PITTSBURGH 2030 DISTRICT ENERGY BASELINE

PITTSBURGH
2030
DISTRICT

GREEN
BUILDING
ALLIANCE
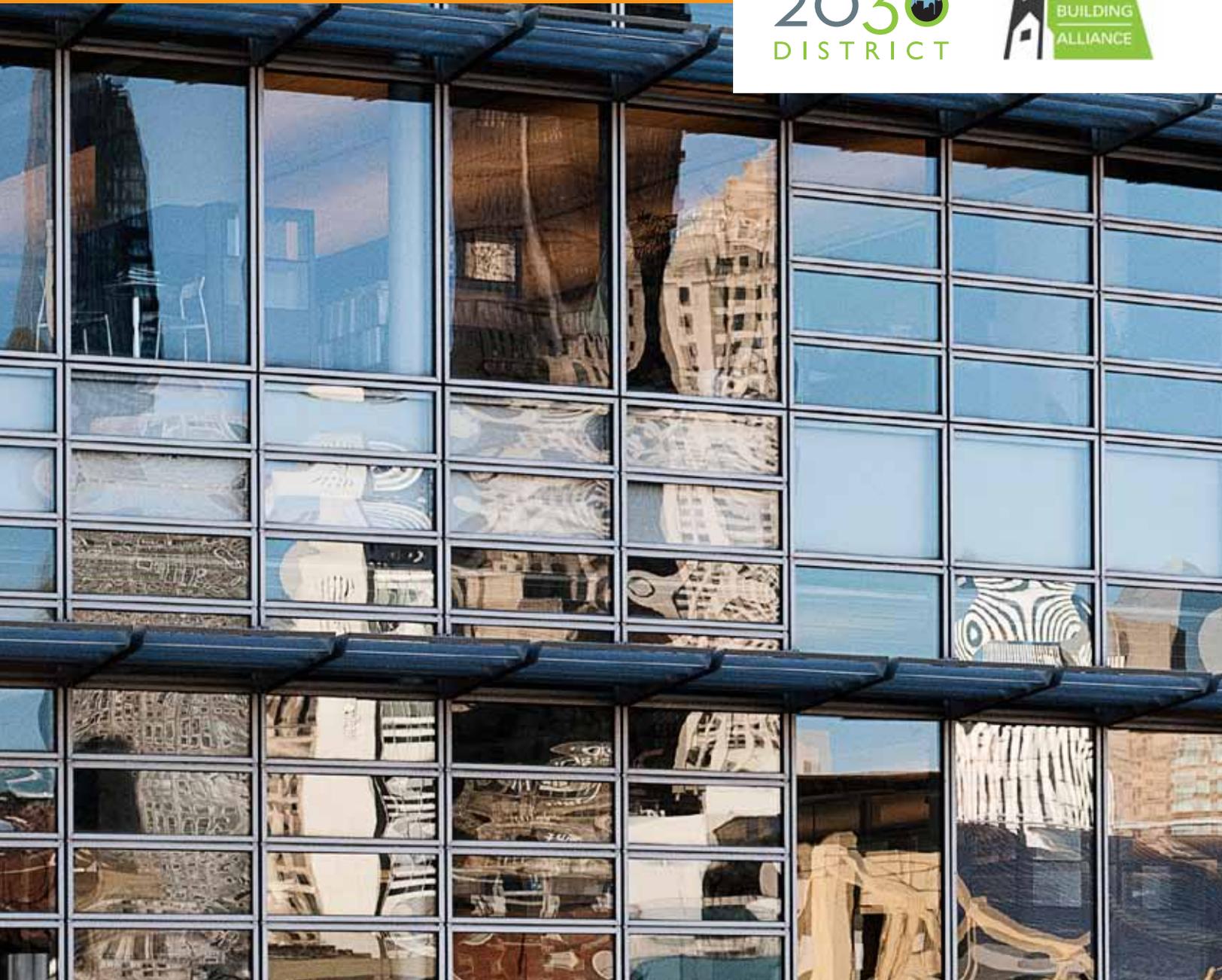
ABOUT THE PITTSBURGH 2030 DISTRICT

The Pittsburgh 2030 District is a collaborative community of high performance buildings in Downtown Pittsburgh working towards 50% reductions in energy use, water use, and transportation emissions by 2030, with new construction reaching carbon neutrality by the year 2030. Pittsburgh is also pioneering an indoor air quality target for 2030 Districts nationwide.

In order to measure the Pittsburgh 2030 District's success in reaching these 50% reduction goals, we must first determine baselines for each reduction category. The reduction goals are measured against a national baseline for energy and against District baselines for water and transportation. As
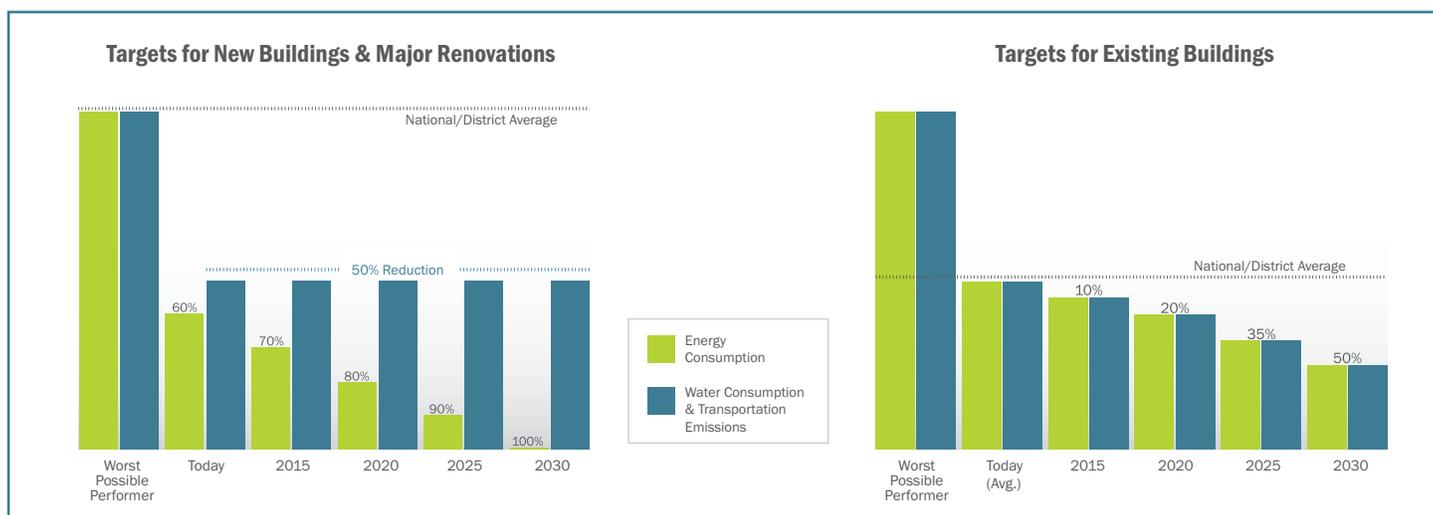
properties commit to and work towards 2030 goals, the individual baselines against which they are measured become very important. This document offers details about the District's energy baseline for individual buildings – as well as the implications for aggregate District energy use and reductions.

BUILDING-SPECIFIC ENERGY BASELINES

In accordance with The 2030 Challenge[1], the energy performance baseline for 2030 Districts nationwide is determined individually for each building using national median building energy consumption values based on 2003 Commercial Building Energy Consumption Survey (CBECS) data[2]. Produced by the Energy Information Association (EIA), a sub-agency of the U.S. Department of Energy, CBECS is a national survey of a representative set of commercial buildings across the U.S. that includes their energy costs, consumption, and energy-specific characteristics. CBECS data has been analyzed to determine national and regional medians of whole building *site* energy use intensity (EUI), which is a building's annual energy use divided by its gross square footage (measured in kBTU/ft^2/yr). Generally, a lower EUI indicates better building energy performance, but EUIs vary widely by building use.

The Pittsburgh 2030 District has compiled *estimated* national median energy

>> We measure the performance of cars with MPG, baseball pitchers with ERA, and buildings with Energy Use Intensity (EUI). EUI measures a building's annual energy performance normalized by its gross square footage.

A national median baseline EUI can help a building benchmark itself and compare ongoing improvement against itself and others. Using Energy Star Portfolio Manager to track performance can also put a building on the path to achieving the Energy Star label, which means it performs better than at least 75% of buildings nationwide.

[1] Architecture 2030. (2007). "The 2030 Challenge Benchmark Set: Building Design Leaders Unite on Energy Reduction." May 4, 2007. architecture2030.org/file_download/25/Press_Release_5_4_07.pdf. Accessed 3 October 2013.

[2] U.S. Energy Information Administration. (2008). 2003 Commercial Building Energy Consumption Survey (CBECS). www.eia.gov/consumption/commercial/index.cfm. Accessed 26 September 2013.

baselines for building use types in Downtown Pittsburgh, shown below in Table 1 and Figure 1. These energy baselines assume default values for all building-specific characteristics (e.g., operating hours, occupancy, etc.). As the "Energy Baseline" columns of Table 1 indicate, the median site EUI for certain building use types is dependent on building square footage (use types with formulas), while other use types have static EUI estimates regardless of square footage.

Due to the fact that they are based on default assumptions, the values in Table 1 should only be used as baseline estimates in evaluating how a building may or may not be achieving 2030 Challenge goals. Guidance on determining building-specific baselines is provided below the illustrations.

Table 1: Energy Baseline Estimates for Single Use Buildings in Pittsburgh 2030 District [3]

BUILDING USE	ESTIMATED ENERGY BASELINE: MEDIAN SITE EUI (κBTU/FT²/YEAR)	
	Static	Variable
Bank or Financial Institution	-	$Y = (3E\text{-}17) * SF^4 - (4E\text{-}12) * SF^3 + (2E\text{-}7) * SF^2 - 0.0039 * SF + 140$
Convenience Store	286	-
Courthouse	-	$Y = 16.664 * \ln(SF) - 61$
Entertainment (Public Assembly)	46	-
Entertainment (Recreation)	64	-
Fast Food	542	-
Fire or Police Station	82	-
Grocery Store	-	$Y = (6E\text{-}27) * SF^6 - (2E\text{-}21) * SF^5 + (3E\text{-}16) * SF^4 - (2E\text{-}11) * SF^3 + (6E\text{-}7) * SF^2 - 0.0091 * SF + 365$
Higher Education	165	-
Hospital	-	$Y = (3E\text{-}34) * SF^6 - (1E\text{-}27) * SF^5 + (3E\text{-}21) * SF^4 - (3E\text{-}15) * SF^3 + (2E\text{-}9) * SF^2 - 0.0006 * SF + 320$
Hotel	98	-
Industrial	200	-
K-12 School	-	$Y = -11.39 * \ln(SF) + 219$
Library	156	-
Medical Office	-	$Y = 13.78 * \ln(SF) - 42$
Multifamily Housing	50	-
Nursing or Assisted Living	144	-
Office (<200,000 SF)	-	$Y = 14.17 * \ln(SF) - 52$
Office (≥200,000 SF)	116	-
Parking (Fully Enclosed)	11	-
Parking (Partially Enclosed)	9	-
Place of Worship	44	-
Residence Hall/Dormitory	-	$Y = -9.42 * \ln(SF) + 218$
Residential	95	-
Restaurant or Cafeteria	230	-
Retail (Enclosed Mall)	95	-
Retail (Non-Mall)	62	-
Retail Store	-	$Y = 9.05 * \ln(SF) + 8.0706$
Service	61	-
Warehouse	-	$Y = 5.76 * \ln(SF) - 25$
Other	66	-
Y = Energy Baseline Estimate; ln = Natural Logarithm; SF = Building Square Footage		

[3] U.S. Environmental Protection Agency (2013) "Energy Star Target Finder." https://portfoliomanager.energystar.gov/pm/targetFinder;jsessionid=92A780906D7F50D53B5C9D2F507EB1CE?execution=e1s1.

BUILDING TYPE:	Median Site EUI (kBTU/ft²/year)
Fast Food	542
Convenience Store	286
Restaurant or Cafeteria	230
Industrial	200
Higher Education	165
Library	156
Nursing or Assisted Living	144
Office (>200,000 ft²)	116
Hotel	98
Retail (Enclosed Mall)	95
Residential	95
Fire or Police Station	82
Other	66
Entertainment (Recreation)	64
Retail (Non-Mall)	62
Service	61
Multifamily Housing	50
Entertainment (Public Assembly)	46
Place of Worship	44
Parking (Fully Enclosed)	11
Parking (Partially Enclosed)	9

Figure 1: Pittsburgh 2030 District Static Estimated Energy Baselines for Single Use Buildings Sorted by Magnitude

ENERGY BASELINES FOR EXISTING BUILDINGS

In order to calculate an accurate national median energy baseline for each existing building in a 2030 District, specific information about location, space use profile, number of regular occupants, operating hours, and other parameters must be used. Though there are other means, the easiest and most accurate method for existing buildings to determine their specific energy baseline is by using Environmental Protection Agency's (EPA) Energy Star Portfolio Manager tool[4]. Due to the way most Pittsburgh buildings are heated and cooled, the District recommends that existing buildings designate vacant upper floors as a "Warehouse" use type instead of as "Vacant."

ENERGY BASELINES FOR NEW CONSTRUCTION & MAJOR RENOVATIONS

New construction or major renovations (as defined by Architecture 2030[5]) can estimate their predicted national energy baselines using EPA's Energy Star Target Finder tool[6]. This free, online tool uses CBECS data to calculate national energy baselines using building type, zip code, occupancy, and operating hours. Design teams using Target Finder to estimate the Pittsburgh 2030 District energy consumption target for new construction or major

renovations should choose an "Energy Reduction Target" of 60% below the national energy baseline and skip "Section 4, Estimated Design Energy" to ensure that the baseline is an average building with an average fuel mix. The 60% reduction is applicable through 2014. Starting in 2015, projects should choose 70%, as indicated by the 2030 Challenge goals for new construction and major renovations.

UNIQUE BUILDING TYPES

Building types not available (or not adequately estimated) in Portfolio Manager or Target Finder should use the national energy consumption median estimates from the *EPA Portfolio Manager Technical Reference: U.S. Energy Use Intensity by Property Type*[7], which are based on 2003 CBECS data and additional EPA information. This table provides national median EUIs for unique use types, most of which are included in Table 1 above.

If a building use type is not covered by Portfolio Manager or Target Finder, property partners should reach out to Pittsburgh 2030 District convener, Green Building Alliance, which continues to work with Architecture 2030 to develop internal baselines for use types that do not yet exist nationally (e.g., museums, convention centers, etc.).

PARKING STRUCTURES

Energy Star Portfolio Manager and other existing sources do not include "Parking" in building specific baseline calculations, nor do they adequately account for parking uses in a building's EUI. For that reason, the Pittsburgh 2030 District has calculated a national parking baseline that can be used to accurately calculate a property-specific energy baseline that accounts for large, attached enclosed or partially enclosed parking garages that are not sub-metered. These parking EUI values (which apply nationally) are provided in Table 1; their calculation methods are briefly summarized below.

The *Energy Star Performance Ratings: Technical Methodology for Parking*[8] estimates that unenclosed parking structures use 0.30 W/ft2, all attributed to 24/7 lighting, as ventilation is assumed to naturally occur as a result of the open walls. Using this lighting power density multiplied by 8,736 hours per year, the site EUI of unenclosed parking garages is estimated at 8.9 kBTU/ ft2/ year (2.6 kWh/ ft2/year).

The same method was used for enclosed parking structures, for which the *Energy Star Performance Ratings: Technical Methodology for Parking* assumes the same 24/7 lighting power density of 0.30 W/ft2 and a ventilation power density of 0.4529 W/ft2. Multiplying the sum of for 6 hours per day and 0.01 W/
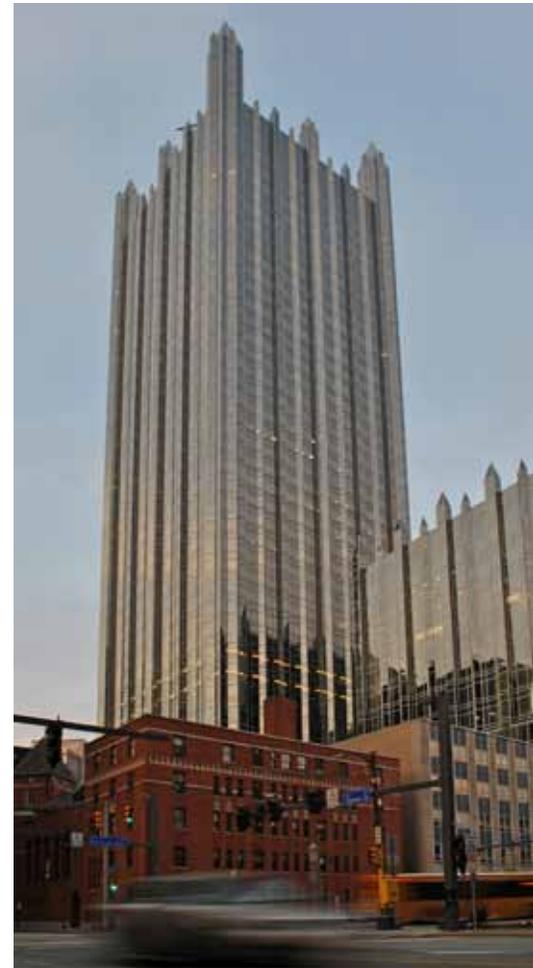
[7] U.S. Environmental Protection Agency. (2013). "Energy Star Portfolio Manager Technical Reference: U.S. Energy Use Intensity by Property Type." July 2013. https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf

[8] U.S. Environmental Protection Agency. (2007). "Energy Star Performance Ratings: Technical Methodology for Parking." October 2007. http://www.energystar.gov/buildings/sites/default/uploads/tools/ENERGY%20STAR%20Score%20for%20Parking.pdf?74ea-84cc

ft^2 for 18 hours per day. Aggregating these power densities by for 8,736 hours of operation per year, the site EUI of enclosed parking garages is estimated to be 22.311.4 kBTU/ ft^2/year (6.53.3 kWh/ ft^2/year).

As with any building, a more accurate baseline can be calculated for solitary or included parking if structure-specific operating hours and detailed parking information is provided. To date, Green Building Alliance has used the calculations above to determine more accurate energy baselines for buildings with non-sub-metered parking structures.

REPORTING ANNUAL ENERGY USAGE TO GBA

Once a building's baseline is determined, the Pittsburgh 2030 District recommends that existing buildings continue to use the free, online Portfolio Manager tool to track their annual energy use with utility bill information. Once a building has entered at least 12 months of building details, Portfolio Manager provides national median energy baseline EUIs for each building that is specific to that building's use, size, and geography. This national energy baseline is based on the 2003 CBECS national median EUI data; a building performing at its baseline level is performing at the national median – and better than 50% of comparable buildings nationwide. Portfolio Manager also allows buildings to track water use and renewable energy use, making it a multifunctional tool.

Through December 2011, EnergyStar Portfolio Manager had been used by over 267,000 buildings in all 50 states, totaling over 28 billion square feet of space (almost 40% of the commercial market)[9]. Of these properties, EPA found that organizations that consistently use Portfolio Manager to benchmark have achieved average energy savings of 2.4% per year[10].

Pittsburgh 2030 District Property Partners who already use Portfolio Manager can track and share both their energy and water use information with the Pittsburgh 2030 District through Portfolio Manager, which makes this tool multifunctional. Instructions to do this are available online at 2030district.org/pittsburgh/existingpmaccount.

GBA will work with Pittsburgh 2030 District Property Partners who do not have an existing Portfolio Manager account. Easy instructions to get started with Portfolio Manager are online at: 2030district.org/pittsburgh/newpmuser Partners who are not interested in using Portfolio Manager can work with GBA to comply with annual reporting using other performance tracking tools.

All building performance information shared with GBA remains individually confidential unless otherwise specified by a Property Partner.

[9] *U.S. Environmental Protection Agency. (2012). "Data Trends: Energy Use Benchmarking." October 2012. energystar.gov/buildings/sites/ default/uploads/tools/DataTrends_Energy_20121002.pdf?8974-74b8.*

[10] *U.S. Environmental Protection Agency. (2012). "Data Trends: Benchmarking and Energy Savings." October 2012. energystar.gov/buildings/ sites/default/uploads/tools/DataTrends_Savings_20121002.pdf?fbb9-6e51.*

AGGREGATED DISTRICT-WIDE ENERGY OPPORTUNITY

To fully comprehend the magnitude of the opportunity the Pittsburgh 2030 District represents, GBA has aggregated actual and estimated property-specific energy baselines to create a single estimate of annual median baseline energy use for the entire District. Using the methods summarized below, GBA estimates that all buildings in the Pittsburgh 2030 District would consume 5.6 TBtu of energy annually if they were operating at their baselines. Thus, if every building in the District was committed to and met the 2030 Challenge goals of 50% energy reductions, the entire District would achieve annual reductions of 2.8 TBtu by the year 2030. Given the October 2013 commitments by 100 buildings, current commitments are to achieve annual reductions of 0.8 TBtu by the year 2030.

DISTRICT-WIDE METHOD

Through October 2013 and as shown in Figure 2, GBA estimated that there are 452 buildings representing 55.2 million square feet in the Downtown boundary of the Pittsburgh 2030 District. Of these properties, 100 were committed to Pittsburgh 2030 District goals – with 42 reporting annual energy consumption to GBA. Thus, GBA had accurate square footages and use profiles for these 42 buildings – and was able to aggregate definitive property-specific median EUI energy baselines for these 42 buildings, as they were calculated by Energy Star Portfolio Manager. For the other 58 buildings committed to the Pittsburgh 2030
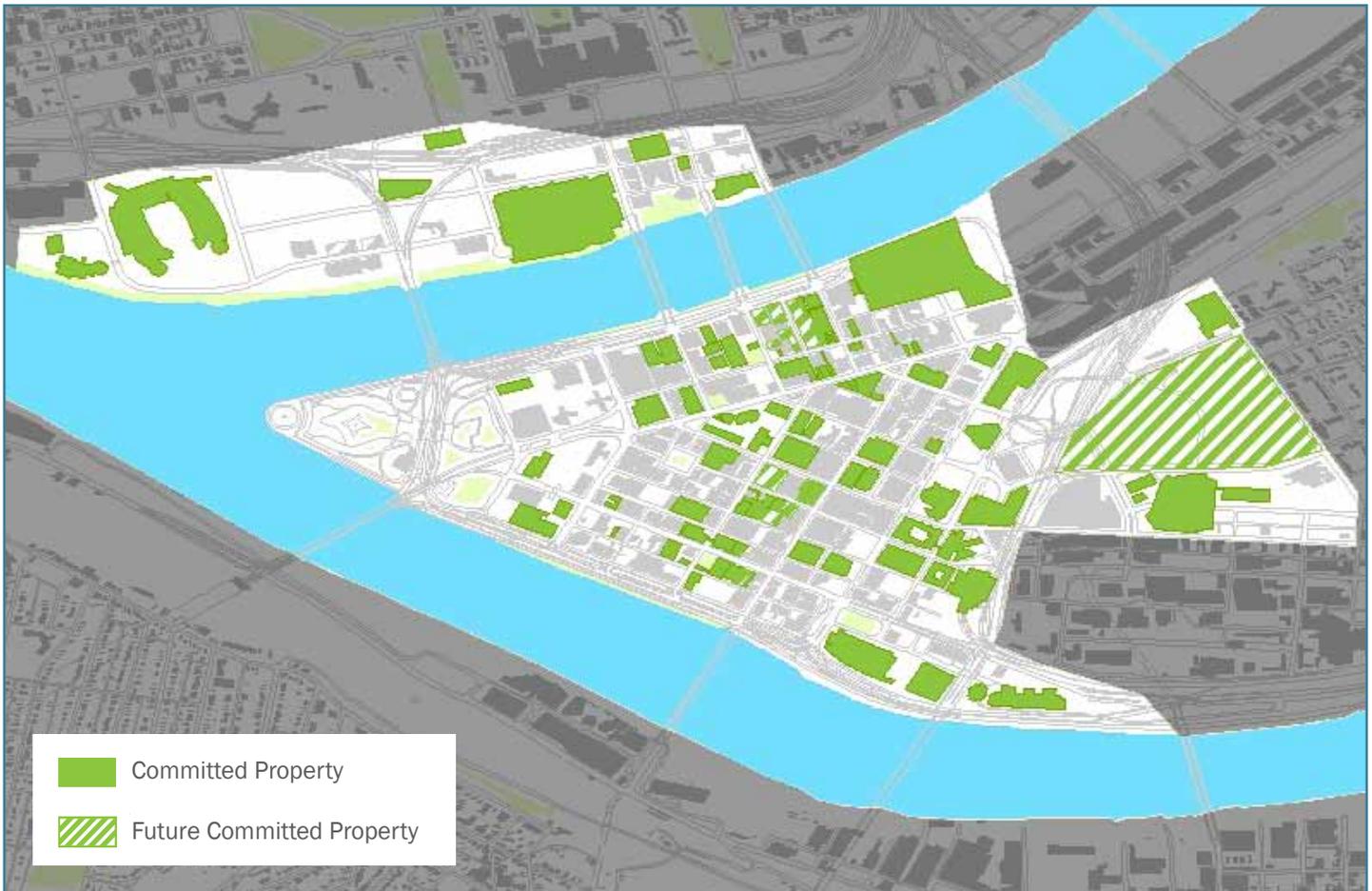

Committed Property

Future Committed Property

Figure 2: Pittsburgh 2030 District Downtown Boundary and Building Footprints, October 2013.

District, GBA had accurate square footage information and varying qualities of building use profiles. For the 348 buildings not committed to Pittsburgh 2030 District goals as of October 2013, GBA used public, private, or estimated information on both gross building square footage and use types to estimate property-specific baselines.

Buildings assigned a single use type were easily assigned estimated baselines from Table 1. EUIs for buildings with multiple uses were determined by calculating a weighted EUI average for the entire building based on the square footage distribution of building use types. Any buildings demolished during 2012 and 2013 were assumed to be vacant land and are not included in these calculations.

Following the completion of these estimates, EUIs for all 452 buildings in the Pittsburgh 2030 District boundary were aggregated, yielding an estimate that all buildings in the Pittsburgh 2030 District would consume 5.6 TBtu of energy annually if they were all operating at their baselines. Thus, if every building in the District was committed to 2030 Challenge goals, the entire District could achieve annual reductions of 2.8 TBtu by the year 2030. Given the October 2013 commitments to 2030 goals by 31.7 million square feet of real estate (100 buildings), current commitments are to achieve annual reductions of 0.8 TBtu by the year 2030. Though the committed buildings represented 54% of Downtowns's square footage, they represent fewer than 30% of potential reductions - primarily due to building use type particulars.

The 65+ Property, Community, and Resource Partners of the Pittsburgh 2030 District are working to individually and aggregately achieve the goals of the 2030 Challenge today. These measurable, time-bounded goals inspire us to achieve them – and we hope our pursuit of them inspires you in turn. **Join us!**