%20of%20Toronto/Environment%20and%20Energy/Action%20Plans,%20Policies%20&%20Research/PDFs/City%20of%20Toronto%20ECDM%20\(2014-2019\).pdf](http://www1.toronto.ca/City%20of%20Toronto/Environment%20and%20Energy/Action%20Plans,%20Policies%20&%20Research/PDFs/City%20of%20Toronto%20ECDM%20(2014-2019).pdf) accessed Nov. 3, 2014

² <http://www.nyc.gov/html/gbee/html/plan/energy.shtml> accessed Nov. 17, 2014

³ http://www.mankogold.com/publications-Philadelphia_Building_Owners_Required_to_Benchmark_Energy_and_Water_Usage.html accessed Nov. 17, 2014

⁴ <http://www.benchmarkenvironmental.com/indoor-air-quality-testing/> accessed Nov. 5, 2014.

⁵ <http://www.seattle.gov/light/streetlight/led/> accessed Nov. 19, 2014

⁶ http://sfwater.org/bids/projectdetail.aspx?prj_id=270 accessed Nov. 22, 2014



Database Manual

The screenshot displays the Microsoft Access interface for a database titled "City of Pittsburgh Facilities". The ribbon includes FILE, HOME, CREATE, EXTERNAL DATA, and DATABASE TOOLS. The left-hand pane shows the "All Access Objects" task pane with categories: Tables (BLDG INFO Table, ENERGY USE Table, USAGE INFO Table), Queries (Master Sheet), and Forms (City of Pittsburgh Facilities M..., Energy subform, Usage subform). The main window shows a form titled "City of Pittsburgh Facilities" with the following fields:

ID	<input type="text" value="1"/>
BLDG NAME	<input type="text" value="POLICE HEADQUARTERS"/>
ADDRESS	<input type="text" value="1203"/> <input type="text" value="WESTERN AVE."/> <input type="text" value="15212"/>
BLDG CODE	<input type="text" value="B400"/>
NEIGHBORHOOD	<input type="text"/>
MAP-BLOCK-LOT	<input type="text"/>
PARCEL ID	<input type="text" value="0007C0022600000"/>
WARD	<input type="text"/>
DISTRICT	<input type="text"/>

Below the form is a subform with three tabs: "Pictures", "Building Usage", and "Energy Usage". The "Pictures" tab is active, showing a photograph of a police station building. A "Build-in search box" is located at the bottom of the subform area. The status bar at the bottom indicates "Record: 14 | 1 of 303 | No Filter | Search".

Objects table

General information

Subforms of picture/
usage/energy information

*Click on tabs to switch to
another subform

Build-in search box

Notice:

General information and pictures are stored in BLDG INFORMATION table, usage information is stored in USAGE INFO table, and energy information is stored in ENERGY INFO table.



Database Management

Instructions of how to use the database



Search For Specific Record

Under the screen you can see the build-in search box. Enter any key words you want to search, then press return.

Entire field or part of the field are both searchable. If there are several records match the keywords, database will go to the first match.



Update and Edit Records

1. Update and edit records in the form view: directly make changes when you find a flaw in the record, then save the database.
2. Open the data table, find the record you want to change, make changes in the data table, then save the table.



Export Excel Sheets

This function allows users to export Excel sheets from the database.

1. Click query design
2. Select the data table that contains the wanted fields
3. Select wanted fields
4. Click run and save the Excel sheet to your computer



Code Book

Description of Code Book goes here

Variable name	BLDG CODE
Description	Unique identifying number of site marked by a letter than series of numbers
Methodology	Provided by City of Pittsburgh
Missing Data	1 site is missing a building code
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	MAP – BLOCK - LOT
Description	Unique identifier of site marked by a series of three codes The Map-Block-Lot number references to the City of Pittsburgh Parcel ID map.
Methodology	Provided by City of Pittsburgh GIS Department
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	PARCEL NO.
Description	Unique identifier of site that references to the City of Pittsburgh Parcel ID map http://gis.pittsburghpa.gov/zoning/
Methodology	Provided by City of Pittsburgh GIS Department
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	Some sites do not have Parcel No.

Variable name	BUILDING NAME
Description	Name of site
Methodology	Provided by City of Pittsburgh Department of Public Works
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	STREET NO.
Description	Site street address number
Methodology	Provided by City of Pittsburgh
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	STREET
Description	Site street name
Methodology	Provided by City of Pittsburgh
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	ZIP
Description	Site street zip code
Methodology	Provided by City of Pittsburgh
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	PRIMARY USAGE
Description	Site's primary usage identified by City of Pittsburgh Office of Finance record and Public Works record
Methodology	Provided by City of Pittsburgh
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	PROPERTY TYPE
Description	Identifies five broad categories organizing each site into easy to understand groupings of site properties by EIA building type.
Methodology	Provided by University of Pittsburgh team
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	http://www.eia.gov/consumption/commercial/building-type-definitions.cfm

Variable name	SQUARE FOOTAGE
Description	Square footage known for each site
Methodology	Provided by City of Pittsburgh Department of Public Works
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	NEIGHBORHOOD
Description	City of Pittsburgh neighborhood where site is located
Methodology	Provided by City of Pittsburgh GIS Department
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	Different departments list the same building in different neighborhood. This database uses neighborhoods defined by City of Pittsburgh GIS Department

Variable name	DISTRICT
Description	City of Pittsburgh contains 9 districts groupings neighborhoods into larger segments for council jurisdiction / representation
Methodology	Provided by City of Pittsburgh
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	WARD
Description	City of Pittsburgh contains 32 wards, dividing the city into smaller segments for administrating of jurisdictions
Methodology	Provided by City of Pittsburgh
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	PUBLIC ACCESS
Description	Is the public allowed to access site (yes or no)
Methodology	Physical observation of site and analysis of primary usage
Missing Data	None
Responsibility Center	Use Team
Privacy / Access Issues	None
Special Notes	

Variable name	EUI
Description	2013 energy intensity data which is the measure of the energy efficiency. That is total energy use divided by square foot
Methodology	Taken from Portfolio Manager and merged to dataset using Building Name
Missing Data	None
Responsibility Center	Energy Team
Privacy / Access Issues	None
Special Notes	

Variable name	% BETTER THAN NATIONAL MEDIAN
Description	Portfolio Manager compares building's EUI against other buildings nationwide
Methodology	Taken from Portfolio Manager and merged to dataset using Building Name
Missing Data	None
Responsibility Center	Energy Team
Privacy / Access Issues	None
Special Notes	

Variable name	ENERGY COST
Description	2013 energy cost
Methodology	Taken from Portfolio Manager and merged to dataset using Building Name
Missing Data	
Responsibility Center	Energy Team
Privacy / Access Issues	None
Special Notes	

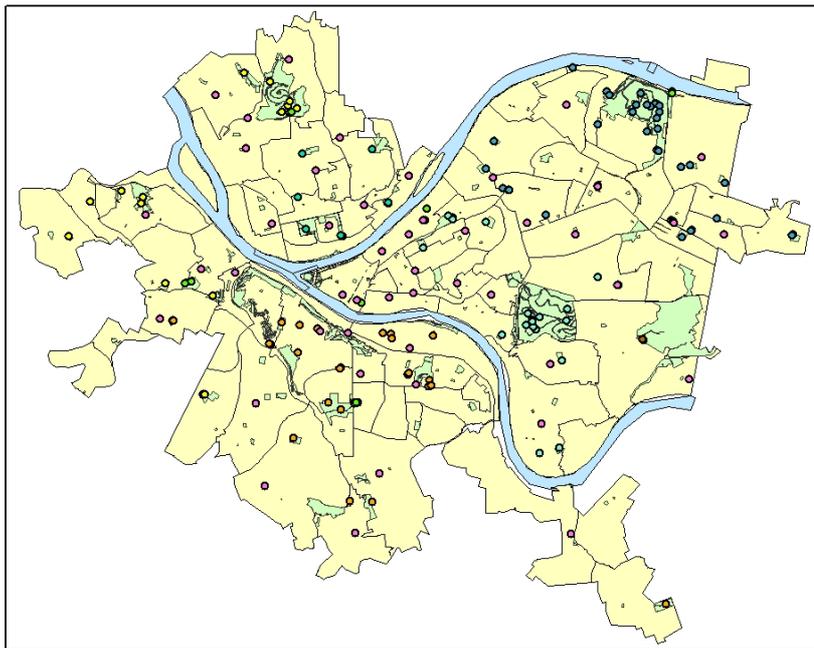
Variable name	PORTFOLIO MANAGER BUILDING NAME
Description	Building name as listed in portfolio manager. This serves as a record of how the data was merged with the full database
Methodology	
Missing Data	None
Responsibility Center	Energy Team
Privacy / Access Issues	None
Special Notes	

Variable name	NOTES
Description	Additional information from our research
Methodology	Physical observations of sites and notes taken during energy evaluation
Missing Data	None
Responsibility Center	All teams
Privacy / Access Issues	None
Special Notes	



GIS Map Layout

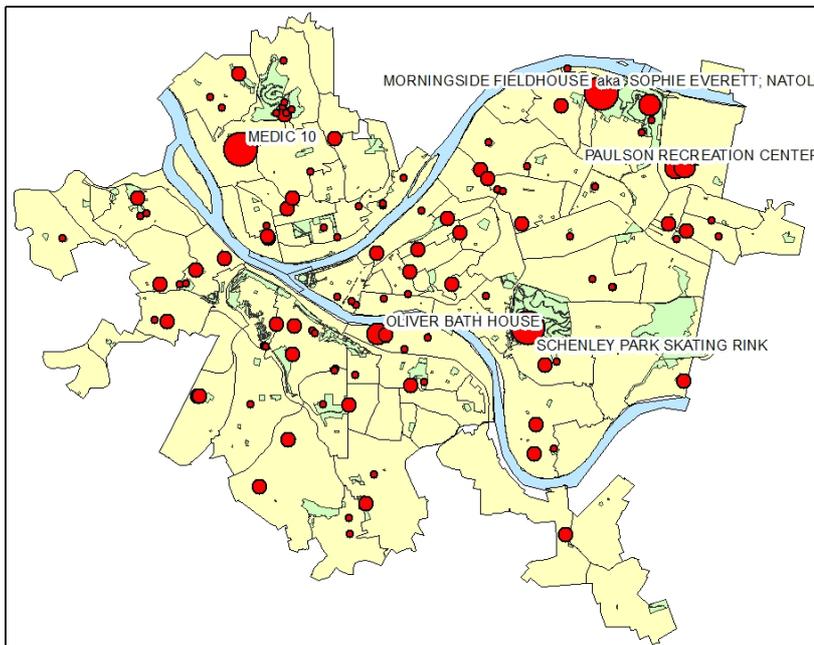
Location and energy usage of Pittsburgh city facilities



Location and Energy Usage of Pittsburgh City Facilities

Legend Building Location by Department

- DPW
- FP
- GS
- NW
- PC
- PE
- PS
- TN



Legend EUI

- <150
- 151 - 300
- 301 - 450
- 451 - 500
- >500

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+ Database & GIS

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The Inventory of Pittsburgh City Facilities

Fall 2014 Capstone Project

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