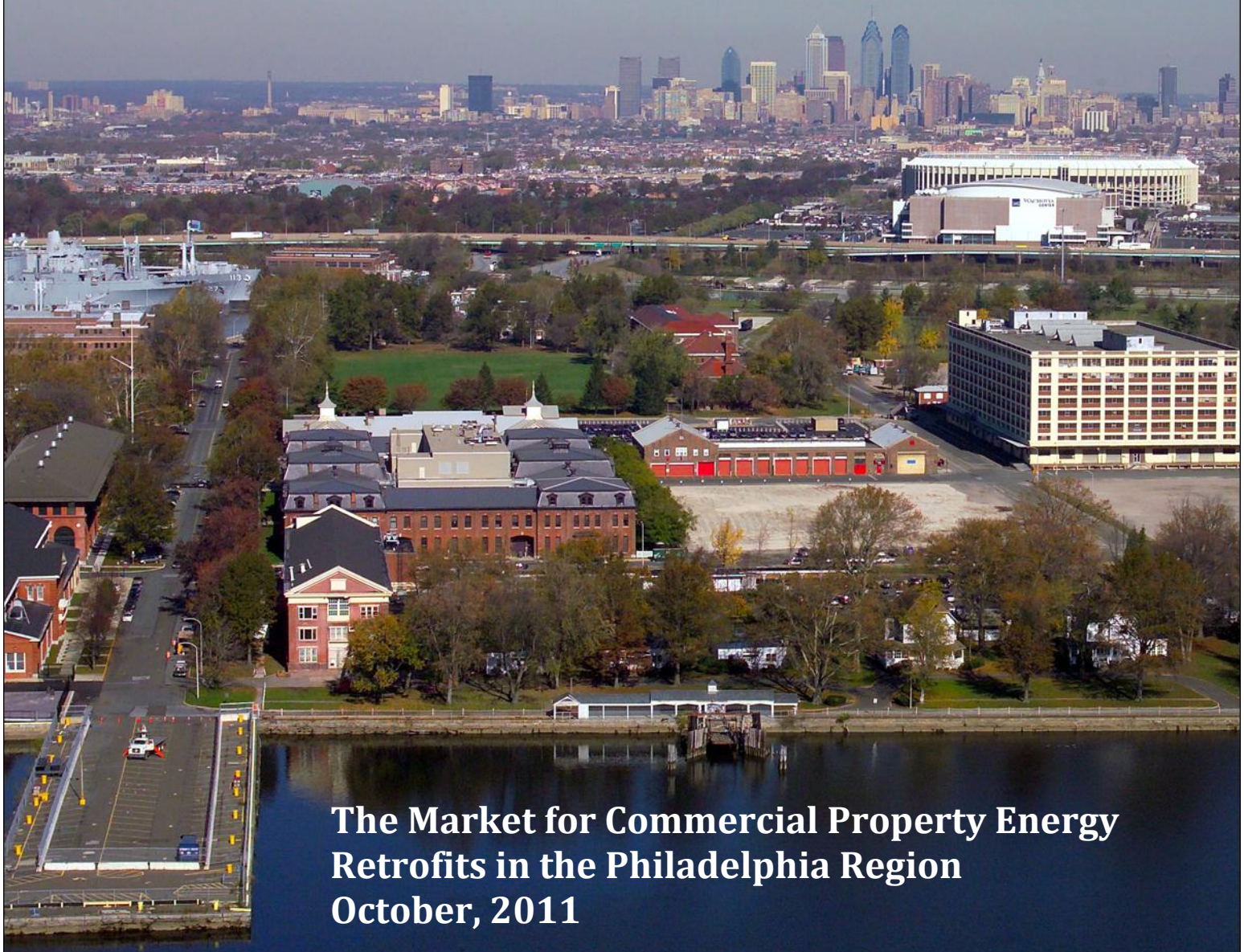
GPIC HUB

Greater Philadelphia Innovation Cluster
for Energy-Efficient Buildings
A U.S. DOE Energy Innovation Hub



The Market for Commercial Property Energy Retrofits in the Philadelphia Region
October, 2011

Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings
Policy Markets and Behavior Task Team

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Background:

The Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings is a consortium of academic institutions, federal laboratories, global industry partners, regional economic development agencies and other stakeholders that joined forces to secure up to $130 million in federal grants, including $122 million from the Department of Energy to establish an Energy Innovation Hub. The Commonwealth of Pennsylvania has also committed $30 million of new capital funding to support GPIC facilities at The Navy Yard. The funding will foster national energy independence and create quality jobs for the region.

The goals of GPIC, located at The Navy Yard in Philadelphia, are to improve energy efficiency and operability and reduce carbon emissions of new and existing buildings, and to stimulate private investment and quality job creation in the Greater Philadelphia region, the larger Mid-Atlantic region, and beyond. The GPIC will focus on full spectrum retrofit of existing average size commercial and multi-family residential buildings.

GPIC is supported by over 70 partners from industry associations, workforce investment boards, economic development agencies, banks and financial institutions and community organizations.

GPIC activities are organized into 6 task areas:

1. **Design Tools**- The goal of this task is to deliver accessible and affordable, calibrated and validated computer based tools built on open architecture to support integrated design of energy efficient retrofit projects by architects and engineers focused on average size commercial and multi-family residential buildings.
2. **Integrated Technologies**- The goal of this task is to develop and deliver optimal configurations of integrated technologies and system solutions for energy efficient retrofit of commercial buildings of varying functionality, size, and aspect ratio, as well as multi-family residential buildings.
3. **Policy, Markets and Behavior**- The goal of this task group is to create public policy and business market environments that support full-spectrum energy efficient retrofit of average size commercial and multi-family residential buildings in Greater Philadelphia.
4. **Education and Workforce Development**- The goal of this task is to ensure a skilled workforce at all levels in the energy efficient buildings sector in Greater Philadelphia.
5. **Deployment and Commercialization**- The goals of this task are to transform the building industry from a serially fragmented method to an integrated systems approach and to create new jobs in Greater Philadelphia
6. **Collaborative Demonstration Projects**- The goals of this task are to demonstrate the performance of GPIC-coordinated, system-integrated and operational technologies, policies, business models, workforce development approaches, and process integration methods in the retrofitting of buildings at the Navy Yard and other sites in the Greater Philadelphia region.

This material is based upon work supported by the Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings an energy innovation HUB sponsored by the Department of Energy under Award Number DE-EE0004261.

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INTRODUCTION AND MOTIVATION

The Greater Philadelphia Innovation Cluster (GPIC) for Energy Efficient Buildings is a consortium that recently received a $129 million from the Federal Government's Energy Regional Innovation Cluster (E-RIC) Initiative. The award included $122 million from the U.S. DOE to create an Energy Innovation Hub to develop innovative energy efficient building technologies, designs and systems. As part of this initiative, GPIC contracted for a series of preliminary analyses, or "Baseline Reports" to give further structure and detail to the overall project. GPIC retained Econsult to develop an estimate of the size and characteristics of the potential regional market for energy saving building retrofits. Specifically, Econsult was asked to perform the following tasks:

- Deliver a description of the region's commercial and institutional building stock, including: building type and use, age, size, energy profile by source and consumption, operations and maintenance structure, ownership, data and size of capital investments in these buildings since initial construction, and geo-coding.

- Deliver a description of the region's market activity in building retrofit for this stock: the number of retrofits, ranging from individual component replacement, like windows or mechanicals, to fully integrated retrofits, that includes the size of these projects, the firms who compete to do them and the number of jobs associated with this activity.

- Undertake an assessment of how these two might combine to provide an estimate of the potential market for commercial and institutional building energy efficient retrofits. How many potential commercial and institutional energy efficiency projects are out there: by building, by square footage, by budget, by owner and portfolio? How many jobs by wage and skill-level are implicated in a ramp-up to those projects?

The Philadelphia area is a large, older, formerly industrial metropolitan area in the northeastern U.S. Its stock of commercial properties is generally more aged than the average U.S. metropolitan area, and hence would seem a likely candidate for energy retrofits to reduce both its energy consumption and utility expenditures[1]. To examine for the veracity of this, the following table gives the average energy expenditure ($/SqFt) for commercial properties in major U.S. cities, broken down between suburban and urban properties. This definition of energy includes "electric, gas, fuel oil, purchased steam,

[1] Throughout the report we use "Philadelphia," "Philadelphia area," "Philadelphia region" to mean the 10-county, 2-state metro area, which does not include New Castle County, DE. When referring to the city proper, the report so notes.

purchased chilled water, and water/sewage expenditures[2]". The table is sorted by expenditure, from least to largest.

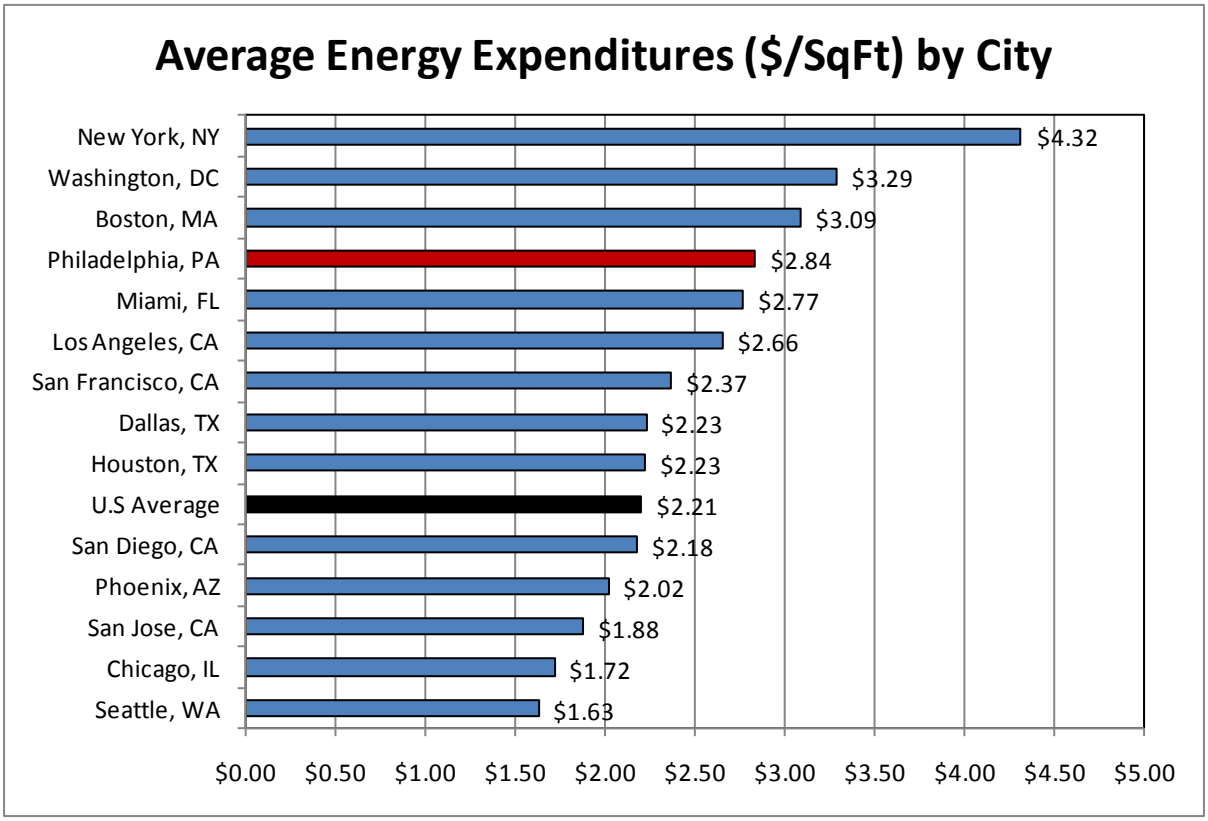
Average Annual Energy Expenditure ($/SqFt) by City

City	Urban	Suburban	Average
Seattle, WA	$1.51	$1.75	$1.63
Chicago, IL	$1.72	N.A.	$1.72
San Jose, CA	N.A.	$1.88	$1.88
Phoenix, AZ	$2.23	$1.81	$2.02
San Diego, CA	$2.67	$1.69	$2.18
U.S Average	**$2.33**	**$2.08**	**$2.21**
Houston, TX	$2.16	$2.29	$2.23
Dallas, TX	$2.27	$2.19	$2.23
San Francisco, CA	$2.55	$2.19	$2.37
Los Angeles, CA	$2.84	$2.47	$2.66
Miami, FL	N.A.	$2.77	$2.77
Philadelphia, PA	$2.81	$2.87	$2.84
Boston, MA	$3.19	$2.99	$3.09
Washington, DC	$3.29	N.A.	$3.29
New York, NY	$4.32	N.A.	$4.32

Source: BOMA International, The Experience Exchange Report 2010, 2010

The (unweighted) average energy expenditure across suburban and urban properties was computed for each city. The following chart ranks these cities by their average annual energy expenditure.

[2] Source: BOMA International, The Experience Exchange Report 2010, 2010



Source: BOMA International, The Experience Exchange Report 2010, 2010

The typical Philadelphia commercial property spends $2.84/ft per foot per year on energy costs. By contrast, the average U.S. commercial property spends $2.21 per foot per year. Thus, Philadelphia's energy expenditures are 29% above than the national average, and the fourth-highest in this sample of major cities.

We now examine the current stock of commercial properties to examine how many may already be benefitting from energy-efficient designs. The following table gives the total stock of commercial properties for both the U.S. and GPIC region, broken down by the total v. eco-labeled; e.g. having Energy Star or LEED certification:

Commercial Stock: U.S. v. Philadelphia Region

	U.S.	Philadelphia Region
Total Stock: SqFt (m)	77,900	399
Total Stock eco-Labeled*: SqFt (m)	1,764	72
Pct of Stock eco-Labeled	2.3%	18.1%

Source: U.S. DOE, USGBC, DVGBC

As the table indicates, there is currently 399m SF of commercial and industrial space in the GPIC region, of which 72m SF is eco-labeled. With just over 18% of its total stock being

eco-labeled, Philadelphia is actually well above the national average for the percent of its space having energy-efficient attributes.

The fact that Philadelphia is above-average in its energy expenditures for commercial buildings, yet also above-average in the percent of its space which is supposedly energy-efficient would seem to be contradictory. However, only 403 buildings out of the region's stock of 9,500 commercial properties, or just over 4% of building, account for this 18% of total eco-labeled space. Hence, Philadelphia's stock of eco-labeled properties is actually concentrated in just a few, very large buildings; e.g. Comcast HQ in Center City. So, the fact that there is a very large quantity of buildings that do not enjoy eco-label status and have above-average energy consumption, combined with the fact that GPIC's mandate is limited to buildings between 20k and 100k SF, would seem to indicate that the Philadelphia region's stock of commercial and industrial properties could substantially benefit from retrofits that would improve their energy efficiency.

The remainder of this report is dedicated to identifying some preliminary quantifications of the size and scope of the market for energy retrofits in this region. It is structured in two parts: (1) establishing a rough estimate of the "retrofitting capacity" of the region's building stock and from this the region's potential energy savings via greater energy efficiency of existing buildings, and (2) measuring the size and scope of the region's "retrofitting industry".

2.0 DATA AND METHODOLOGY

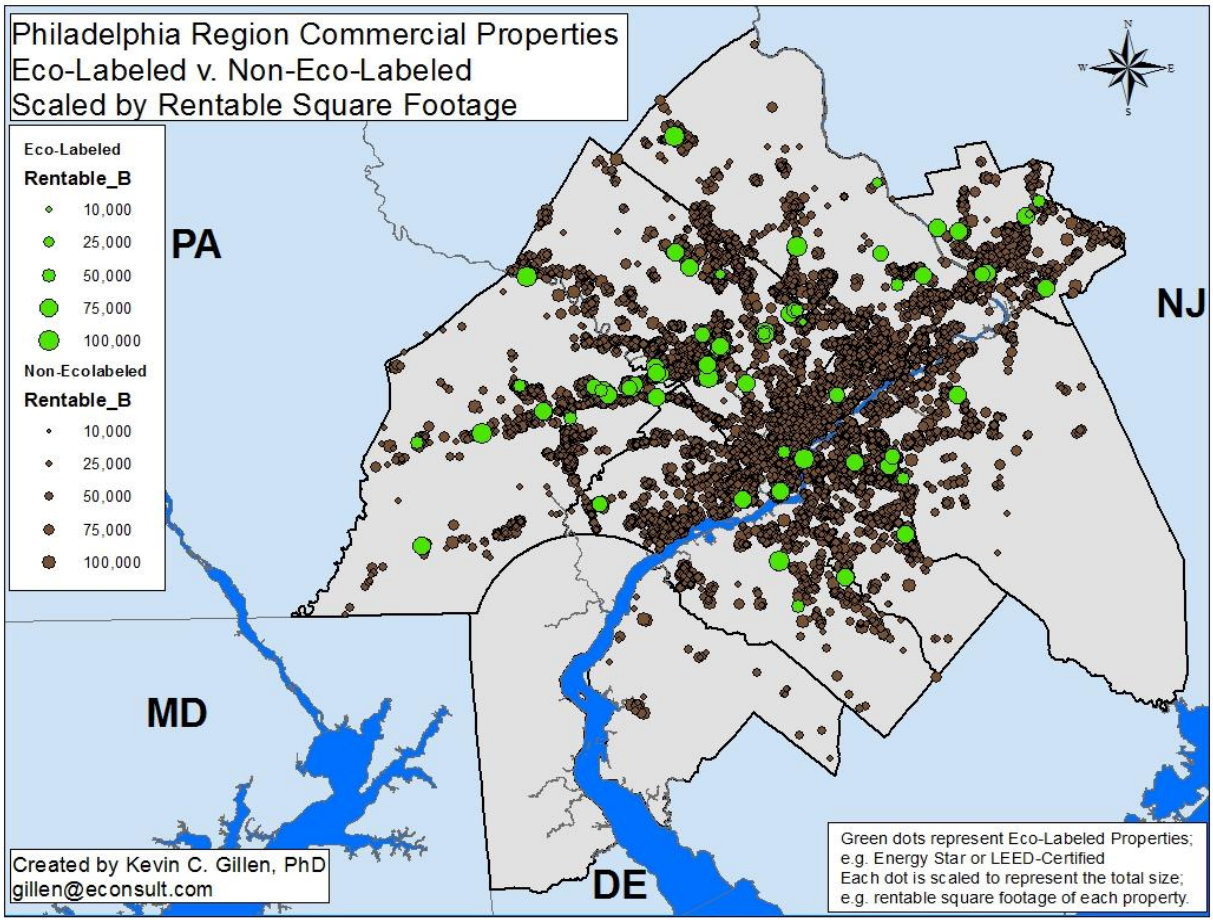
The data on the region's stock of commercial property is from a file was provided by CoStar that contained property-level information on the region's stock of commercial properties which are between 20,000 and 100,000 square feet[3]. The data covers all categories of property types except single-family residential, multifamily residential (e.g. apartment buildings) and government-owned properties. The file contains the subset of the region's building stock that are listed by CoStar, and that are or may become available for lease. It is not the list of total building stock, which no vendor has, but GPIC is currently constructing as part of its Data Group's task effort. The property characteristics included in the data are: location, owner, property type, class of property, square footage, year built, number of floors, type of construction, typical floor size and whether or not the property had an eco-label status; e.g. Energy Star or LEED certification.

In an ideal world, we would have comprehensive data on the region's entire building stock, which would contain detailed information on each property's energy consumption, utility expenditures, lighting density and type, appliance and equipment schedules, type of building envelope, age of HVAC equipment, latent load burden and building ventilation

[3] These buildings are the target for the GPIC effort, and are mandated by its scope to be limited to properties that tend to be too small to have major central power plants. As such, this subset of buildings excludes the largest central city office towers and the largest industrial buildings.

rates. Unfortunately, this data is not commonly recorded and even where it is, it is not typically public information. As such, our empirical work led us to identify what information we had and how it is correlated with the aforementioned metrics, in order to identify which properties were relatively ideal candidates for energy-efficient retrofits. While we recognize the limitations of this approach, it should be understood that they really reflect limitations of the data rather than limitations of our empirical approach. As such, the results in this study should be considered as the first, rather than last word on the potential market for energy-efficient retrofits in the Philadelphia area, and that the limitations of the data used in this study suggest the greater need for the collection of more expansive data within the execution of a more fully-resourced study.

In this data file, there are 9,058 properties, covering a total of 397.5 million square feet in the ten-county metropolitan area[4]. The following map shows the location of all the properties, scaled by their total size (square footage). Eco-labeled properties are represented by green dots.



Source: CoStar

[4] Although New Castle county, Delaware, is considered part of the Philadelphia Metropolitan Statistical Area, it is not included in GPIC's geographic scope.

Of these, there were 71 eco-labeled properties covering 5.1 million square feet; just 1.3% of the entire stock.

Unfortunately, detailed information on the energy consumption, efficiency and expenditures of these properties were not available in this data nor in any other public source we could identify. However, based upon a review of the literature, we were able to identify what property characteristics were correlated with either above-average energy consumption and/or above average expenditures on energy costs. From this research, and based upon the information contained in this data, we devised 6 property-level metrics to identify whether or not an individual building would be likely to benefit from an energy retrofit:

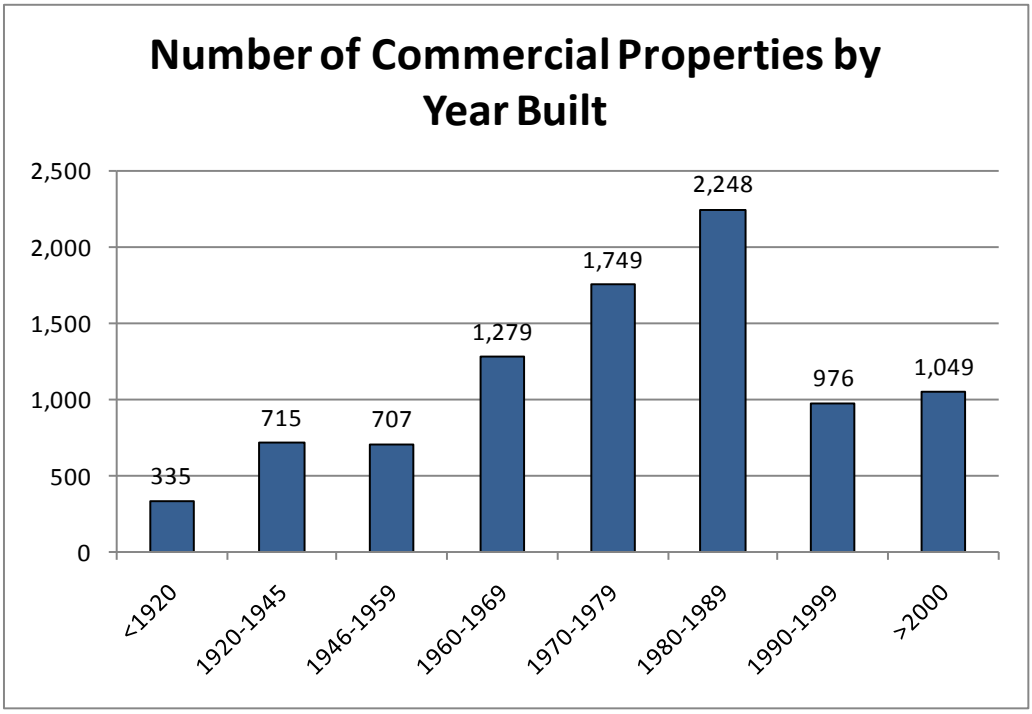
- **Age Index:** Older buildings are likelier candidates for improvements.
- **Property Type Index:** Different property types have different levels of energy consumption.
- **Enclosure Index:** Shorter buildings are more cost-effective candidates for improved energy efficiency via improvements to their envelope or enclosure.
- **Materials Index:** Buildings with masonry exteriors, rather than steel and/or glass, are likelier to have more gaps in their envelope and hence benefit from improvements to their exterior.
- **Internal Load Index:** Buildings in which daylight is unable to penetrate to interior spaces must use greater amounts of synthetic light, which increases their energy consumption.
- **Owner-Concentration Index:** Multiple buildings which are owned by a single entity are easier to retrofit for the purely practical reason that it is logistically and legally easier to deal with one owner rather than several.

The following section gives details on the computation of each index and the number and type of buildings that each index identifies as likely beneficiaries of an energy retrofit.

3.0 THE MARKET FOR ENERGY RETROFITS: ELIGIBLE PROPERTIES

3.1 AGE INDEX

The Age Index measures the age of a building. Age is positively correlated with the need for a retrofit, since older buildings are typically more depreciated, are more likely to have outdated mechanical (e.g. HVAC) systems and are generally less energy-efficient[5]. According to the The Real Estate Roundtable's 2011 Annual Report, any property that is more than twenty years old is identified as "ready for a retrofit[6]". The following figure shows the distribution of commercial properties by the year they were built, for the Philadelphia region:



Source: CoStar

According to the data, 77% of Philadelphia's commercial stock was built prior to 1990, and thus meet's the Real Estate Roundtable's threshold to qualify as a candidate for an energy retrofit. This amounts to 6,962 properties[7] with a total of 304m square feet of space. By contrast, the Real Estate Roundtable reports that 75% of U.S. commercial buildings are more than twenty years old and are thus qualified for consideration of a retrofit. So,

[5] We understand that age and efficiency are not fully correlated, which introduces some variation here.
[6] Real Estate Roundtable 2011 Annual Report, page 24.
[7] This number is less than the sum of properties in the chart because we exclude older properties that have a LEED or Energy Star certification, since they have already likely to have received a retrofit or other energy-related improvements.

Philadelphia's Age Index for commercial retrofits appears to be in line with the national average.

3.2 PROPERTY TYPE INDEX

The Property Type Index is a proxy metric for a building's energy consumption. Since energy consumption or expenditure is not contained in the data, we take advantage of the fact that energy usage is correlated with property type. The U.S. Department of Energy records and reports the average annual energy consumption of different property types, which is measured as thousands of BTU[8]s per square foot. The following table reports this measure, by property type, along with the number of properties in each category in Philadelphia.

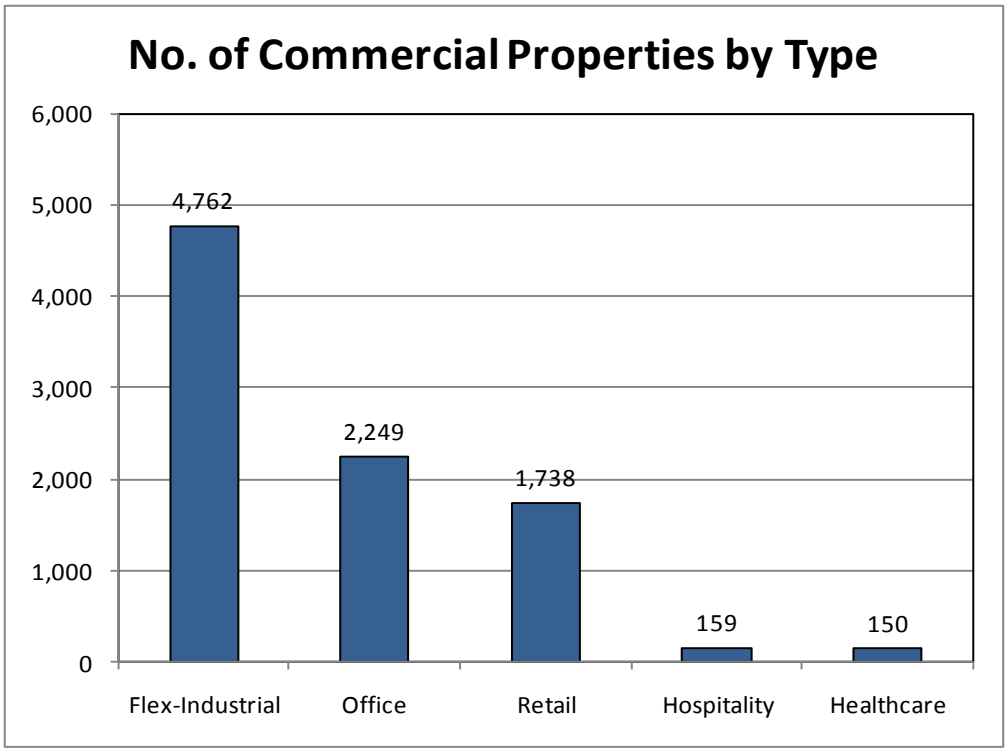
Annual Energy Consumption[9] by Property Type

Type	Energy Consumption	No. of Properties
Flex-Industrial[10]	45	4,762
Office	93	2,249
Retail	99.5	1,738
Hospitality	100	159
Healthcare	188	150
Average	**91**	

Source: Buildings Energy Data Book, Dept. of Energy
http://buildingsdatabook.eren.doe.gov/ChapterIntro3.aspx

The average energy consumption across all categories of property is 91k BTUs/SqFt[11] per year. For the types of property in the Philadelphia area, only Flex-Industrial properties are below the national average in terms of energy consumption, and this is likely due to the preponderance of warehouse properties rather than factories in the data. Office properties are above average in their energy consumption, but only by a small margin. If we only include retail, hospitality and healthcare (e.g. hospitals) in our definition of "significantly above-average" consumers of energy, we can identify the properties that fall into this classification as candidates for retrofits. The following chart shows the distribution of property types in the data:

[8] "BTU"="British Thermal Unit". It is approximately the amount of energy needed to heat one pound of water from 39 to 40 degrees Fahrenheit.
[9] Energy consumption is measured as thousands of BTUs per square foot.
[10] "Flex-industrial" is a standard industry term that includes warehousing, light manufacturing, distribution and can include some office space and even light lab-type research space, in addition to traditional industrial/manufacturing space.
[11] This average is not the average of the numbers in the table because it includes property types that are not in our Philadelphia-area data, such as houses of worship, schools and government-owned properties.



Source: CoStar

The distribution shows an inverse relationship between energy consumption and the number of properties: the greater the energy consumption of a property, the fewer the number of properties. Using our cutoff, only 22% of buildings in the Philadelphia-area data meet the Property Type Index's threshold as "significant" consumers of energy, and thus meet the criteria for a retrofit. After omitting eco-labeled properties from the count, this includes 1,976 buildings with a total of 86.3m square feet.

3.3 RETROFIT INDEX[12]

We define a Retrofit Index as a composite of the three indices that are different measures of a building's energy efficiency: an Enclosure Index, a Materials Index and an Internal Load Index. This was done because the data had significant amounts of missing data for the property-level characteristics that were the inputs to the individual indices. So, we compute the individual indices for the sample of the data that had populated values, and then apply the resulting percentages to the entire population of the data via a composite index. The three component indices are defined as follows:

[12] This index was derived with the significant assistance of Brian Uher, MSE, CPHC LEED AP. Brian Uher is owner of Core Form Design Consulting and Chief Technology Officer of ECoRe Living, LLC Both companies are active in bringing energy efficiency technologies to the real estate industry and are based in Washington, DC. He was trained in biology at the University of Chicago and in molecular biology, engineering and business management at The University of Pennsylvania.

Enclosure Index: High-level data limits us to using averages and other global data related to commercial buildings that are readily available. Using data and findings from Emmerich, et al[13] that suggest primary energy savings (HVAC) from reducing air infiltration averages 20-30% is only cost-effective for low-to-mid-rise buildings of five stories or less, we determined that buildings five stories or below in height are likely candidates for envelope or enclosure improvements, irrespective of age.

Materials Index: It is well known in the industry that physical connections between materials in an exterior wall's assembly often create air leaks as well as thermal bridges. Here, we recognize the potential for corrective action by categorizing the enclosure materials based on likelihood of improvement. We expect that steel frame buildings with glass exteriors have tighter envelopes due to extent of glazing and the likelihood of attention to maintenance requirements. Further, is it described by Emmerich and colleagues that the infiltration rates of wood frame and masonry construction commercial buildings are similar, but also less noticeable than in steel framed and glass exterior buildings, which suggests that a binary metric parsing of enclosure types may be of value. Hence, we identify all non-steel-framed buildings as candidates for a retrofit via tightening of the building's envelope to reduce air and water penetration[14].

Internal Load Index: The actual activities within a commercial space can vary greatly. Except by property type it is difficult to infer much about energy loads from the given data. However, we recognize that lighting is a universal energy expenditure regardless of property type, and that moreover, it is likely related to the size and dimensions of a building's floor area. Also, it is clear from experience with green building design and standards that daylighting is thought to substitute for electric lighting under general conditions. According to the Energy Star building manual (2006)[15], electric lighting accounts for upwards of 35% of electricity use in commercial buildings. We infer here that the architectural standard of 12-foot light penetration through glazing can serve as an approximate basis for a lighting fixture use intensity index, a proxy for retrofit-suited internal loads. We determine the perimeter of the building by the dimensions of its floor area and aspect ratio, and then calculate a percentage of "daylit" space that serves as the relative intensity measure for the building. If more than 50% of a building's floor area is not daylit, then the building must necessarily utilize an above-average amount of synthetic lighting as a necessary substitute, and hence it is likely to cost-effectively benefit from an energy load retrofit.

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[13] Airtightness of Commercial Buildings in the U.S. , Steven J. Emmerich and Andrew K. Persily, Building and Fire Research Laboratory, National Institute of Standards and Technology , Gaithersburg, MD, USA; Impact of Infiltration on Heating and Cooling Loads in U.S. Office Buildings, Steven J. Emmerich, Andrew K. Persily, and Timothy P. McDowell, Building and Fire Research Laboratory, National Institute of Standards and Technology , Gaithersburg, MD USA; NISTIR 7238, Investigation of the Impact of Commercial Building Envelope Airtightness on HVAC Energy Use, Steven J. Emmerich, Tim McDowell, Wagdy Anis

[14] Although we recognize that air leakage is but one measure related to a building's materials, R-value is also another important one, but is not included in the data. Given the dataset's constraints, the other indices infer from age and building type the potential correlated with R value

[15] http://www.energystar.gov/ia/business/EPA_BUM_CH6_Lighting.pdf

While energy consumption for lighting is typically a minority percentage of a building's internal energy load (HVAC usually composes the majority of energy consumption), the lack of information in the data about a building's mechanical systems prevents us from being able to impute anything about each property's total internal load. Consequently, we attempt to divine a reasonable, and thereby conservative, approach.

Overall, the floor and materials index reflect envelope-side opportunities that impact HVAC usage. The Internal Load Index is a proxy for just that: internal loads which include equipment efficiency, controls and waste heat. To stay conservative with the Internal Load Index, we are inferring only opportunities for lighting retrofits and control strategies; e.g. waste heat. Direct HVAC impact is not included in the background computations. Future research will attempt to address the HVAC systems directly, with better empirical data that is able to identify opportunities for HVAC upgrades and equipment efficiency improvements[16].

We define a binary metric for each index. If a property meets or exceeds the critical threshold for each of the three component indices, it is assigned a value of "1", and a value of "0" otherwise. The Retrofit Index is then simply the sum of these values for the three indices. If a property has a value of "3" for its Retrofit Index, then it is identified as a qualified candidate for a retrofit.

The following table reports the number of properties and their Retrofit Index scores:

Retrofit Score	Percent of Properties	Number of Properties	Total Square Footage of Properties
0	0.41%	37	1,598,680
1	2.60%	233	10,191,583
2	17.57%	1,579	68,943,059
3	79.42%	7,138	311,642,610

Source: CoStar

Under our self-defined thresholds, nearly 80% of properties in the Philadelphia region's stock of commercial properties meet the candidacy requirements for consideration of an energy retrofit. This includes 7,138 properties with a total square footage of 311.6m square feet. While this number may seem high, it is close to the percentage offered by the Age Index. Moreover, we recognize that this high number is overwhelmingly driven by the critical threshold used by the Enclosure Index, since over ninety percent of the properties in the data are five stories or less in height. A more stringent index could be created by cross-tabulating building height with age, class or some other metric.

[16] Although building size, as measured by total square footage, is in the data, we chose to omit that as an index for retrofit candidacy because it is a better metric for the economics (i.e. costs) of retrofit, rather than the potential energy-saving benefits of retrofit. A related, but better metric that is correlated with a building's size is its configuration (density, footprint, height), which are aspects covered in the other indices.

3.4 OWNER-CONCENTRATION INDEX

The Owner-Concentration index is not based upon any physical or energy-related considerations of a building. Rather it is grounded in the purely practical notion that, insofar as GPIC is interested in promoting the retrofitting of significant numbers of properties, then it is logistically and administratively easier to deal with relatively few owners that own multiple properties rather than many individual owners of single properties.

We define the index to identify any property as qualified if it is owned by any of the top 25 largest owners of commercial property in the region. This was done by computing a frequency table of the names of property owners in the data, and examining the distribution of the number of properties owned across owners. Since the concentration of ownership for multiple properties owned declines quite quickly after the top 25, we chose this as our critical threshold. The following table lists these owners and the quantity of property they own, ranked from smallest to largest:

Top 25 Largest Owners of Commercial Space in the Philadelphia Region

Owner Name	Number of Properties	Total SqFt (m)
Hilton Realty	16	0.7
The Korman Company	15	0.7
Philadelphia Industrial Development Corp.	17	0.8
HCP, Inc.	13	0.8
Cedar Shopping Centers, Inc.	15	0.8
SEB Immobilien-Investment Group GMBH	13	0.8
Sant Properties	17	0.9
Endurance Real Estate Group, LLC	18	0.9
Philadelphia Industrial Development Financing Corp	14	0.9
Developers Diversified Realty	15	0.9
Keystone Property Group	17	1
Condos Individually Owned	33	1
Gambone Development Co.	26	1.1
Industrial Investments, Inc.	21	1.2
Cobalt Capital Partners, LP	22	1.3
Centro Properties Group	23	1.3
Kimco Realty Corporation	28	1.6
The Henderson Group	37	2
Nappen & Associates	51	2.1
Public Storage, Inc.	42	2.5
The Bloom Organization	73	2.8
Whitesell Construction Company Inc.	55	2.9

Mack-Cali Realty Corporation	51	3
Brandywine Realty Trust	105	5.9
Liberty Property Trust	140	7.1
Total	**877**	**44.9**

Source: CoStar

877 properties covering nearly 45m square feet meet the Owner-Concentration Index's criteria of potentially benefitting from a retrofit. Since this is barely ten percent of all commercial properties in the Philadelphia region[17], it is by far the most stringent of the indices. Indeed, the index really reveals how diffuse the ownership of mid-sized commercial properties is in the Philadelphia area. Even the two largest and most recognized commercial landlords, Brandywine Realty and Liberty Property, account for only 3% of all commercial space in the data, whether measured by number of properties or total square footage[18]. But, despite the exclusiveness of this index, it does seem to suggest that any large-scale program to retrofit commercial properties in this region would be well-advised to focus on the larger landlords as a practical and logistical matter.

3.5 COMPOSITE INDEX

The Composite Index is computed as the cross-tabulation of all the previous indices, and hence identifies those properties which qualify as a retrofit candidate in *all* of the indices. Because it is the most stringent of the indices, it is best thought of as index that identifies not just properties that could be considered for a retrofit, but one that identifies the *top* candidates for a retrofit, since a property must simultaneously meet all of the component criteria for consideration.

The following table summarizes the quantity of properties and square footage in all of the indices, including the Composite Index:

Index	Pct. Candidates	No. of Properties	Total Square Footage (m)
Age Index	77%	6,962	304.0
Property Type Index	22%	1,976	86.3
Retrofit Index	79%	7,138	311.6
Owner-Concentration Index	10%	877	44.9
Composite Index	3%	232	49.1

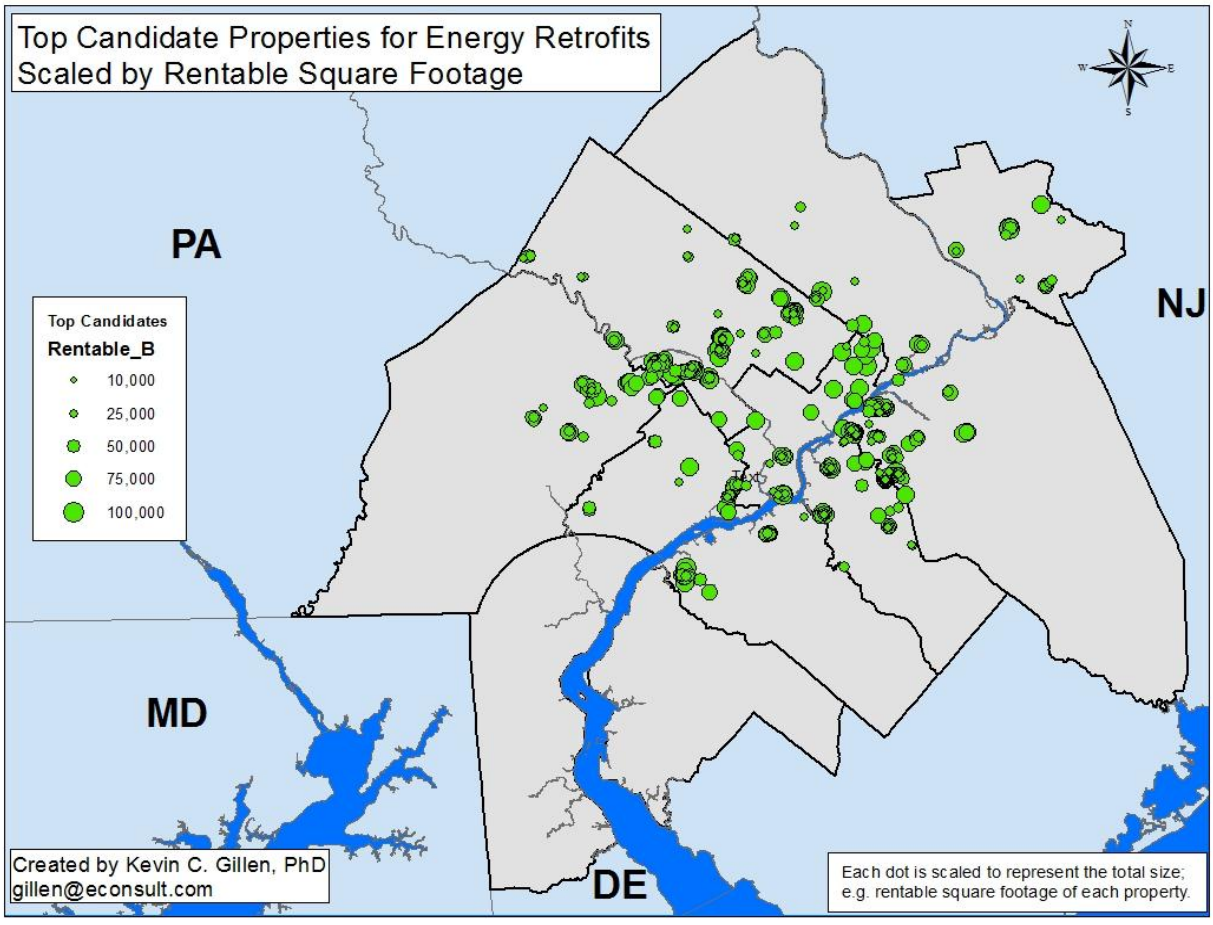
Source: CoStar

[17] This is not to suggest that the many other buildings are not targets for retrofit. This consideration is used to define a plausible case for the "lowest hanging fruit."

[18] Of course, we recognize that this data omits buildings larger than 100k square feet. If they were included, the concentration of ownership, at least as measured as a percentage of total square footage, would likely to appear more pronounced.

The Composite Index indicates that three percent of the commercial stock, which includes 232 properties covering nearly 50m square feet, meets the most rigorous threshold to be considered for a retrofit. These are properties that are more than twenty years old, have above-average energy bills, are less than six stories in height, have an envelope that is not steel-and-glass, have below-average daylight penetration and are owned by one of the top 25 largest commercial landlords in the region. In addition, it can be inferred that the individual properties are, on average, relatively large in size because even though these properties account for only three percent of the number of total properties in the stock, their area accounts for 12.5 percent of the total square footage in that same stock. Since there are presumably some economies of scale in energy retrofits, this is actually an additional attribute that makes these properties well-positioned to not only accrue the greatest benefits from a retrofit, but to do so in a relatively cost-effective manner.

To gain some further insights on these top candidates, the following map shows their location in the region.



Source: CoStar

The map indicates that most of these properties are located in the commercial corridors of older, inner-ring suburbs, such as Pennsauken, Valley Forge, Plymouth Meeting, Mount Laurel and Malvern. Some are located in industrial corridors or near transportation hubs such as Thorofare, Bridgeport, Hamilton, Bristol, Northeast Philadelphia, the Navy Yard (appropriately!) and around the Philadelphia International Airport. Thus, their location in older, inner-ring suburbs and commercial corridors would seem to be consistent with their characterization as older, low-to-mid-rise commercial buildings.

4.0 THE MARKET FOR ENERGY RETROFITS: SCOPE AND EMPLOYMENT

Pervading through the array of assessments, estimates, and forecasts regarding the energy efficient building market is the constant notion of accelerated, reliable growth. Our particular focus of interest, commercial and industrial retrofits in the GPIC area, appears to follow a path of growth representative of the country as a whole. As became clear through the literature review, and following with the suggestions of established theory, the health and potential of this market must be addressed from more than one frame of reference. To briefly establish the parameters of the market as we represent it here; employment in both human and monetary terms, economic size and composition, public support and disposition, and actual physical size (in terms of building area) are the various aspects represented by the different vectors of information collected for this market assessment[19]. Analyzing this selectively defined market against its own components, as well as the world around it, have been essential parameters to this endeavor.

In order to characterize this market in the GPIC region, we first provide context by identifying the market and environment from a national level:

Key Facts and Figures:

- The total National commercial building stock in 2009 was 77.9 billion square feet, or approximately 5.3 million buildings[20].
    - 1.8% was new construction
    - 8,741 buildings were ENERGY STAR-labeled
    - 26,385 buildings were registered with the USGBC for LEED consideration
    - 4,327 buildings were certified LEED by the USGBC
- The tax incentive program Better Building Initiative (BBI) is projected to:

[19] All statistics in this section courtesy U.S. Green Building Council, Delaware Valley Green Building Council and U.S. Department of Energy.
[20] Note that this includes all buildings, not just those between 20K SF – 100K SF.

  - generate over 114,000 jobs
  - save $1.4 billion in energy bills
  - generate over $8.5 billion dollars in funds for the retrofit industry

- Currently, the universe of all commercial and industrial properties in the GPIC area contains:

  - 207M SF of industrial building space and
  - 191M SF of commercial space.
  - 72M SF of certified LEED and EnergyStar buildings/projects
  - 324 LEED properties, and
  - 79 EnergyStar Labeled properties
  - 26% of the industrial and commercial office space in urban Philadelphia
  - 50% in the Philadelphia area suburbs
  - 24% in all covered New Jersey counties
  - This LEED and EnergyStar activity translates to an estimated $289,566,013 in spending.
  - Over the entire GPIC region, LEED and EnergyStar activity cover approximately 18% of the entire commercial and industrial building stock.

Literature covering the retrofit market addresses market activity using three general categories of varied specificity: energy-efficient building, "green" building, and certified building. Energy-efficient building applies to any improvement in energy or reduction in environmental impact. McGraw-Hill defines "green" building succinctly as, "energy efficient, water efficient, have improved indoor air quality, and include aspects of the building that use resources efficiently through materials selection". This category does not necessarily follow any certifiable guide, though programs such as LEED provide measurable standards that define the last category. Indeed, LEED standards are held as guiding principles for measuring and classifying projects in the "green" retrofit market. Analyzing the information gathered for this project hinged upon understanding the relationship of these categories. In 2009 the major commercial retrofit market (projects over $1 million) totaled $41 billion; energy-efficiency retrofits comprised 66% of that market, and "green building" comprised 8%.

Through apportioning estimated percentages of LEED and ENERGY STAR accreditations to new construction and completed construction, at the end of 2009 it is estimated that:

- 5.18 million buildings are pre-existing and are not Energy Star-labeled, LEED-certified, or LEED-registered.
- 82,000 buildings are new construction, but are not Energy Star-labeled, LEED-certified, or LEED-registered.

From these estimates, the percentages of buildings not already "officially" involved with energy-efficient or "green" initiatives are:

- 97.7% of the 2009 pre-existing building stock
- 86% of the 2009 new-construction building stock

Considering the ratio of "green" retrofits against "energy-efficient" retrofits in the major retrofit market mentioned above, we may further say that:

- 94% of the pre-existing building stock has not made any recent efficiency-improving retrofits.

The Real Estate Roundtable, a collection of some of the largest leaders in the real estate market, presents an interpretation of EIA (Energy Information Administration) data in their 2011 report claiming 75% of all US commercial buildings are ready to be retrofitted. This figure stems from the fact that 75% of all US commercial buildings were built before 1990. If we interpret this with respect to the number of retrofits calculated above, it may be feasible to say that a portion of that 75% have undertaken retrofits already as represented by the "94%" above. Thus, it may be fair to say that:

- 69% of US commercial buildings are ready for a retrofitting project.

There are other aspects to be considered when defining the current energy-efficient retrofit market; mandates from building codes, tax incentives, and public opinion are some of the more prominent ones.

The US Department of Energy seeks to save 30% on energy use from the 2004 standard level through the release of 2012 building codes. To reach the desired level of energy efficiency, a report released by the DOE replaced 80% of existing building stock with hypothetical building models following the new building codes. Taking this number as a guideline, it may be safe to assume that:

- some of the existing building stock may be pressured via building codes to undertake energy-efficient retrofitting projects in the coming years.

The tax incentive program Better Building Initiative (BBI) aims to reduce commercial building energy consumption 20% by 2020. In terms of jobs and spending, the incentive is projected to:

- generate over 114,000 jobs
- save $1.4 billion in energy bills
- generate over $8.5 billion dollars in funds for the retrofit industry

The GPIC area, and our sample of its 20K SK-100K SF buildings, though a very small portion of the national market discussed above, is nonetheless sizeable and representative when

compared to other similarly sized areas. Transposing the figures and ratios discussed above onto the GPIC market should, therefore, be fairly representative of actual market conditions.

Using the "average spending per square foot" for LEED awards (as released by the USGBC), this LEED and EnergyStar activity translates to $289M in spending. According to data from the LEED and EnergyStar databases we have the following shares of square footage and properties per area (in this representation, share of square footage also equals share of spending):

Share of Total by Urban/Suburban

	LEED Project SF of project	EnergyStar Labeled Location SF	LEED Project # of properties	EnergyStar Labeled # of properties
Urban Philadelphia	50.32%	71.78%	36.42%	37.97%
Philadelphia Suburbs	21.22%	19.09%	37.65%	70.89%
New Jersey	28.46%	9.13%	25.93%	29.11%

Over the entire GPIC region, LEED and EnergyStar activity cover approximately 18% of commercial and industrial building stock. Compared to more aggregated figures this number is high. In light of the fact that the area is consistently more proficient in building code, LEED, and similar performance metrics, the elevated level is explainable.

LEED and Energy Star certifications are only a portion of the energy-efficient retrofit market. It is clear, however, that the level of "green" activity in the GPIC region is notably higher than the national average, and so the national ratio of "green" to energy-efficient retrofits may not be a fair representation. Instead, drawing from the estimated effects of forces addressed above (namely: the Better Building Initiative, building code evolution, building age, and "green" building certification), we have developed a simple forward looking model of the region's retrofit market. The table below shows possible potential retrofit square footage, spending, and direct employment from OUR four modular estimations[21]:

Estimated Size of Retrofit Market (millions SF)

[21] The spending amounts are calculated using the lowest LEED certification $/f^2 estimate and the average $/f^2 estimate from the USGBC, and the direct employment multiplier (9.9/$1 million) is included in the same USGBC report as the direct employment effect of nonresidential "green" maintenance and repair.

Model	Retrofit Rate	SF for retrofit market	Retrofit spending (@$3.31/SF)	Retrofit spending (@$4.01/SF)	Direct employment (@$3.31/SF)	Direct employment (@$4.01/SF)
Adjusted	0.69	275	$910	$1,102	9,012	10,918
RER/EIA	0.75	298	$989	$1,198	9,796	11,867
Building Code	0.80	318	$1,055	$1,278	10,449	12,658

The type and size of individual projects in these aggregated figures are also highly relevant to this market analysis. Projects in this industry vary dramatically in size and commitment; the variety spanning from property-wide weather outfitting (referred to commonly as "enveloping") to small installations of energy-efficient lighting fixtures. The less intensive variety of retrofits are common, well dispersed, and rarely receive coverage or attention from the public. More sizeable projects, however, are experiencing a growing trend of public interest.

Meyer, Scherer & Rockcastle, Ltd. recently received the 2010 AIA Honor Award for Architecture for their work in transforming four buildings in the Philadelphia Navy Yard into what is now the Urban Outfitters Corporate Campus. The project, which also employed a LEED certified internal designer and project manager, totaled $100 million dollars and 285,000 square feet. Also receiving notable media coverage was the 2010 transformation of Philadelphia's former U.S. Post Office on 30th street into an IRS office center. The project, undertaken by Brandywine Realty Trust, maintained the historic appearance and value of the building while completely modernizing the electrical, mechanical, and plumbing systems within the building. Large projects such as these contribute to the demand of a wide range of retrofitting services. Herder to account for is the more selective contributions of smaller projects. As these smaller projects comprise a large portion of the overall market, understanding what products are most demanded by this portion of the market will be essential to understanding the market's composition.

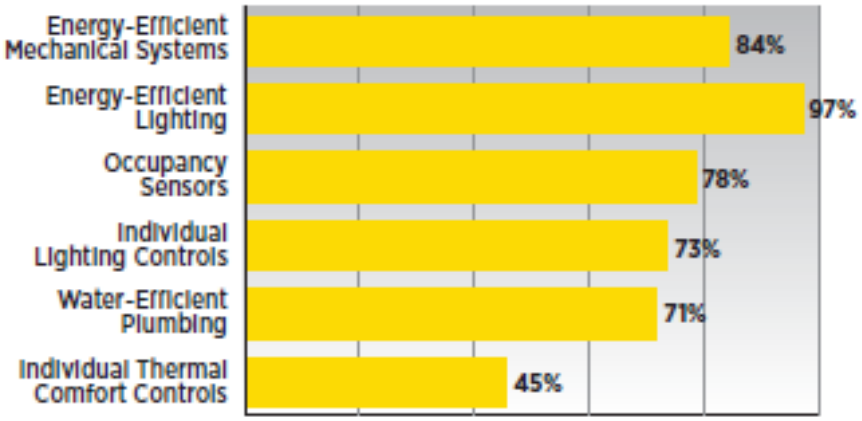
According to a selective study[22] of 24 major firms in the GPIC area that contracted energy-efficient retrofits on their properties:

- 19 were involved in lighting upgrades
- 17 were involved in water, electric, and gas consumption reduction
- 20 agreed to monitor and manage energy use
- 14 installed solar, geothermal, or other renewable installations
- 15 were installing automated energy management systems
- 15 were employing a Sustainability Director or some equivalent addition

These figures indicate an extensive focus on energy-efficiency and future planning to continue that focus. In addition, these figures reflect the indications of the McGraw-Hill construction market report responses, as shown below:

[22] "Competitor Efforts in Sustainability Arena", internal research document, Brandywine Realty Trust

Figure 32
Popular Products for Building Owners Conducting Retrofit/Renovation of Existing Buildings



Source: *Green Building Retrofit & Renovation SmartMarket Report*, McGraw-Hill Construction, 2009

Consequently, we should expect to see elevated employment and firm activity in sectors corresponding to the retrofit activity above. The USGBC website contains information on LEED certification by type and state for all of the United States. Though not perfectly indicative of the amount of energy-efficient retrofit jobs, it should nonetheless serve as a fair indicator to the magnitude of employment and coverage in the area. The next page contains a list of the number of LEED accredited professionals in PA and NJ by area of profession[23]:

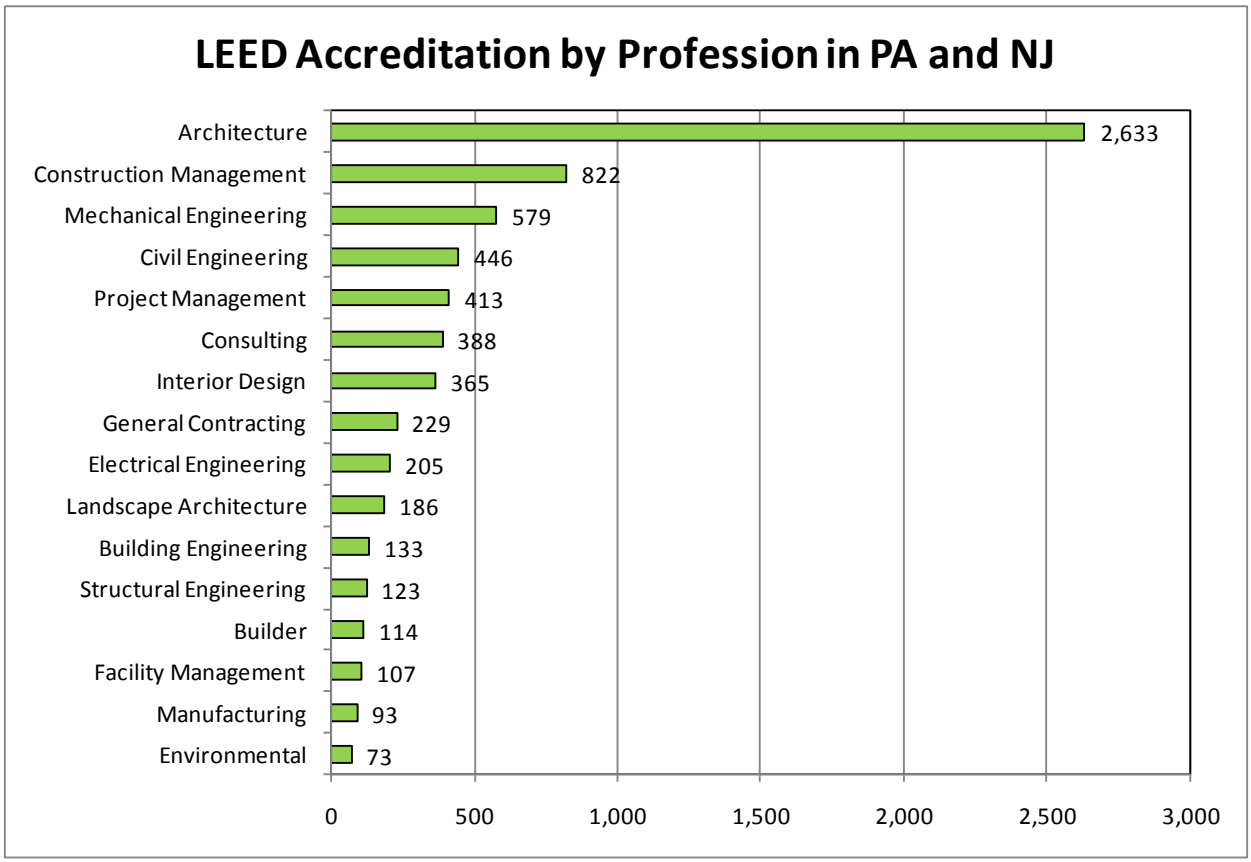
[23] Only select professional areas are represented below. "Total" for each state reflects the total number of certificates, some of which are not represented in the displayed table.

Select PA LEED Accreditation per Area		
	Frequency	Percent
Architecture	1468	32
Assistant Project Mgr.	3	0.1
Brokerage	2	0
Builder	59	1.3
Building Engineering	78	1.7
Building Owner	3	0.1
Building Products	36	0.8
Civil Engineering	243	5.3
Code Official	2	0
Commissioning	35	0.8
Construction Management	429	9.4
Consulting	223	4.9
Design Build	11	0.2
Developer	43	0.9
Director	2	0
Electrical Engineering	128	2.8
Environmental	42	0.9
Estimating Department	14	0.3
Facility Management	57	1.2
Finance	7	0.2
General Contracting	161	3.5
Interior Design	243	5.3
Landscape Architecture	140	3.1
Legal	42	0.9
Lighting Engineers	10	0.2
Manufacturing	65	1.4
Marketing	38	0.8
Mechanical Engineering	363	7.9
Non-Profit	24	0.5
Planner	39	0.9
Plumbing Engineering	19	0.4
Project Leader	7	0.2
Project Management	218	4.8
Property Management	15	0.3
Real Estate	24	0.5
Research	7	0.2
Specifications Writer	6	0.1
Structural Engineering	59	1.3
Subcontractor	28	0.6
Urban Design Consulting	2	0
Total	4585	100

Select NJ LEED Accreditation per Area		
	Frequency	Percent
Appraisal	2	0.1
Architecture	1165	34.2
Assistant Project Mgr.	4	0.1
Brokerage	5	0.1
Builder	55	1.6
Building Engineering	55	1.6
Building Owner	10	0.3
Building Products	32	0.9
Civil Engineering	203	6
Code Official	3	0.1
Commissioning	37	1.1
Construction Management	393	11.5
Consulting	165	4.8
Design Build	13	0.4
Developer	22	0.6
Director	5	0.1
Electrical Engineering	77	2.3
Environmental	31	0.9
Estimating Department	12	0.4
Facility Management	50	1.5
Finance	4	0.1
General Contracting	68	2
Interior Design	122	3.6
Landscape Architecture	46	1.3
Legal	30	0.9
Lighting Engineers	5	0.1
Manufacturing	28	0.8
Marketing	15	0.4
Mechanical Engineering	216	6.3
Non-Profit	6	0.2
Planner	30	0.9
Plumbing Engineering	16	0.5
Project Leader	5	0.1
Project Management	195	5.7
Property Management	18	0.5
Real Estate	36	1.1
Research	8	0.2
Specifications Writer	7	0.2
Structural Engineering	64	1.9
Subcontractor	24	0.7
Total	3409	100

LEED Accreditation in PA and NJ by Occupation area of recipient.

The following chart ranks the top 25 professions with the greatest number of LEED-Accredited in PA and NJ:



As the chart and data indicates, there are nearly 8,000 individuals in PA and NJ with LEED accreditation. Of these, 40% of all job categories account for nearly 80% of these individuals, and just one profession, architecture, accounts for a third of all of these individuals.

5.0 THE MARKET FOR ENERGY RETROFITS: GROWTH OF THE MARKET

A report conducted by Global Insight for the Conference of mayors estimated that the Philadelphia MSA held over 14,000 of the nations "green" jobs in 2006, and estimated that by 2038 would hold almost 114,000. With respect to the rest of the country, the Philadelphia MSA ranked 7th; outranked only by economically gargantuan areas such as the New York City and Washington DC areas. The United States, according to this study, will see "green" jobs grow from 751,051 in 2006 to 2,540,800 in 2018, and 4,214,700 in 2038. For the retrofitting market, the study maintains a conservatively low forecast (only 81,000

new jobs created) and bounding increases in research, consulting, legal, and engineering services (almost 1.5 million new jobs by 2038). These breakdowns, however, may not fully account for the effects of a robust increase in demand. Both type and number of retrofits should increase dramatically as technology and return on investment grows, creating need for a greater number of more specialized operations. These effects could easily espouse a job growth in the retrofit market not captured by this report.

Though these figures of size and growth may seem large, particularly in light of the currently prevailing market conditions, this opinion of "green" employment persists through current literature without credible exception. McGraw-Hill's construction market reports posit a similar sentiment. These reports, often extensively cited by the Department of Energy, capture the insight and opinion of hundreds of knowledgeable and influential professionals involved in the construction industry. Overwhelmingly, the responses at both the worldwide and country-region levels indicate growth to a degree consistent with the previously mentioned report:

- For North America, the percent of firms with a significant share of their activity being "green" or energy efficient is projected to grow from 67% in 2008 to 96% in 2013 (of that 96%, almost 44% will have over 60% of projects classifiable as "green").
- Worldwide, over half of the studies' respondents feel that "green" building will either help the workforce grow or have no negative impact, and 86% believe profit levels and sales growth will grow either rapidly or steadily (56% and 30%, respectively).
- Current building retrofits are seen to comprise 45% of all "green" building activity, with 53% of those retrofits taking place in North America.

Analyzing this report in concert with the U.S. Census's Capital Spending report, which indicates business spending on structures rose to 41.1% of all capital spending in 2009 (up from 31.4% in 2000), and the Global Insight report, which clams "green" jobs, "could be the fastest growing segment of the United States economy over the next several decades", suggests that the industry focus on energy efficiency and "green" initiatives is spurring on spending and labor in the US.

6.0 SUMMARY AND CONCLUSION

The following table summarizes the number and square footage of properties that meet the various indexed thresholds for energy retrofits:

Candidates for Energy Retrofits by Index

Index	Pct. Candidates	No. of Properties	Total Square Footage (m)
Age Index	77%	6,962	304.0
Property Type Index	22%	1,976	86.3
Retrofit Index	79%	7,138	311.6
Owner-Concentration Index	10%	877	44.9
Composite Index	3%	232	49.1

Using the average of percent candidacy for retrofits in the GPIC region:

- 47% of the commercial and industrial space in the Philadelphia area is identified as potential candidates for energy retrofits.
- This covers 4,201 buildings with 154m square feet of space.
- This is estimated to generate $618m in local spending, supporting 23,500 jobs.

Comparing this to the current stock of eco-labeled space in the GPIC region:

- 18% of Commercial space is currently eco-labeled.
- This covers 403 buildings with 72m square feet of space.
- The construction/conversion of this space has generated $288m in local spending, supporting 11,000 jobs.

Thus, compared to the existing stock of eco-labeled space, the potential stock for future retrofitted space:

- is 10 times the number of properties that are currently eco-labeled;
- is 2.1 times the total square footage of space that is currently eco-labeled;
- is estimated to generate 2.2 times the amount of local spending than what was spent on the existing stock of space that is currently eco-labeled; and
- the retro-fitting of this stock would support just over twice as many jobs as the construction/conversion of the existing stock of space that is currently eco-labeled.

Since, by any metric, the potential market for energy retrofits is substantially larger than the current stock of energy-efficient space, we conclude that the potential market for energy-efficient to commercial and industrial properties in the greater Philadelphia area is substantial.

7.0 BIBLIOGRAPHY OF STUDIES REVIEWED FOR THIS REPORT

In addition to those explicitly cited in the text, our research included a number of excellent studies, both academic and trade-related. Key examples are listed here.

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