Using Planning Tools to Promote Energy Efficiency

Green Building Studio, Fall 2013

eeB HUB Energy Efficient Buildings Hub

RUTGERS

RUTGERS Center for GREENBUILDING

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Contents

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Overview

This document reflects the outcomes of the graduate-level studio, *Planning Standards to Encourage Energy Efficiency Retrofits in the Delaware Valley*, conducted at Rutgers University's Edward J. Bloustein School of Planning and Public Policy in Fall 2013. Planning studios connect academic education and preparation for professional practice, providing an opportunity to apply concepts and theories to practical real world projects. For a visual summary of this work, see the studio PowerPoint,[1] which represents the final presentation conducted in December 2013. This paper is a compilation of student work, largely unedited, and also includes a technical planning memo on the proposed zoning changes in Upper Merion Township, PA (see Appendices).

Figure 1 Studio Presentation
Source: MaryAnn Sorenson Allacci

The most significant outcomes of the studio are the building stock analyses on the regional (see page 30) and local (see page 34) levels and the implementation and analysis of an energy efficiency survey fielded in the Delaware Valley Region (see page 26). These pieces are accompanied by student submissions that highlight planning design approaches that produce energy efficiency benefit, a summary of planning regulatory points of leverage, and supportive case studies, including research regarding the intersection of energy efficiency and resilience.

Introduction

In the United States, buildings comprise over 40% of total energy consumption, the most of any other type of energy use (U.S. Department of Energy 2008, p.4). Improvements to building energy efficiency therefore hold great potential to reduce total U.S. energy consumption. While many initiatives are already underway to reduce building energy consumption, the existing regulatory and institutional framework inhibits meaningful improvements due to several barriers, including:

- Inconsistent regulation through building codes within and between states;
- Focus on regulation of new buildings when retrofits to existing buildings hold the greatest potential for improvements;
- Lack of standardized data on current building energy consumption; and
- Lack of education on the true costs and benefits of retrofits to improve energy efficiency (The Economist Intelligence Unit 2013)

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1. Rutgers Center for Green Building. 2013. *Planning Standards to Encourage Energy Efficiency Retrofits in the Delaware Valley*. Green Building Studio Power Point Presentation.

These persistent barriers necessitate continued development of new approaches from different angles to reduce building energy consumption in the United States. The Rutgers studio, Planning Standards to Encourage Energy Efficiency Retrofits in the Delaware Valley, focused on the planning angle, identifying approaches that planners can use to contribute to efforts aimed at promoting energy efficiency.

Building codes, which are not typically within the purview of the planner, are the primary tools used to address building energy use. However, there are many other innovative ways in which planners can play a role in reducing building energy use. Climate Action Plans, zoning incentives, the development/redevelopment process, promotion of compact development/adaptive reuse, public outreach, and informational strategies are just a few of the planning points of leverage that can impact energy efficiency. This studio demonstrates the application of planning tools such as benchmarking, incentives, and education. These informational and educational strategies help stakeholders understand their current conditions and help facilitate improvements to energy efficiency by informing the goals of such an undertaking.

The geographic focus of this study is Pennsylvania's Delaware Valley Region, comprising 239 municipalities within five counties (U.S. Census Bureau 2010). A national review of best practices for achieving energy efficiency in commercial and multifamily buildings through land use planning and zoning regulations (Rutgers Center for Green Building 2014) informed the original work of the studio, as did two companion pieces comparing the regulatory environment for energy efficiency upgrades in Pennsylvania and New Jersey (Rutgers Center for Green Building 2014). The studio contributed case studies as examples of municipalities that exceed the status quo, a regional survey of existing energy efficiency strategies in municipalities, and a building stock analysis provide context for the Delaware Valley Region. At the local level, the studio conducted an analysis of the office building stock in King of Prussia's Business Improvement District to provide estimated current energy consumption, pointing to potential site specific and district wide solutions. Each level of analysis illustrates how informational and educational strategies can address the lack of understanding among stakeholders that inhibits implementation of energy efficiency measures in buildings.

Planning Design Approaches that Produce Energy Efficiency Benefit

Compact Development

Urban Land Institute (2010) identifies several features of compact development:

- Concentrations of population and/or employment
- Medium to high densities appropriate to context
- A mix of land uses
- Interconnected streets

- Innovative and flexible approaches to parking
- Pedestrian-, bicycle-, and transit-friendly design; and
- Access and proximity to transit

Figure 2 Compact Philadelphia, PA. Source: Vlasta Jurocek, 2006

Although the concept of compact development originally aims to build compact urban patterns in response to urban sprawl and related undesirable environmental issues, it can also promote local energy efficiency through strategies such as:

- Increasing the proportion of attached and multi-unit buildings
- Mixing types of buildings (residential or commercial)
- Building transit-oriented communities and work places

These elements contribute to local energy efficiency in a variety of ways. By increasing multi-family building units, average area of buildings will decrease and thus heating and cooling expenses will be reduced. Meanwhile, mixed-use development establishes links between residential and commercial sectors, which provides the opportunity for urban symbiosis. For example, a nearby co-generation facility provides cooling and heat for commercial buildings in the day time and provides for residential sectors at night because of time-varying demands of occupants. In addition, transit-oriented development reduces vehicle miles traveled (VMT) and costs of infrastructure.

There are several additional points related to compact development that are worth planners' attention. First, it's important to advocate for preservation of open and green space in compact development. Although high-density building units can offer environmental benefits, clustered population and buildings generate of carbon dioxide, which can contribute to the urban heat island effect. The urban heat island effect refers to an increase in air temperature in urban areas that results in part from the replacement of vegetation with buildings, roads and infrastructure (Berkeley Lab 2014). Buildings thus have to consume more energy to control interior temperatures. In ecology, generators or human beings become sources of the carbon footprint while plants are sinks of the carbon footprint since photosynthesis absorbs carbon dioxide and regenerates oxygen. Preserving open space and incorporating more green spaces into our communities can help mitigate disturbances to the microclimate.

Second, the configuration of dense buildings may undermine the performances of renewable energy technologies such as solar panels and wind turbines. An area with a high density of buildings may have structures that block sunlight and/or wind. This means that if shorter buildings stand among tall buildings, the solar panels on the shorter buildings may not have enough access to sunlight. Therefore, it is important to consider the overall configuration of buildings in a community so as not to reduce the efficiency of renewable energy systems.

Renewable and Efficiency Ready Site and Buildings

Renewable and efficiency ready site and buildings refer to strategies such as distributed energy generation and smart grid technology. Different from centralized facilities such as fossil fuel or nuclear power plants, distributed energy generation serves to meet smaller local needs and results in less environmental impact. Smart grid technology integrates innovations to take advantage of dynamic electricity pricing options and affect the users' behaviors. Both of these initiatives improve local energy efficiency. Moreover, more mature energy efficiency technologies can be utilized such as:

- *ENERGY STAR efficient lighting and appliances*: The ENERGY STAR program has boosted the adoption of energy-efficient products, practices, and services through valuable partnerships, objective measurement tools, and consumer education (EPA 2012). In regard to lighting and appliances, certified ENERGY STAR products are readily available.
- *Storage facilities:* renewable energy and distributed energy generation options generate electricity and reduce demand on the grid but since wind and sunlight are not available at all times, it is essential to adopt technologies to store it.

Reuse of Existing Buildings

Reuse of existing building eliminates energy consumption needed for new construction as well as the need to transport and produce materials for new construction. Reusing existing buildings also facilitates compact development and reduces urban sprawl, thus relieving pressure for greenfield development and avoiding extra energy loss that occurs with electrical transmission or pipelines.

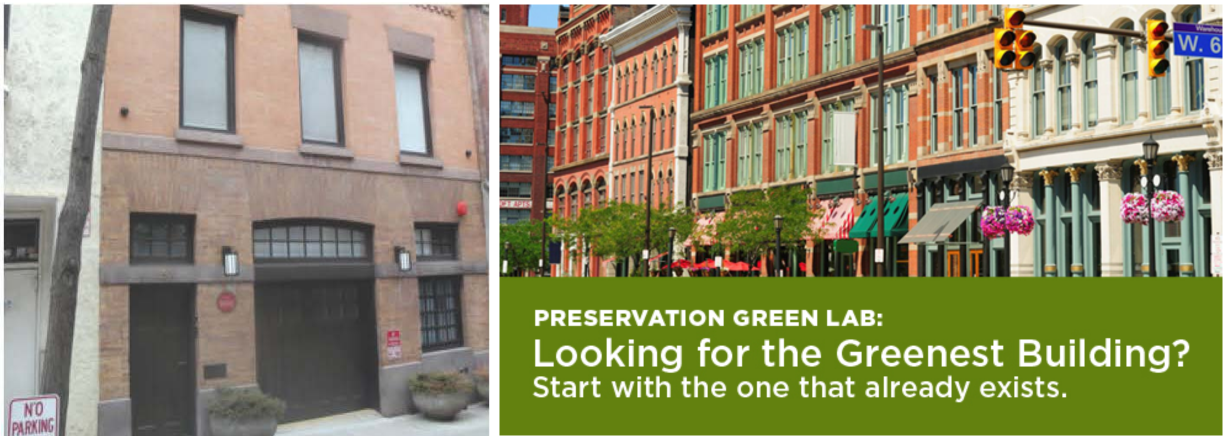


Figure 3 Reuse of Existing buildings, Source: Jim Henderson, National Trust for Historic Preservation

Planning Regulatory Points of Leverage

Plan Making

Climate action plans on the national, state and local levels can be used to encourage better land use and promote energy efficiency. Some examples of best practices related to plan making and energy efficiency include:

- Updating land use maps to allow for compact development, reducing vehicle miles travelled
- Updating zoning ordinances to allow small wind turbines and remove barriers that can impede energy efficiency
- Encouraging heterogeneity in the zoning ordinance - what works in one area may not work in another, and while an ordinance may be generally effective; it may not work in every case. Open space preservation could fall in this category. Although open space preservation has many benefits, sometimes infill of improperly preserved land leads to better energy efficiency

Local examples of elements related to energy efficiency in climate and energy plans are:

- Stretch codes and more stringent energy requirements of building codes
- Time of sale energy use disclosure requirements
- Energy friendly ordinances and permitting requirements on every scale
- Energy smart zoning like walkable downtowns
- Unambiguity in the commitment to energy efficiency

And as specific ways to implement these examples:

- Complete streets policy
- Bicycle and Pedestrian Planning / Mass Transit Planning / Parking requirements

- Sustainability elements in Master plans (guides for sustainability for 10-20 years into the future that generally contain the plan for exactly what the jurisdiction is expecting to accomplish regarding sustainability and often includes creative strategies with direct application to energy efficiency)

Regulations and Policies

In a planning context, regulations and policies pertain to things such as zoning codes and subdivision regulations. This section mentions many of the ways that planners can influence the built environment and improve energy efficiency. The following list includes examples of strategies that planners can facilitate or encourage to promote energy efficiency:

- Requiring energy efficiency targets for projects requesting density or height above matter of right limits such as GHG emission levels and energy consumption performance standards below the regional average
- Reducing energy use in outdoor lighting through light pollution ordinances
- Allowing energy-related sustainability features to break setback rules and exceed standard roof coverage limitations (such as photovoltaic panels)
- Allowing wind and solar generation in all zones
- Restricting discretionary development that would block existing roof mounted solar power or solar hot water facilities
- Permitting district energy systems in all districts
- Using evapotranspiration adjustment factor (ETAF) to set water use requirements. The ETAF is a coefficient that adjusts reference evapotranspiration values based on plant factor and irrigation efficiency and is then used to find the maximum amount of water that can be applied to a landscape, based on standard grass surfaces etc. Plant factor includes plant type and the microclimate of the landscape (California Department of Resources 2008). Palo Alto, California requires an ETAF of 60% and developers/redevelopers must show this in the calculations and the plans before the development is approved. Requirements related to ETAF will vary greatly based on the climate of the area (City of Palo Alto 2013).
- Requiring water use restrictions in drought prone areas or during times of drought, reducing the amount of water that is wasted and therefore the amount of energy used distributing it
- Creating tree ordinances that require strategic tree and vegetation placement. Trees mitigate the urban heat island effect and can reduce heating and cooling costs.

Development and Redevelopment Review

Development and redevelopment review is one of the strongest tools that planners have to influence energy efficiency in an area as redevelopment plans can require that new buildings to meet specific efficiency standards. The above-noted provisions can be incorporated into a redevelopment zone, along with other best practices in development and redevelopment review including:

- Create more compact forms
- Integrate land use and transportation
- Promote mixed use development / Develop centers with high density
- Establish transit-ready locations
- Facilitate job-housing proximity
- Plan infill development and redevelopment
- Redevelop Brownfield sites
- Provide developer incentives
- Strategically locate public facilities

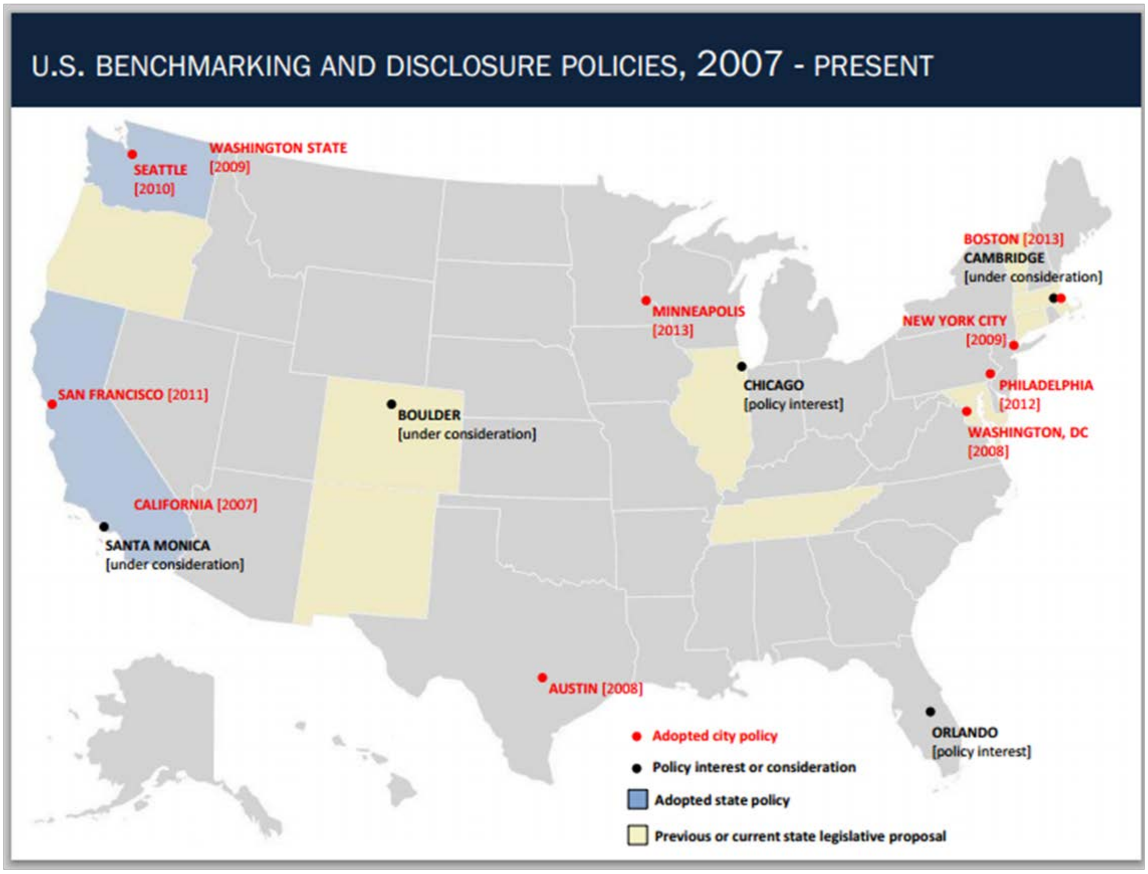
Incentives

Incentives such as those listed below can encourage energy efficiency and are often less controversial than strict codes. Incentives are often included as part of a negotiated planning outcome, especially within the context of a redevelopment agreement. Specific types of incentives include:

- Expediting plan review / permitting
- Waiver or fees / rebates
- Provision of technical assistance to help developers meet goals
- Rebates for purchasing energy efficiency appliances
- Density/Floor Area Ratio/Height Bonuses
- Reductions in requirements of something else, such as parking
- Tax incentives / loan programs
- A land value tax on developments that encourage sprawl
- Recognition programs – for example, the U.S. EPA and Department of Energy honor organizations/individuals for significant energy savings contributions, for a commercial business or building this could mean positive publicity and can become a financial gain for being energy efficient (Conservation Services Group 2013).
- Impact fees can be returned as a reward for energy efficiency. For example, Arkansas has a scorecard for builders that they use to show they are including energy efficiency features such as LED lights and solar panels and if they score high enough, impact fees are returned (Ward 2008).
- Rewards for incorporating specific energy efficiency measures such as ENERGY STAR® qualified doors, weather stripping, revolving doors, or improved insulation to reduce the energy use needed to heat and cool buildings (Department of Energy 2012).

Benchmarking Standards

An emerging planning tool, benchmarking disclosure, can be voluntary or required (regulated). Benchmarking is measuring information about utility performance use, sometimes water use as well, and comparing the level of energy efficiency with that of similar facilities. Disclosing this data can make facilitate more efficient (informed) transaction decision-making by market actors, and should lead to increased retrofits and other building improvements. As such, benchmarking disclosure is both a behavioral and an environmental/asset-based tool.



Source: http://www1.eere.energy.gov/wip/solutioncenter/pdfs/bbs2013_bum_overview.pdf
May 30, 2013 | U.S. Department of Energy Better Buildings Summit

Figure 4 U.S. Benchmarking and Disclosure Policies, 2007 - Present

Case Studies

Throughout the country, there are many examples of places where jurisdictions are using their resources and innovative strategies to make changes in energy efficiency. Below we summarize several of these examples and describe the methods they use and how they could be further applied to other areas in the country.

Benchmarking in New York City and Philadelphia

In 2009, Mayor Michael R. Bloomberg signed the Greener, Greater Building Plan (GGBP) to enact a series of energy efficiency requirement for existing buildings in New York City. According to the PlaNYC (2013a), GGBP includes four regulations directly related to energy efficiency:

- Local Law 84: Benchmarking
- Local Law 85: NYC Energy Conservation Code
- Local Law 87: Energy Audits & Retro-commissioning
- Local Law 88: Lighting & Sub-metering

Credit: http://phillybuildingbenchmarking.com

Credit: www.nyc.gov

Figure 5 Benchmarking in Philadelphia and NYC

These laws aim to reduce GHG emissions by 30% of the 2006 level by 2017. The benchmarking law requires all privately-owned properties with individual buildings more than 50,000 square feet and properties with multiple buildings with a combined gross floor area more than 100,000 square feet to annually measure and upload their energy and water consumption data to the City by an online tool called the ENERGY STAR Portfolio Manager. The Portfolio Manager will then compute consumption metrics like Energy Star Score, Site Energy Use Intensity (EUI) for both the government entities and the owners. In terms of building areas covered through benchmarking annually, New York City accounts for the largest proportion nationally, covering more square footage than all of the other cities combined.

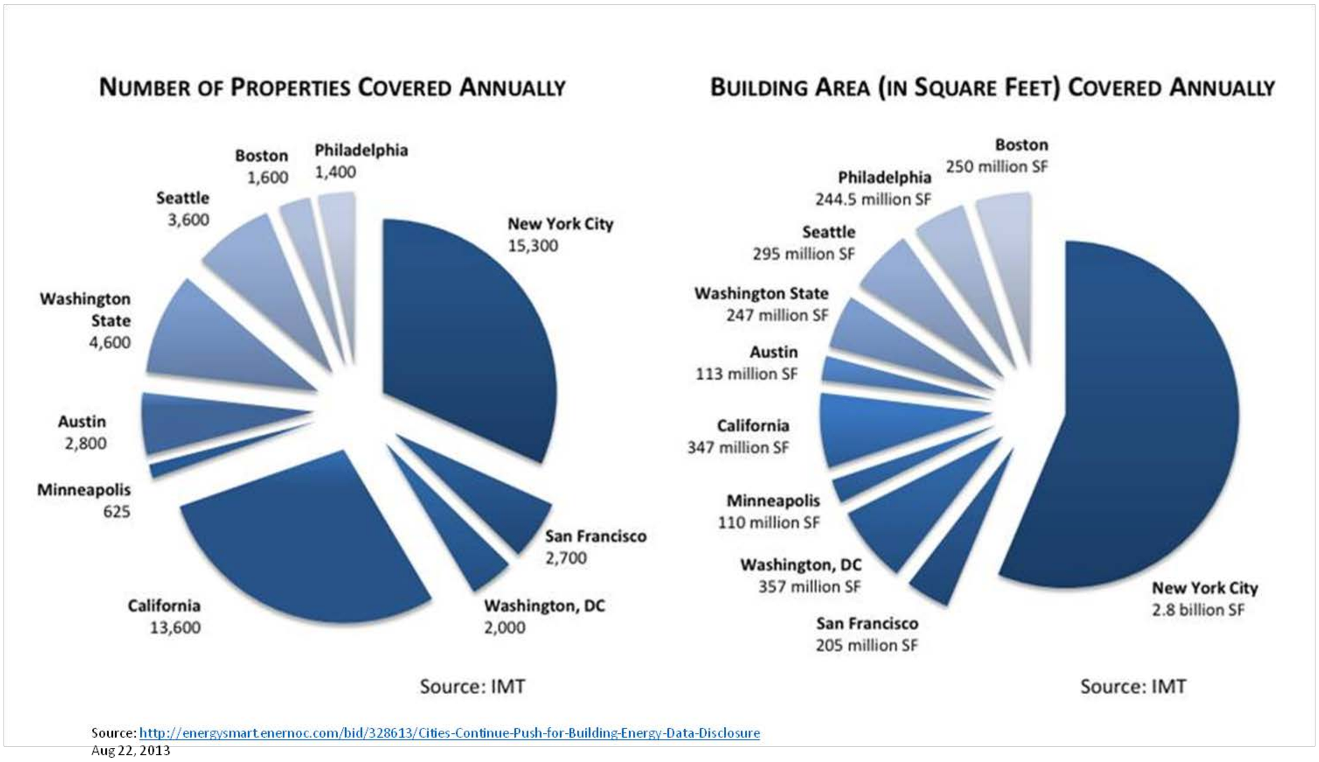


Figure 6 Number of Properties and Building area covered annually

The Division of Energy Management at the New York City Department of Citywide Administrative Services (DCAS Energy Management) manages the energy account and conservation initiatives for the City. Since 2009, the city has benchmarked 24,071 buildings such as schools, communities, libraries, police stations and courthouses (PlaNYC 2013b). Although benchmarking is a tool for acquiring energy consumption data, it can integrate other data to further promote energy audits, retrofits etc.

The current database can provide general performances of energy consumption for a significant number of commercial and residential buildings In NYC, an impressive result considering that New York City adopted this law not long ago. According to the 2013 New York City Law 84 Benchmarking Report, the city had identified several factors that affect energy consumptions: building age, geographic distribution, building type and fuel mix. The datasets assist policymaking to create a greener and greater New York. Specific policies like initialization of automated meter reading equipment or upgrading Portfolio Manager are derived from the analysis of building consumption data.

The City of Philadelphia adopted a benchmarking law in June, 2012 and the law asks owners of nonresidential spaces of 50,000 square feet or more within Philadelphia County to track and report energy and water use data annually via Energy Star Portfolio Manager (Andrews, Actman, & Jennifer, 2013). The law also requires building owners to report building characteristics and provide a statement of energy usage performance when selling or leasing the building. This law went into effect in October of 2013 and reports go to the Mayor's Office of Sustainability (MOS), and MOS will make the reports public.

Highland Park, New Jersey

Highland Park is a compact borough located in Middlesex County, NJ. Highland Park participated in the New Jersey Sustainable Energy Efficiency Demonstration Project (NJ SEED) from February 2010 to March 2013. The project had specific greenhouse gas reduction goals and the borough implemented an Energy Plan to achieve these goals. The Highland Park Energy Plan (Highland Park 2011) set goals of an annual rate of 4 percent greenhouse gas emission reduction and a total of 80 percent decrease by the year 2050. It calls for collective efforts from homeowners, renters, businesses and municipal government to reduce their carbon footprint. The plan requires building owns or renters to comply with the following:

- *Home Performance with ENERGY STAR*: A certified contractor examines household heating and cooling equipment, appliance efficiency, lighting standards and the like to provide suggestions to save up to 30% savings on annual energy costs. Upon installation, residents are eligible for low interest loans and rebates up to $4,000.
- *Refrigerator/freezer recycling*: Of all the appliances, refrigerators and freezers consume the most amount of energy. This project provides subsidies for recycling of old refrigerators and freezers. According to the plan, new models of refrigerators and freezers cost 1,000 fewer kWh annually than a refrigerator or freezer made before 1990.
- *Purchase only ENERGY STAR appliances*: Highland Park also provides rebates for tenants who purchase Energy Star appliances like air conditioners, washing machines and refrigerators.
- *Install programmable thermostats*: ENERGY STAR programmable thermostats lower energy use by changing the setting of heat or air conditioning for unoccupied room or workplaces. When the room is not empty, users can reset the related parameters of the heat or air conditioning system.
- *Utilize the Direct Install or the New Jersey Smart Start Programs:* The Direct Install program begins with an assessment of a facility and replaces old equipment with more energy efficient equipment in commercial buildings and Direct Install pays 70% of the total project cost. Similarly, the Smart Start program provides renovations, remodeling and equipment replacement for smaller business (NJ Clean Energy 2014).

The draft of Highland Park 2020 (Highland Park Borough 2012) positions this borough to be an environmentally, economically and socially sustainable community. In achieving the first goal, the government has conducted several technical interventions to improve its local energy efficiency. It retrofits lighting and provides solar power with

Credit: highlandpark.cielpower.com

Figure 7

photovoltaic roof tile systems and has a tree-planting program and designates open space for recreation. In the main street of Highland Park, nearly 25,000 commuting cars pose stress on local ecological capacity in this high-density community every day. Planting trees along the street and preserving open space can reduce impacts from vehicles and reduce urban heat island effect, thus reducing use of HVAC and associated energy use.

These efforts in Highland Park, along with other sustainable initiatives like green fairs and carbon footprint documentation, gave this borough the title of a Sustainable Jersey silver certified municipality. This case of Highland Park illustrates what a municipality can do regarding energy efficiency and provides a model for other smaller municipalities in the Delaware Valley Region.

Chico, California

The city of Chico, California is located in the northern Sacramento Valley and has a population of about 86,187. Chico is home to California State University and has a vibrant downtown. Chico California has a strong residential energy conservation ordinance that includes retrofit requirements for property owners selling properties that were built before 1983. The code includes energy efficiency requirements and water conservation requirements and has been updated to apply to every home or apartment building built before 1991 (City of Chico 2013).

The requirements are specific, including:

- Minimum insulation and a thermal resistance rating of R-30
- Cracks and openings must be caulked or weather striped
- Low flow faucets with maximum water flow rates of 2.75 gallons per minute or an aerator
- In-line shower restrictors and low flow toilets at 1.6 gallons per flush or less
- Programmable thermostats
- Insulation of cold water lines and water heaters with external insulation blankets with a minimum rating of R-6 except where not feasible

Cost limitations are set and the maximum amount that multi-family dwellings have to spend to comply with the ordinances is $560/unit or the cost of insulation if that is higher. Credit for making energy efficient retrofits to the building are given within 42 months prior to the sale and if owners partake in other energy conservation measures that are not specifically listed they are given credit for those as well. The ordinance is enforced through inspection and a certificate of compliance is given. Violations are met with a fine (City of Chico 2013).

The City of Chico delineates clear and appropriate standards for efficiency and requires them using the regulatory power of the municipality. Although their ordinance only applies to residential buildings, it could be used as a model for commercial buildings as well.

Downtown Chico. Credit: www.csuchico.com.

Figure 8 Downtown Chico

Easton, Pennsylvania

Easton, PA is one of the main cities in the Lehigh Valley and has a population of about 26,800. There are various industries and large employers in Easton, such as the Crayola factory. The township is using a number of measures to promote energy efficiency. In 2012, Easton initiated a development a program for housing rehab and energy efficiency in owner-occupied and renter-occupied units. Economic Development Initiative (EDI) funds were used to assist 6 buildings containing 30 units with energy efficiency (City of Easton 2012). Creating a sustainable living environment is part of Easton's municipal code and conserving energy resources and the use of renewable energy resources is listed as one of the main goals. The City of Easton has an Amendment to the Zoning Code and Subdivision and Land Development Ordinance proposed to create solar energy system regulations (City of Easton PA 2013). This proposal includes:

- The use of photovoltaics for electricity
- Proper use of vegetation in a building, regarding shade and where the solar radiation falls on the buildings
- Proper development around existing solar panels

The City of Easton demonstrates how a municipality in Pennsylvania can use zoning code to promote energy efficient measures. As a city with a relatively small population, Easton is good example of what a small city can do to promote energy efficiency.

Downtown Easton. Credit: http://www.bigandtallworld.com/

Figure 9 Downtown Easton, PA

Energy Efficiency and Resilience

This section investigates the potential benefits of focusing on synergies between energy efficiency and resilience and the review of key resources. Sustainability has become an important issue in planning, architecture and society as a whole. Energy efficiency retrofits are a major facet of sustainable development or redevelopment. Planning for and implementing energy efficiency retrofits is a good time to think about how to incorporate resiliency into the building and when thinking about strategies for resiliency, it's important to consider opportunities for improving energy efficiency. This is because many of the preliminary tasks for review and research not only overlap, but when integrated can provide synergy throughout the entire process. Additionally many of the physical retrofits or other measures are similar and so the marginal cost of implementing retrofits or standards that are both sustainable and resilient is much less than the marginal benefit given the natural synergy that exist between the two. It is important to consider the opportunities to improve energy efficiency when pursuing resiliency retrofits, and vice versa.

Over the past decade natural disasters and sustainability have become major issues. Whether it's tornadoes in the Great Plains, hurricanes along the coasts, landslides on the west coast or floods in the Rocky Mountains, natural hazard mitigation is fundamental to homeland security and has become an essential aspect of modern planning. Additionally, increases in the frequency and intensity of natural disasters has brought to light larger issues about energy efficiency and sustainable development. As a result the prevailing view is that the best solutions are those which realize, explore and enhance the already existing synergies of natural hazard mitigation and sustainable planning.

Methodology

Figure 10 Standards for Sustainability &Resiliency

There is a wealth of available standards concerning both sustainability and resiliency. This research focuses on the American Planning Associations Comprehensive Standards for Sustaining Places and the Insurance Institute for Business & Home Safety (IBHS) FORTIFIED © standards. Given the intersection of sustainability and resiliency, these two sets of standards are reviewed as it pertains to both new commercial development and energy efficiency retrofits in the region. Additionally this literature review and lessons learned will be applied and compared to real-world examples of construction or retrofits that include both sustainable and resilient standards.

Additional resources were reviewed to better understand the intersection between resiliency and sustainability, and in particular, energy efficiency. Important resources for energy efficiency include the 2008 ENERGY STAR ® Building Upgrade Manual, the 2012 Managing Deep Energy Retrofits report from the Rocky Mountain Institute and the USDEP's Advanced Energy Retrofit Guide. This research also included the review of the Urban Land Institute's After Sandy report, the NYC Resiliency Plan, and the Oregon Resiliency Plan.

Observations

There are common points that appear again and again throughout resiliency standards, reports or guides. While on the surface resiliency plans may seem to focus mainly on large infrastructure (sea walls, levees, bridges, etc.) there is a growing emphasis on public health and civic resources (State of Oregon 2013). Additionally the use of "soft systems" or nature can greatly increase an areas ability to mitigate the force of severe weather or other natural hazards as well as partial or flexible compliance measures (Urban Land Institute 2013).

Figure 11 Source: 2013 NAHB International Builder's Show

Trends also emerge throughout research on sustainability and energy efficiency. An emphasis on lighting and internal climate control can be observed in many sustainability or energy efficiency standards including the EPA's ENERGY STAR® Building Manual (EPA 2008), specifically the implementation of daylighting. HVAC measures are also very important components of energy retrofitting because they can be affected by so many other features of a building (EPA 2008; US Dept. Energy 2011).

Measures that overlap between sustainability and resiliency are important part of AERs. Common measures that overlap both energy efficiency and resiliency include daylighting, because it significantly decreases energy costs for both lighting and HVAC and potentially serves as emergency lighting, soft systems, that can create a physical barrier to perils (foliage disrupting flood waters) while HVAC systems can limit the spread of airborne toxins. Additionally these measures can lower energy costs for a facility through increased insulation and decreased urban heat island effects.

Resilient retrofits should be implemented alongside energy efficiency retrofits because the dual nature of many measures typical in both provide both short term returns via increased energy savings and long term returns via increased building lifespan.

Figure 12 Source: planning.org

APA Comprehensive Standards for Sustaining Places

Recently the APA has created a set of comprehensive plan standards to aid in the development and creation of sustainable places. The first draft of these standards was vetted after the APA National Planning Conference in April 2013. A white paper titled “Comprehensive Plan Sustainability Standards” was written in August of 2013 to “lay out a set of practice standards to be used in the preparation of comprehensive plans aimed at sustaining places (APA 2013).” The paper and its accompanying task force define planning for sustainable places as:

> *“a dynamic, democratic process through which communities plan to meet the needs of current and future generations without compromising the ecosystems upon which they depend by balancing social, economic, and environmental resources, incorporating resilience, and linking local actions to regional and global concerns.”*

The standards are broken down into the three categories of principles, processes and attributes where each contains a specific group of best practices (APA 2013). The six principles for sustainability are livable built environment, harmony with nature, resilient economy, interwoven equity, healthy community and responsible regionalism (APA 2013). A common theme of including stakeholders, involving the public in the process, committing priority funds, following up with regular implementation checkpoints and the creation and dispersion of an evaluation tool for municipalities is evident throughout the paper. The practices within each principle also have an overlaying theme of mixed use, community development and improved transportation.

The APA has selected pilot communities throughout the nation based on their size, geography, stage in the comprehensive planning process and commitment to conference calls and the 2014 APA Conference (APA 2013). These communities cover the majority of the climate and metropolitan or socio-economic regions within the United States, some of which could be applicable to the region. Given the infancy of this program many of these pilot communities are still in the initial processes of adopting or applying the APA Standards. The most applicable standards or practices from the APA for the region will likely be those that involve public transit, mixed use and preservation of nature, all of which have an intersection with resiliency.

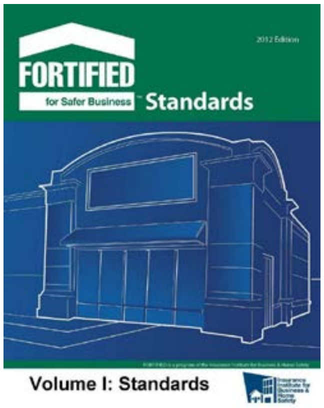


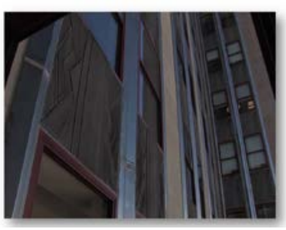
Figure 13 Source: FORTIFIED © for Safer Business

The IBHS has recently created the FORTIFIED© standards for both residential and commercial buildings, specifically the FORTIFIED© for Safer Business Standards 2012 Edition. This program "specifies construction and design guidelines intended to increase the resistance of new light commercial buildings to natural disasters common in the area where the building is located. Additional criteria and recommendations include best practices for reducing damage due to interior fire, water risks, burglary, and electrical surge (IBHS 2012)." While these standards are primarily for the structural aspects of any given building there are intersections with sustainability.

The standards dictate the specific perils for each state as well as within/between states. The region's greatest natural perils, according the IBHS are severe winter weather, and strong winds. For winter weather and strong winds many of the standards involve insulation and the prevention of storm water runoff, especially from snow fall. The standards are exhaustive and detailed, discussing many different types of natural hazards including fire, earthquakes, flood, hail, wind, etc… For our region the specific severe winter weather requirements from FORTIFIED © include:

- Ground snow loads 1.2x ASCE 7 or locally adopted ground snow loads
- Additional moisture barrier applied to roof deck of steep slopes to prevent intrusion caused by ice dams
- Extended from roof edge to at least 2ft towards interior of building beyond the exterior wall enclosing conditioned space
- No localized heat source installed in non-conditioned attic space such that it creates localized heating of the roof surface
- Uninsulated recessed lights shall not be installed where they could cause localized heating of the roof surface
- all attic or roof access doors between conditioned and non-conditioned space shall be treated as exterior doors, properly insulated, sealed and weather-stripped or gasketed
- all attic penetrations (stack vents, partition walls, electrical chases, etc…) shall be properly sealed and insulated
- protection from Frozen Pipes: Water pipe runs are prohibited in exterior walls and unheated spaces

Similar to the APA standards, FORTIFIED© for Safer Business is in its infancy, with limited availability or limited adoption to date. The website lists FORTIFIED© builders in Florida, Illinois, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Washington and Wisconsin. Consequently the immediate and direct implementation of FORTIFIED in the region may need to wait or be implemented in a more indirect a manner e.g. using similar standards in stretch codes or other means.



Figures 14, 15, 16 Source: esbsustainability.com

Think Small – Empire State Building

One of the trends that can be observed in both the FORTIFIED© and APA standards is to think small (images source: esbsustainability.com). That is to say, many of the micro level and site specific physical measures for both sustainability and resilience are actually not the "sexy" or large-scale measures that may get more press such as photovoltaic and other renewable energy or green roofs. More realistically, sustainability and resiliency can be achieved through much smaller measures such as new windows, better insulation, and increased daylighting. The realization of this will allow property or business owners in the region to install or construct many AERs at a low cost to developer or land owners. This may seem daunting or unrealistic but the Empire State Building recently implemented a massive number of AERs in a very old building that has incredibly complex ownership, costs and utility demands (Empire State Building Company 2013).

The Empire State Building went through an extensive and exhaustive study to decide what AERs to implement and ultimately they focused the majority of their effort on windows and radiative barriers. Ultimately one of the major measures decided on was to remanufacture existing insulated glass units (IGU) within the Empire State Building's approximately 6,500 double-hung windows to include suspended coasted film and gas fill (Empire State Building Company 2013). These windows decreased HVAC costs considerably because they insulated and helped maintain internal climate conditions as well as making the building much, much stronger because the thicker windows are more resilient and will withstand a more intense barrage of projectiles such as trees, debris, burning embers, etc… In addition, the Empire State Building's new windows allowed for the reduction of lighting power density in tenant spaces and increase daylighting which decreased HVAC costs through increased sunlight as well as decreasing utility demands through the reduction in the necessity of overhead lighting (Empire State Building Company 2013).

Building on this theme the Empire State Building implemented new chiller, HVAC and similar units to increase efficiency as well as installing radiative barriers behind radiator unites on the perimeter of the building. By pursuing such measures the building decreased both HVAC costs as well as the ambient temperature of the exterior of the building which can aid in the decrease of storm water runoff or snow melt runoff.

Figure 17 Before and After Retrofitting Source: https://www.northernplains.org/about-us/our-building/

Site Specific Environment – Home of the Range, Montana

Home of the Range was built as the home for the Northern Plains Resource Council (NPRC), a member of the Western Organization of Resource Councils (WORC) who built Home on the Range in Billings, MT. The measures taken are even more impressive given the age and poor quality of the original building. Although extremely exhaustive in their measures to accomplish this advanced energy retrofit, those which stand out use the site specific environment to the advantage of the facility. Specifically they chose to use the "big sky" that is symbolic of Montana and the northern plains. The building incorporates considerable daylighting strategies to the extent to where it is almost entirely daylight. Additionally the building has a 9.9 kilowatt photovoltaic system as well as a solar water heater on the roof (New Buildings Institute 2012).

Figure 18 Source: https://www.northernplains.org/about-us/our-building/

The NPRC and WORC had to face political and cultural hurdles to achieve their goals. The owners discuss having to make "believers" out of both architects and engineers in addition to getting variances for measures such as permeable pavements. By following these and other measures, Home on the Range is 51% better in terms of energy efficiency than the average US building while being in one of the least populated and most politically conservative states in the US. Lessons learned from Home on the Range can help on both the specific level for implementation strategies to overcome cultural or political hurdles as well as the more macro level focus on using an area's environment and weather to our benefit instead of trying to combat it (New Buildings Institute 2012).

Lessons and Applications

There are many standards, practices, energy conservation measures and implementation strategies that can be drawn from the APA Comprehensive Standards for Sustaining Places, FORTIFIED © for Safer Business, the Empire State Building and Home on the Range to put in place AERs that both promote sustainability and resiliency. The two general themes are to think small and use the natural surroundings to maximize opportunities for energy efficiency and resiliency. Specifically, focus should be on windows, insulation, HVAC and boilers as well as preservation and use of trees, shrubbery and other natural elements. Additionally implementation strategies can be taken from the APA standards as well as further review of other case studies, the Empire State Building and Home on the Range. Through this research the analysis concludes that energy efficiency retrofits should be implemented alongside resiliency retrofits.

Context of DVRPC Region

Purpose Statement

The purpose of this section is to provide a regional context of buildings types, their energy use, and of municipal attitudes and activities' relating to energy efficiency in the private sector in the Delaware Valley Regional Planning Commission Region. To accomplish this goal, the research team performed two tasks: Created a building profile using building data gathered from CoStar Database and energy intensities derived from CBECS data; and developed a survey with the Delaware Valley Regional Planning Commission. The purpose of the survey is to determine what municipalities in the region are doing to promote energy efficiency in the private sector. This paper outlines the region, methodologies and documents findings related to both tasks.

DVRPC Regional Background

The Delaware River Valley Region is comprised of nine counties across two states in the Northeast USA. In Pennsylvania, Delaware Valley Region counties include; Montgomery, Bucks, Delaware, Chester and Philadelphia. Camden, Burlington, Gloucester and Mercer counties are in New Jersey. This region is important for several reasons. Most importantly is the population; Philadelphia (1st), Montgomery (3rd), Bucks (4th), Delaware (5th) counties rank among the most populous in Pennsylvania. The total population of the Pennsylvania counties is 4,008,994. The New Jersey county population ranks are; Camden (8th), Burlington (11th), Mercer (12th) and Gloucester (14th). While less relatively populated by rank, the sum population of these New Jersey counties is 1,617,192.

Together the Delaware River Valley region had a 2010 population of 5,626,186 (U.S. Census 2010); a significant population and a worthwhile target area for energy efficiency implementation. Further, the Philadelphia-Camden-Trenton-Wilmington (Delaware) metropolitan area is the fifth largest in the United States as of 2010 (U.S. Census 2013). The implication is that energy-efficiency standards, plans and/or incentives adopted in these areas are going to be applied to many buildings and thus magnify the net energy savings.

The composition of the counties vary between heavily urban and primarily forest. Of important note is that the Delaware River Valley area encompasses two different CBECS climate zones:

> "The CBECS climate zones are groups of climate divisions, as defined by the National Oceanic and Atmospheric Administration (NOAA), which are regions within a state that are as climatically homogeneous as possible. Each NOAA

> climate division is placed into one of five CBECS climate zones based on its 30-year average heating degree-days (HDD) and cooling degree-days (CDD) for the period 1971 through 2000 (U.S. Energy Information Administration 2010)."

A CDD is an indicator of how hot an area was over a period of time, relative to a base temperature (65 Fahrenheit), and a HDD is an indicator of how cold an area was over a period of time, relative to that same base temperature. The difference (either above or below 65 Fahrenheit is used to calculate the total heating or cooling degree-days. For example, if the average temperature of a single day is 80 degrees, then the cooling degree-days for that specific day equals (80-65=15) 15 cooling degree-days. The same applies for heating degree-days, but for average temperatures below 65 Fahrenheit. The difference between the two climate zones in the Delaware River Valley Region is in the amount of annual heating degree-days. As the focus of the research is on energy-efficiency, it is important that this climate zone difference is taken into account during data analysis.

Municipal Energy Efficiency Survey

Survey Background and Methodology

In Fall 2013, the Rutgers Center for Green Building and Delaware Valley Regional Planning Commission aided the Rutgers Studio research team to create and distribute a survey to better understand energy efficiency implementation. The goal was to better understand energy efficiency efforts at the municipal scale to help private commercial building owners and managers interested in pursuing energy efficiency building upgrades. The research results from the survey are valuable because energy efficiency building upgrades save money on operating costs and reduce energy use. In addition, it is useful because the data will come directly from the communities that the research team is focused on aiding. Therefore, the data from the survey will be both locally relevant and up-to-date.

The survey was designed by Rutgers graduate students in the Urban Planning program, with help from the Rutgers Center for Green Building and the DVRPC. The survey research is confidential and designed to inform Rutgers' study to identify energy efficiency building investment trends. The survey response from the survey will educate the research group; and thus aid in reducing the emissions of pollutants and greenhouse gasses as part of regional efforts to make a more sustainable community. At the most basic level, the survey was created in order to obtain information that will help the research team with decision-making and policy-recommendations.

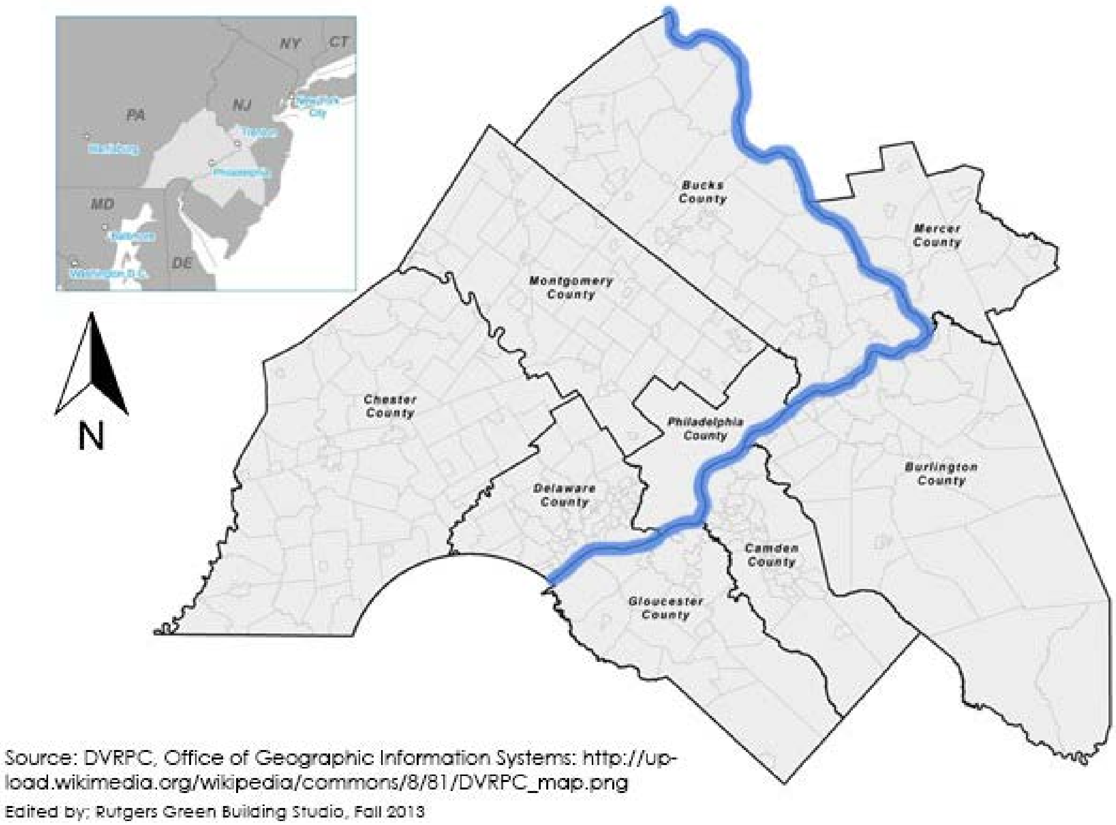


Figure 19 Delaware River Valley Region Planning Area

Survey Findings

The findings from the research team's 2013 Survey show that there is a modest presence of energy efficiency and sustainability in the Pennsylvania portion of the Delaware Valley Regional Planning Commission region. There are several levels of government and categorical metrics that indicate the varying levels of green policy. Factors were compared to an analogous response rate from a 2009 DVRPC survey, which allows for directions and trends to be determined. Table 1 lists these analogous questions:

Table 1: Analogous Questions in 2009 & 2013 Survey

Question in 2013 Survey	Question in 2009 Survey
Is there an individual in the municipality who is responsible for overseeing municipal activities related to energy use by commercial/multifamily building owners?	Does your municipality have any citizens' commissions related to the maintenance of natural resources or sustainability committee?
Has the municipality adopted any ordinances to promote energy efficiency in commercial and/or multifamily buildings?	Has the municipality adopted any ordinance enacting policies related to sustainability?

Please indicate the status of the development of initiatives that training about energy efficiency for commercial building owners and tenants.	Does your municipality offer any green fairs or other educational forums related to local environmental sustainability initiatives?
Does the municipality master plan set goals for energy efficiency in commercial and/or multifamily buildings?	Does your municipality set any greenhouse gas reduction targets?
Please check the types of energy efficiency projects that are common in commercial buildings in your municipality (check all that apply)?	Has the municipality implement any energy efficiency upgrades in municipal owned or operated facilities?

For the first metric there is a lack of leadership and role specialization; the survey shows that only one fifth of the respondents have a designated municipal appointee in command of energy efficiency/sustainable matters. It is important to note that this does not intrinsically imply a lack of interest in green policy by a municipality. However it certainly shows where the municipalities priorities lie. With only 21% of survey responses stating they have a specialized administrator for green policy, many of the municipalities either; do not have the resources for such an office, or the municipality has determined that it does not want to invest in such an office. However, the 2009 DVRPC survey responses showed a rate of 15%, which suggests an increasing trend in the creation/appointment of municipal administrators in charge of energy efficiency.

A second metric of green policy in the DVRPC region is the rate of adoption of energy efficiency ordinances. The 2013 survey shows that only 16% of the respondent municipalities have enacted energy efficiency ordinances compared to 13% in 2009. The gains made in this field are modest, but still trending upwards. This is an especially noteworthy metric because the “stick” of legal ordinances is one of the most potent tools a municipality has in the pursuit of energy efficiency in its building stock.

A third metric is the “soft power” of education, municipal outreach programs, offering specialist training, and citizen empowerment through knowledge. Municipalities can foster energy efficiency by distributing information about state/federal energy efficiency programs, or providing training on energy efficiency to commercial building owners and tenants, and much more. Our survey respondents show that 21% have used the tool of education to promote energy efficiency in their building stock, compared to 15% in the 2009 survey. Soft power is an interesting and more nebulous factor than metric one because the capacity and also plausibility of energy education varies wildly by the specifics of that municipality. For example, one of our respondent municipalities stated “Township is rural, mostly, residential, practically no commercial development” (Pipersville, PA). It is unlikely for an educational strategy to be employed by that specific municipality because there is not a large enough commercial/multi-family building stock to provide a positive energy efficient return on invest.

A fourth metric is related to the goals for energy efficiency. The research survey asked municipalities; "Does the municipality master plan set goals for energy efficiency in commercial and/or multifamily buildings?" Only 10% of the respondent municipalities replied in the affirmative. 2009 survey asked municipalities "Does your municipality set any greenhouse gas reduction targets?", and also had a 10% response rate. However, the meaning for these 10% rates is different. Having goals for energy efficiency in the master plan is an important factor in promoting energy efficiency in municipality level, which shows green policy, has become more popular and prevalent in American society.

Finally, there is a fifth factor in gauging energy efficiency practices of the respondent municipalities, physical results. In other words, has the municipality actually implemented building upgrades in municipal facilities? Here the research team observed the largest net gain in rates from the 2009 DVRPC Survey to the 2013 Bloustein Studio Survey. In 2009, 39% of respondent municipalities affirmed that they had implemented energy efficient building upgrades. However, in 2013 that number grew to 66%. This physical factor is a nuanced indicator and suggests that municipalities have much more demand, and/or capacity, to create energy efficiency in public buildings than in the private sector. The rest of the survey questions that are not comparable are summarized below:

Findings for the 2013 Energy Efficiency Survey:

- 48% of municipalities reported that the implementation of projects intended to reduce energy use in municipal operations have been completed. 21% of municipalities reported streetlight retrofits have been completed. 52% reported traffic signal upgrades have been completed. These findings show that the most implemented upgrade is to traffic signals. A close second most implemented upgrade is the implementation of projects intended to reduce energy use in municipal operations. However it worth further research to more accurately define what those energy use projects are, and if the municipality has planned for any further energy efficiency projects.
- Half of the respondents reported that there is no civilian demand upon the municipality for aid in pursuing energy efficiency in their buildings.
- 27% of the municipality responses reported no demand for incentivizing energy efficiency through easing building permit requirements. 42% reported very low demand.
- 98% of municipalities are not aware of energy efficiency upgrade permit requests that were rejected due to existing zoning or design standards. One possible reason might be that some EE retrofits do not necessarily require a permit. Further research is warranted.
- 25% of the respondent municipalities support and encourage performance based pathways to complying with energy code. Examples include the Whole Building Modeling Approach of ASHRAE 90.1 and IECC performance-based compliance. However, 69% of municipalities reported no preference on it.

- 83% of municipalities in Pennsylvania have "opted in" to locally amend and enforce the International Building Code, International Energy Conservation Code and the International Existing Building Code. The reason for "opted-out" could vary from economic burden implications for small municipalities, to political barriers in larger municipalities. Further research is warranted to determine municipal motives in deciding to "opt-in" or not.

In conclusion, the five factors of analysis offer useful insights into the change of energy efficiency attitudes and practices of municipalities over time. This report serves as a great fact resource for planners in the policy-making arena. Some tentative conclusions can be drawn from the trends in comparing the survey responses.

The relative low level of regulatory changes (a mere 16% adoption of EE ordinances) to the relatively high level of physical factors (66% implemented building upgrades) suggest that there are political barriers that impede the municipality from implementing green policy in the private sector. There is a clear will and capacity of many of the responding municipalities to "go green" with their own building stock, yet this green attitude has not translated to the private sector.

However, the above conclusion is muddied because there is a constant 10% rate of direct energy efficiency goals present in the master plan. This is a curious observation because there was an increase in the administrative, legal, educational and physical factors from 2009 to 2013. It seems plausible that as green attitudes became more popular, there would be an increase in explicit energy efficiency goals in official planning documents. Yet this is not what the survey has observed, and further research is warranted.

Building Stock Analysis

Methodology

A building stock analysis was prepared in order to build a more accurate picture of the existing building stock that can help inform decision-makers about policy and planning initiatives related to energy efficiency in the private sector. Due to data limitations, the summary focuses on the five counties in Pennsylvania. In addition, energy estimates were estimated using energy use per square foot estimates derived from CBECS data. The estimates are based on building data taken from the CoStar database. This database includes information on the buildings location, use type, year built, and rentable square footage.

Building type was broken down into twenty-eight different categories. Table 2 lists these uses:

Table 2: Property Types			
Flex	General Retail	Industrial	Office (Strip Center)

	(Regional Mall)	(Regional Mall)	
General Retail	General Retail (Strip Center)	Industrial (Strip Center)	Office (Super Regional Mall)
General Retail (Community Center)	General Retail (Super Regional Mall)	Office	Specialty
General Retail (Lifestyle Center)	Health Care	Office (Community Center)	Specialty (Community Center)
General Retail (Neighborhood Center)	Hospitality	Office (Lifestyle Center)	Specialty (Neighborhood Center)
General Retail (Outlet Center)	Hospitality (Community Center)	Office (Neighborhood Center)	Sports & Entertainment
General Retail (Power Center)	Industrial	Office (Power Center)	Sports & Entertainment (Power Center)

However, due to a lack of information of how to estimate energy uses, or being out of the scope of this studio some property types were removed, and some were added to others. Types removed included: Health Care, Hospitality, Hospitality (Community Center), Industrial, Industrial (Regional Mall), Industrial (Strip Center), Specialty, Specialty (Community Center), Specialty (Neighborhood Center), Sport & entertainment, and Sports & Entertainment (Power Center). All General Retail types were combined, with the exception of three: General Retail (Regional Mall) and General Retail (Super Regional Mall) were added to a new type titled "Mall"; any General Retail properties that had a secondary use of either "Fast Food" or "Restaurant" were added to a "Food Service" group; and any property with secondary use "Supermarkets" was added to a new type labeled "Food Sales." Additionally, all Office types were combined to a single type called "Office." In total, the data is broken into six types: Flex, Food Service, Food Sales, Mall, Office, and General Retail. After these reductions 22,874 properties remained (down from 30,052 properties).

The energy projections were calculated using the same Major Fuel and Electricity Intensities calculated from CBECs in the previous section. The following assumptions were made. Flex building type is defined by CoStar as:

"A type of building(s) designed to be versatile, which may be used in combination with office (corporate headquarters), research and development, quasi-retail sales, and including but not limited to industrial, warehouse, and distribution uses. At least half of the rentable area of the building must be used as office space. Flex buildings typically have ceiling heights under 18', with light industrial zoning. Flex buildings have also been called Incubator, Tech and Showroom buildings in markets throughout the country (CoStar 2013)."

As such, the energy use calculations were determined by the following formula: '(Rentable Building Area x 0.5) x Office Energy Intensity.' Thus, calculations provide an underestimate of actual energy use. Additionally, due to gaps in the CBECs data, energy projections of malls built in 2000 or later were based on 1990-1999 mall energy intensities, and malls built in 1927 were based on 1946 mall energy intensities. Lastly, all property types built before 1880 were excluded.

One limitation of the CoStar data was a lack of total square footage for the building. The data only includes rentable square footage. There is no way to determine how much of a building's total square footage was not included. For these reasons, these projects should not be used as true energy consumption. However, since all properties are subjected to this limitation the data is still useful as a relative data, and areas and buildings with high-energy consumption can still be identified.

Another limitation is that the CoStar data divided the study area by both municipality boundary and census tract boundary, which did not match the GIS data well (GIS data only has the municipality boundary). For example, Willow Grove, a census-designated place in Montgomery County, is located in three different townships: Upper Dublin Township, Abington Township, and Upper Moreland Township. We cannot directly asset the number of buildings in Willow Grove to these three townships and more detail research on the location of each building should be conducted for future study.

Summary of Findings

Building Stock

The data was analyzed in a number of ways to gain an understanding of the types of buildings that are located within the PA DVRPC region. In terms of property type, we found that a majority of buildings are General Retail (54.99%), followed by Office (34.99%) Figure 2 summarizes the rest of this data. In terms of year of construction we see a more even distribution. Buildings built between 1920 – 1929 accounted for the largest percentage, 12.49%, followed by buildings built between 1980 – 1989 (11.43%), 1970 – 1979 (10.91%), and 1960 – 1969 (10.14%) TABLE in the appendix provides additional information about this data.

Building sizes were very varied. The range was between 100 SQ FT to 2,291,103 SQ FT. The mean building size is 18,182 SQ FT, the median is 4,640 SQ FT, and the mode was 3,000 square feet. Due to the size difference between the mean and median, it can be concluded that building size is skewed to the right, suggesting that there is a small proportion of very large buildings. A majority of buildings are small, between 100 and 5000 SQ FT (52.78%). Figure 3 summarizes the rest of this data. Due to the large percentage of buildings being between 100 and 5,000 SQ FT, this data was broken down further in table 2.

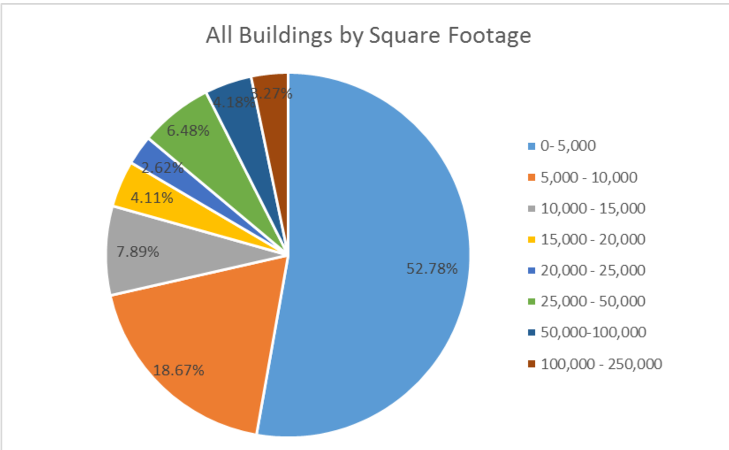


Figure 20

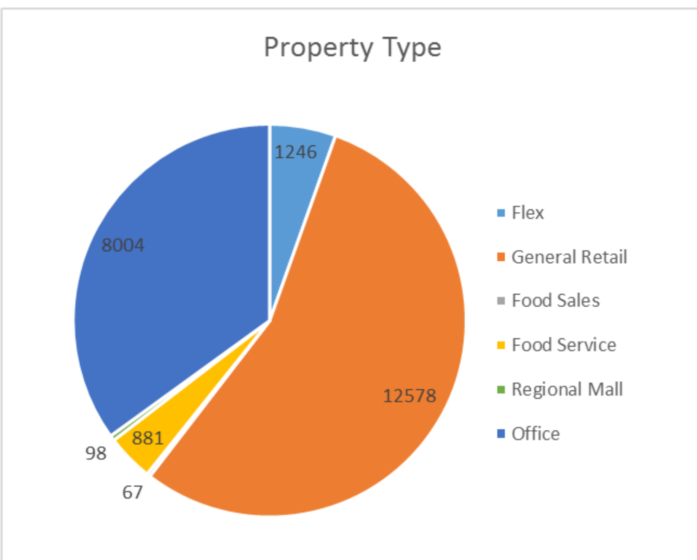


Figure 21

Small Buildings	Count	Percentages of Small Buildings	Percentage of Total Buildings
0 – 1000	594	4.92%	2.60%
1000 – 2000	3362	27.84%	14.70%
2000 – 3000	3867	32.03%	16.91%
3000 – 4000	2596	21.50%	11.35%
4000 – 5000	1655	13.71%	7.24%
Total	12074		

Table 2: Percentage of Buildings by Sq. Ft.

Energy Projections

Energy usage was broken down by "Property Type" and "Rentable Building Area." By far the largest energy user was Office Buildings. Office buildings accounted for 63.13% of major fuel energy consumption and 62.70% of electricity consumption. Retail buildings were the second biggest user of energy, accounting for 22.37% of major fuel consumption and 22.26% of electricity consumption. Table 3 summarizes the rest of this data:

Table 3: Percentage of Energy Use by Building Type

Property Type	% MF Consumption	% EL Consumption	% of Total Buildings
Flex	5.76%	5.82%	5.45%
Food Sales	1.35%	1.64%	0.29%
Food Service	2.70%	1.46%	3.85%
General Retail	22.37%	22.26%	54.99%
Office	63.13%	62.70%	34.99%
Regional Mall	4.68%	6.13%	0.43%
Grand Total	100.00%	100.00%	100.00%

By size of buildings, the largest (50,000 sq. ft. plus) buildings consumed more energy than the smaller (less than 50,000 sq. ft.) buildings, despite having a significantly smaller percentage of the total buildings. Figure 4 summarizes this data:

Energy Use and Number of Buildings by sq. Ft.

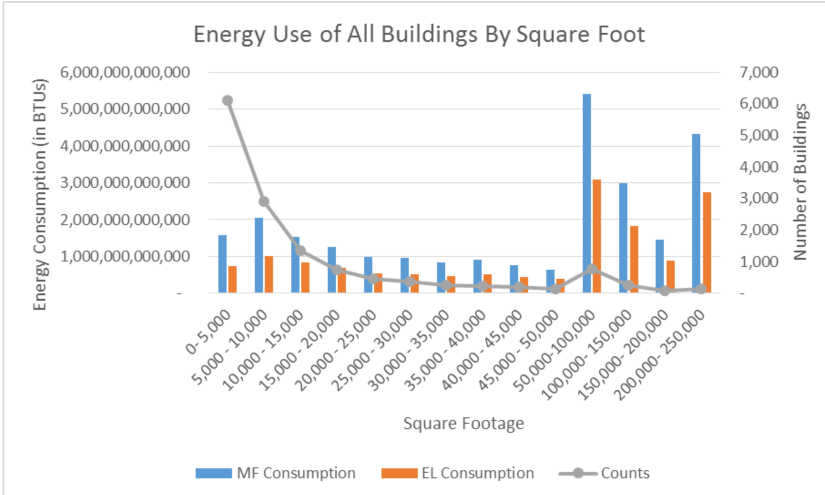


Figure 22

Office buildings made up 48.41% of larger buildings (greater than 50,000 SQ FT), followed by General Retail, which made up 32.47%, and flex, which made up 14.56%. Regional Malls, Food Sales, and Food Service, combined made up less than 5% of the building stock. Table 4 summarizes this data:

Top Energy Consumers

Based on this data the top 10 energy-consuming municipalities were identified. Notable Municipalities identified were Philadelphia and King of Prussia. As to be expected, the largest energy consumer by far was Philadelphia. This is beneficial since a large amount of energy savings can be achieved through changes in a single Governmental entity. Philadelphia, as per the city master plan, seeks to reduce energy consumption by 10% (Green Buildings Studio 2013). If achieved, the city can reduce 1501.6 million BTU's of major fuel usage and 787.7 million BTU's of electricity consumption. This is more major fuel and electricity than Malvern (third largest user) uses for its entire building stock. Table 4 summarizes the rest of the municipalities, and their energy usage.

Additionally, all top municipalities, with the exception of Pottstown, have their Office Buildings as their largest consumer of energy, followed by retail. However, if the municipalities King of Prussia, Langhorne, North Wales, have Regional Mall as their second highest energy consumer.

Table 4: Top 10 Energy Using Municipalities

Municipality	MF Usage (Million BTU)	EL Consumption (Million BTU)
Philadelphia	15,016	7,877
Upper Merion (KOP)	2,447	1,426
Malvern	1,131	600

West Chester	1,025	569
Norristown	877	462
Horsham	862	450
Langhorne	611	365
Conshohocken	601	338
North Wales	510	334
Pottstown	500	292

Need for Data Collection Improvement

As stated previously, the data used in these estimates was not collected by the Municipalities themselves. Instead, a third party, CoStar, collected it. Of all of the counties in both New Jersey and Pennsylvania, only one county, Montgomery County, had parcel data that included fields such as "use," "year built," and square footage. Many counties did have information of newly constructed buildings publically available. Chester County of Pennsylvania has parcel-specific data on energy use when it is shown on a land development plan, but this data is not aggregated. The other counties lacked this data completely.

New Jersey counties do have parcel data available in a shape file and excel file. The data is titled MOD IV data, however it is very limited. Square footage was only available for a small percentage of the data. When square footage was listed, it was not in its own column, and would require manual extraction. Additionally, property use was not available at all. Year built however was available. It would be very beneficial for future research to have this data readily available. Montgomery County is a good model for how other counties should be recording their parcel data.

Conclusion

A regional energy efficiency context was created by this research group to provide a large-scale backdrop to complement the previous research in this report. To create this regional context, two research tools were created. The research group focused on a study area that contains five counties; Bucks, Chester, Delaware, Montgomery and Philadelphia. These counties are all among the top 10 most populous in the state, which makes it ripe for energy efficiency research.

Our first research tool is a building energy use estimate. Building energy consumption by year, use and size were calculated using CoStar and CBECS data. To ensure uniformity across the entire studio project, our group employed the same methodology as the King of Prussia research group. This energy use estimate offered a ranking of municipalities by energy consumption. Philadelphia consumes more energy than the next nine municipalities combined.

The building energy use estimates also offered insight into different building trait energy use patterns. A worthwhile observation is that while the majority of buildings are general retail, our research shows that office buildings consume more total energy. Diving a little deeper; when looking at buildings with more than 50,000 square feet, the most common use is office. There is a much larger count for smaller buildings, but the majority of energy consumption is by units 50,000 square feet or larger. These discoveries taken in sum supported our previous targeting conclusion; energy efficiency solutions should focus on offices.

Year constructed is an additional building trait that reveals energy consumption patterns. For offices the highest energy consumers were built in 1980-89, and for retail it is buildings constructed after 2000.

The second toolset created by the research group was an energy efficiency survey. The research was built on two different surveys. The first was a 2009 sustainability survey created by the DVRPC. The second was a 2013 survey created by this studio. By comparing and contrasting the surveys, policy-makers are able to gauge shifts in sustainable attitudes and practices. The surveys reveal increases; in the administrative, legal, educational, and physical metrics. Surprisingly there are no gains in the master plan metric.

Our research group has created two different resources to guide policy. The surveys offer a baseline of energy efficiency attitudes and practices. While the energy estimates serve as an inexpensive alternative to data acquisition. The two toolsets created by this research group revealed new information on energy efficiency in the study region. The surveys revealed; modest increases in most metrics, but a large increase in implemented building upgrades. For Energy Estimates, the research suggested that energy efficiency policy should target office buildings.

King of Prussia/Upper Merion Township: A Case Study in the Delaware Valley

Introduction

The case study for the Delaware Valley region in this studio is King of Prussia Business Park, located in Upper Merion Township, Montgomery County, Pennsylvania. Located approximately 20 miles from Center City Philadelphia and sited at the intersection of several major regional roads and highways, the King of Prussia area (a census designated place) has become the largest employment center outside of Philadelphia in the entire region, home to over 57,000 jobs and over 13 million square feet of office space (KOP-BID 2013). In addition to the Business Park, King of Prussia is home to the largest retail mall in the eastern United States, with over 4 million square feet of leasable retail space and over 25,000 daily visitors. As the second largest employment center in the region, and home to a large share of regional commercial building stock, Upper Merion and King of Prussia (KOP) are an ideal case study for examining policies for energy–efficient retrofits.

Credit: Connect KOP

Figure 23 Map of King of Prussia

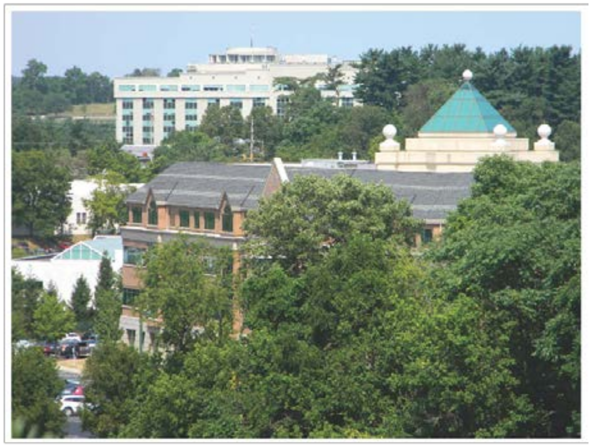
This analysis set out to identify the buildings that consume the most energy and demonstrate the benefits of using advanced energy retrofits to greatly reduce the energy intensity of the building stock. Once the building stock analysis is complete, with a baseline estimate for current energy consumption in the King of Prussia area, our case study examined possible solutions that will encourage retrofits in existing buildings. These recommendations consist of both site specific solutions, designed to impact behavior within a single structure and district wide solutions, which will utilize and leverage the existing network of stakeholders (in particular the King of Prussia Business Improvement District and the municipal government of Upper Merion Township) to encourage property owners to undertake retrofits and embrace energy reduction behavior. Policies and strategies have been developed to suit the Pennsylvania and local context in the form of an implementation plan that municipalities can use to promote energy efficiency.

Methodology

As part of our methodology, the group made a site visit to Upper Merion Township and the King of Prussia Business Park, and conducted numerous conversations with Eric Goldstein, Executive Director of the King of Prussia Business Improvement District (KOP-BID). The site visit exposed the group to existing form of development in King of Prussia, some of the existing energy-efficient buildings in the area (buildings that have received LEED certification) as well as the envisioned changes to the area through new development and the proposed zoning code overhaul. Further conversations with Mr. Goldstein helped us to understand the business conditions in the region and identify key points of leverage to encourage properties to undertake energy retrofits. For the last part on the background of King of Prussia, the group examined the existing zoning code for King of Prussia (which falls under two designations, SM and SM-1, the Suburban Metropolitan use districts) and compared the regulations to those proposed by the draft zoning code for the Suburban Metropolitan District (which would cover existing SM and SM-1 districts as well as other sections of Upper Merion with strip mall development). The proposed code consisted of bulk and use regulations, as well as style guidelines. Our study was restricted to the bulk and use regulations.

Energy data is not included in the building stock data collected by Montgomery County. In order to estimate the energy consumption of the King of Prussia building stock, we first downloaded the 2003 Commercial Buildings Energy Consumption Survey data (CBECS) from the U.S Energy Information Administration website and analyzed the data. CBECS is a "national sample survey that collects information on the stock of U.S. commercial buildings, their energy-related building characteristics, and their energy consumption and expenditures" (EIA, n.d.). The most current survey data available from CBECS describes building characteristics from 2003. The Mid Atlantic CBECS microdata was sorted out by square feet, year built, and the principal activity. The data was further narrowed down to the principal activity categories that best reflected the commercial building stock in King of Prussia.

Site visit to KOP. Credit: Jennifer Souder.

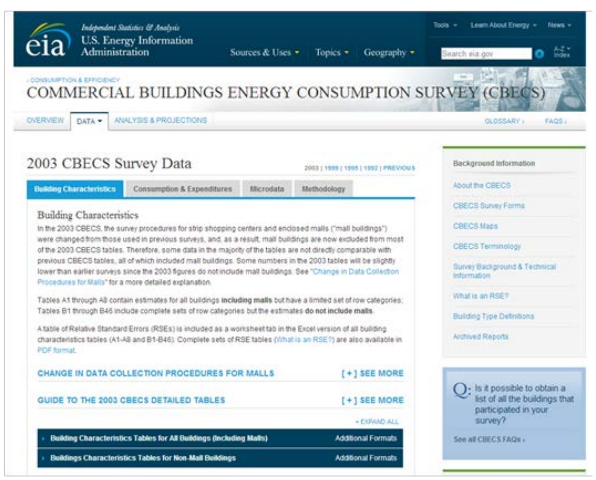


Aerial view of KOP Business Park. Credit: King of Prussia BID.

Figure 24 Site Visit to King of Prussia

Figure 25 Physical Improvements to the KOP Business District through Landscaping and Signage

151 Warner Road, Liberty Property Trust. Credit: King of Prussia BID.



CBECS website: http://www.eia.gov/consumption/commercial

Figure 26 Liberty Property Building Trust in KOP and CBECS Analysis

The following commercial categories were identified for analysis based on their relevance to the King of Prussia building stock: Office, Labs, Food Services, Food Sales, Lodging, Vacant, Mall, Retail, and other Services. These commercial categories were sorted out by the building year of construction, square footage, major fuel consumption and electricity consumption. The sorted information for each category was organized by year of construction, since buildings constructed during a particular decade have similar energy consumption rates per square foot.

It is important to acknowledge that the regulatory framework has a marked impact when examining CBECS microdata. In the late 1970s, to combat the impacts of the American Energy Crisis, energy standards were codified by the National Council of States on Building Codes and Standards (NCSBCS) in its 1977 model code (US DOE 2008). While these standards have been updated many times since their inception, the introduction of energy standards makes a clear demarcation in the dataset, since buildings erected before the implementation of the standards may not have been required to renovate to present standards. To that end, energy intensities were calculated by sampling buildings in the CBECS constructed in the same decade or grouping. This helps to distinguish energy intensity as it relates to the regulatory framework that was present at the time of construction.

The total major fuel consumption and electricity consumption was calculated for each building age category. Building samples that exceeded 300,000 square feet were excluded, since no buildings in our case study equaled or exceeded this size threshold. In order to translate energy consumption into energy intensity rates per square foot, major fuel and electricity consumption figures were multiplied by 1000 BTUs and divided by total square feet of all the buildings in that decade. Energy intensity is a measure of energy per square foot per year. Energy intensity analysis was focused on the samples of office buildings for two main reasons. The CBECS microdata had a relatively high number of office building samples in comparison to other principal activities. In addition, office buildings are the most prominent principal activity in King of Prussia’s Business Improvement District.

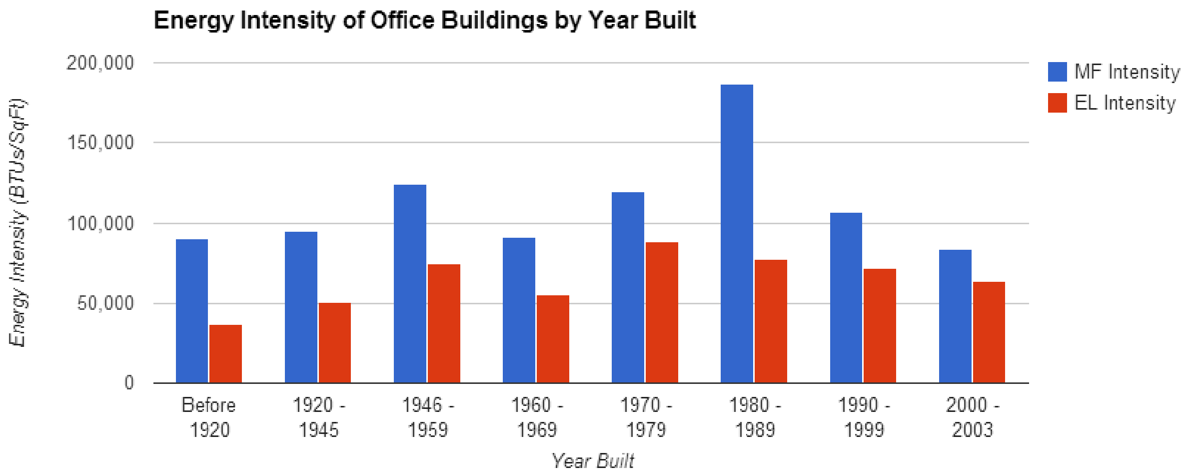


Figure 27 Energy Intensity of Office Buildings by Year Built

Energy Intensity Estimates

	Vacant	Office	Laboratories	Food Sales	Food Service	Lodging	Mall	Retail (Other)	Service
Year Built	**Major Fuel Intensity (BTUs/sqft)**								
Before 1920	67,890	**90,034**		524,790	193,397	28,743		64,389	87,001
1920 - 1945	3,208	**95,193**		220,285	177,649	102,993		104,057	57,580
1946 - 1959	2,141	**124,177**		193,184	153,525	189,145	76,590	100,236	44,337
1960 - 1969	12,182	**91,128**	139,360	127,224	141,247	93,721	75,933	31,799	106,367
1970 - 1979		**119,462**	369,723	225,815	193,897	119,512	159,642	36,307	17,190
1980 - 1989	50,454	**187,301**	271,241	66,598	671,722	81,365	84,928	59,579	54,775
1990 - 1999	27,813	**106,634**	334,161	220,939	177,630	146,373	99,313	65,900	106,631
2000 - 2003	28,533	**84,103**		158,535	436,837			89,293	

Energy intensity estimates were derived from CBECS data (2003)

Figure 28 Energy Intensity Estimates derived from CBECS data

After applying the CBECS data results of energy intensity to the square footage of buildings in King of Prussia's SM district, the greatest energy users among the building stock were identified by both their age-specific energy intensity and the size of the building, as both of these factors contribute to total energy consumption. Identifying these problem sites is a key component to improving energy efficiency throughout the district.

Upper Merion Township, PA and the King of Prussia Business Park

Existing Zoning Code and Proposed Zoning Code Overhaul

The major stakeholders in the case study are the municipal government for the Township of Upper Merion and KOP-BID, which represents property owners in the Business Park, the Mall, and other commercial corridors in the Township. KOP-BID and the Township have been working together on the zoning code overhaul, including proposed changes to the zoning codes regulating uses in the Business Park. At present, the Business Park is covered by the Suburban-Metropolitan 1 zone in the Upper Merion zoning code. The existing code permits offices, laboratories, hotels, light manufacturing and warehousing to be constructed in the district. Retail and drive in restaurants are explicitly forbidden (Upper Merion Township Code Section 135). While some industrial activities remain, many warehouses and manufacturing facilities have been converted to office space.

The zoning code has led to the creation of a single use district, dominated by offices, with few buildings devoted to other uses. Existing zoning codes have also required large quantities of off-street parking (4 spaces per 1,000 square feet of office space) and large setbacks from the street, prohibited lot coverage greater than 50%, and prohibited buildings taller than 65 feet, which has resulted in an inefficient allocation of land (Upper Merion Township Code Section 191). As the Business Park is nearly built out in its present form, KOP and the Township undertook the zoning code overhaul as a means to ensure the Business Park remains economically viable and continues to meet demand for additional office space.

Tied in with the goals of maintaining the competitive edge in the suburban commercial real estate market, KOP and the Township decided that the zoning code overhaul would simultaneously promote two goals: enabling the Business Park to develop mixed use properties, with retail and residential units alongside offices, and encouraging the adoption of sustainable construction techniques and energy efficient building practices. The former goal will be achieved by permitting a greater variety of activities inside the Business Park's zoning district: this will now include multifamily housing, convenience stores, liquor stores, florists and hardware stores, among others. The latter goal (the focus of this studio) is achieved through the offer of density bonuses (permitting a larger building than the regular zoning code) for including sustainability elements in building designs (Upper Merion Township 2013).

The proposed code creates two tiers of bonuses, tied to particular sustainability improvements that must be met in order to gain approval for the density bonuses. The bonuses are also tied to the size of the lot the proposed buildings will sit on. A lot that is at least 4 acres in size will be allowed to have a building that is 65 feet tall and cover 65% of the lot area (this is already an increase in allowable building coverage, representing a 30% increase in building coverage permitted). If developers include enough practices to reach the first tier, their building will be allowed to cover up to 70% of the lot area and go up to 80 feet in height. If developers include enough practices to qualify for the second sustainability tier the building can be up to 120 feet tall and cover 75% of the lot. Compared to the existing zoning code, a building that includes the required sustainability practices can be as much as twice as tall as existing buildings and cover nearly 50% of the lot area. The sustainability practices run the gamut from the small (waterless urinals, shared parking with different uses in order to reduce the amount of off-site parking) to the large scale (installing solar panels to generate 20% of electrical power, or vegetable roofs or greywater filtration systems) in order to achieve the density bonuses.

While the proposed zoning code overhaul may bring many positive benefits to the King of Prussia Business Park, particularly through diversifying building uses and economic activities, the sustainability elements included in the zoning code overhaul will not likely be applicable to existing commercial buildings in the Business Park. This is due to the fact that zoning codes are only applicable to existing buildings when the owner seeks to change the active use of buildings, or when new buildings are proposed as additions or in place of the existing structure. As the zoning code continues to permit commercial office space, buildings that retain that use will not be compelled to enact any sustainability measures in exchange for incentives offered in the zoning code. Due to the nature of the building stock in the business park, any property owners that wish to pursue mixed-use development will likely need to start over on their properties, tearing down the existing structure in order to construct a new building, or massively renovate and expand the existing structure, both of which would then fall under the guidelines of the new zoning code. Thanks to the zoning code overhaul, it may be more likely that the enactment of sustainable building practices will be achieved in King of Prussia through a significant program of demolishing and replacing the existing building stock with more efficient multi-use buildings than encouraging existing buildings to undergo efficiency retrofits. Therefore, other efforts must be undertaken to persuade owners of the remaining building stock on the benefits of energy efficiency improvements and renovations.

SM and SM-1 District Building Profile

This study focused on energy efficiency improvements that can be achieved among office buildings located in Upper Merion's SM and SM-1 districts. Within these districts, there are 72 reported office buildings or buildings with an office component, comprising about 70% of the total building stock in the district. The office buildings are evenly distributed across year of construction, with roughly one quarter of the buildings having been constructed in each of three decades: 1970-79, 1980-89, and 1990-99. Only 7% of the office buildings in the district have been constructed since 2000. In terms of size, the majority of office buildings are mid-sized, falling within the ranges of 25,000-50,000 sf and 50,000-100,000 sf (Figure 32).

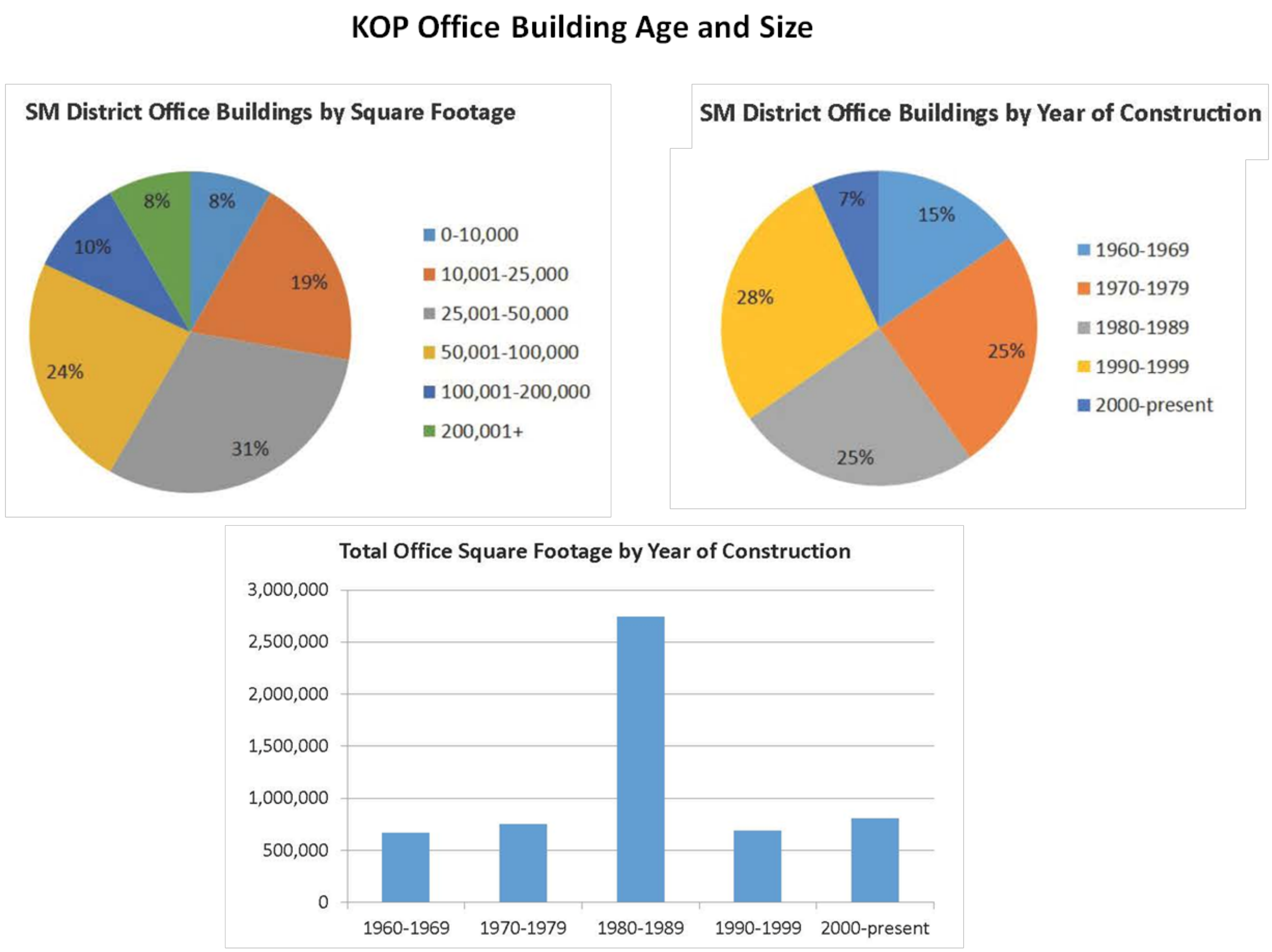


Figure 29 King of Prussia Office Building Profile

After calculating an estimated intensity of energy use per square foot for each decade of construction using the CBECS data, this measure of energy use was applied to the square footage of the office buildings in King of Prussia's SM and SM-1 districts. The result is a comparison of total and average energy use among office buildings by year of construction. Figures 3a and 3b illustrate the total and average energy use by year of construction, both for all fuels and electricity alone. The outliers among total energy use are the buildings constructed from 1980-1989. Among average energy use, the 1980s are again a major outlier, though the most recently constructed buildings also emerge as high energy users. The high average energy use among buildings constructed since 2000 is attributable to the size of these buildings, all of which are larger than 100,000 sf. Their estimated energy intensity according to the results of the CBECS analysis is the lowest of any decade. The office buildings constructed from 1980-1989 have high energy intensity based on the CBECS and high total and average energy consumption based on square footage. Based on these results, the buildings constructed from

1980-1989 and since 2000 will be the focus of recommendations for energy efficiency investments.

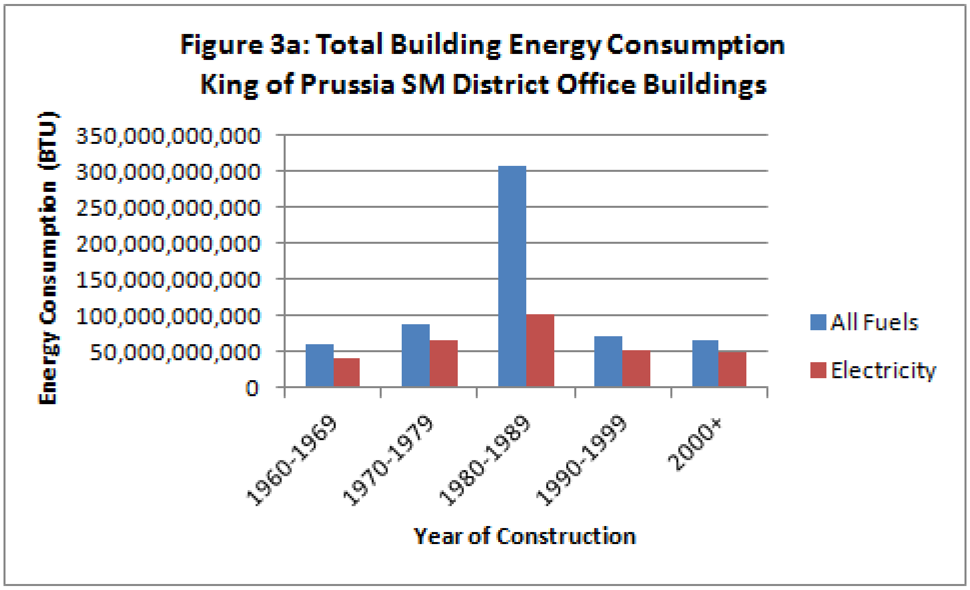


Figure 30

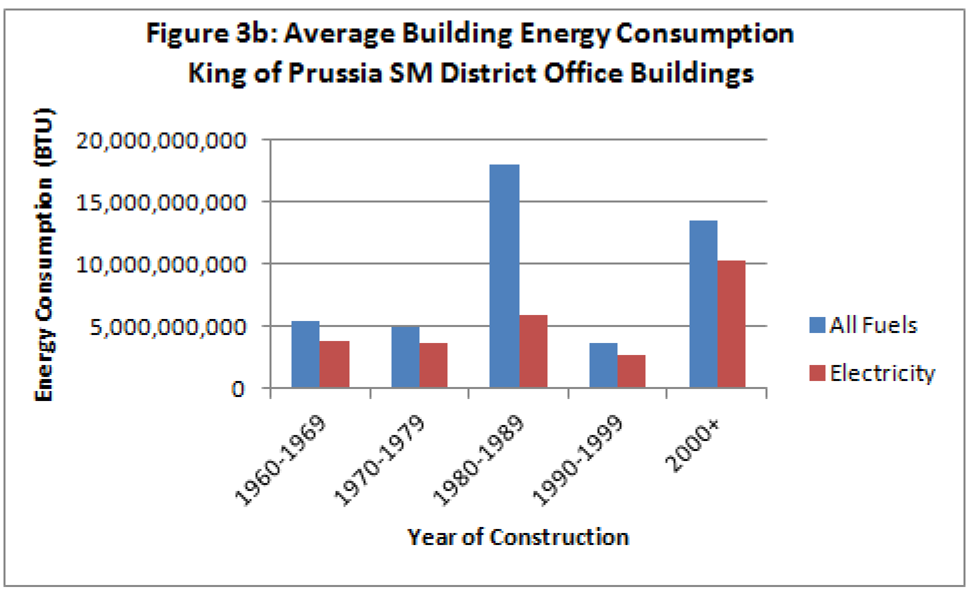


Figure 31

Site Specific Solutions

Identify Problem Sites for Energy Efficiency

While the millennial buildings appear to be energy hogs based on the application of CBECS data, in reality their energy consumption per square foot is the lowest of any decade. The result is misleading because all buildings constructed during this time period are larger than 100,000 square feet. While the size of the buildings important because it does mean they are consuming a large portion of total energy in the district, the buildings from 1980-1989 are perhaps a greater cause for concern because their intensity of energy use on a per square foot basis is so high. Additionally, the 1980-1989 buildings comprise 25% of all office buildings in the district. The high energy use, combined with their strong representation within the building stock, make this decade the strongest candidate for Advanced Energy Retrofits.

Among the buildings constructed from 1980-1989, the biggest energy users will be the largest buildings. There are four buildings in this category that are larger than 100,000 square feet. These buildings will be the primary focus of site-specific recommendations because they are estimated to be the largest energy users in the district, and therefore have the greatest potential to improve energy efficiency for the district as a whole. The highest energy users are as follows:

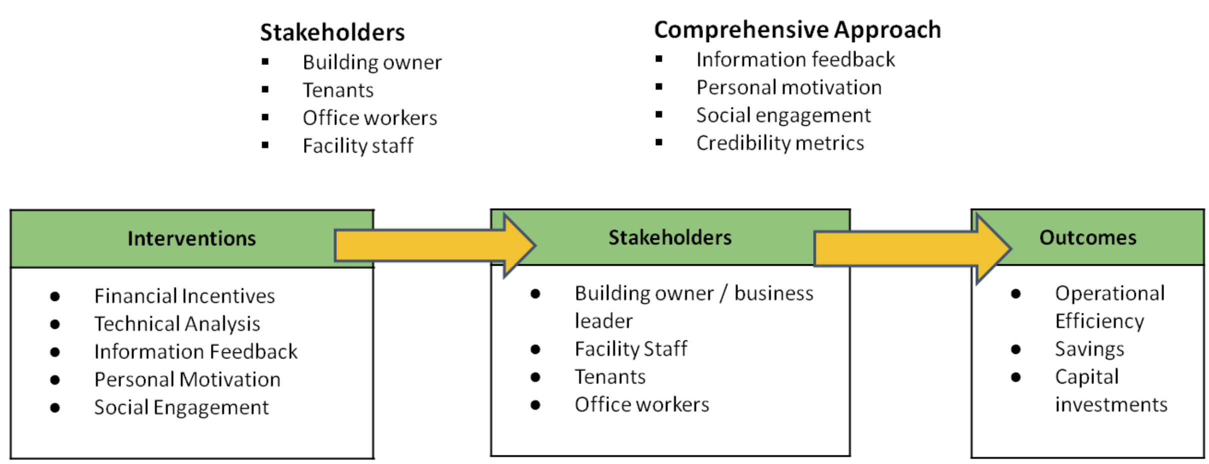
- Devon International Group, located at 1100 First Avenue
- Lockheed Martin, located at 4000 Geerdes Boulevard
- University of Phoenix, Philadelphia Campus, located at 1170 Devon Park Drive (Wayne, PA)
- Triad Building (presently vacant), located at 2200 Renaissance Boulevard

The King of Prussia BID and the municipality should partner with the owners of these buildings to improve energy efficiency through Advanced Energy Retrofits and other sustainability measures. This is already occurring in one of the cases identified above. According to the King of Prussia-BID, the University of Phoenix Building, owned and operated by Liberty Property Trust, is currently undergoing a $2.5 million renovation. In addition to improvements to entrances and the lobby, Liberty is undertaking some efficiency upgrades and is seeking LEED certification for this property. The three other properties are currently in states of flux, and may not be presently receptive to significant renovations to reduce energy consumption. However, the King of Prussia BID should continue a dialog with these properties regarding energy efficiency practices by offering assistance in monitoring energy consumption. In the future when the economic health of these properties is improved, the BID can utilize actual consumption data to assist the property owners in pursuing energy retrofits at that time.

Application of Energy Efficient Strategies to King of Prussia

We identified several energy efficiency strategies employed in commercial building circles around the country that may be applied to King of Prussia. One effective strategy was encouragement through incentives. Utility, financial, and building code incentives provided to the owners and developers for adopting energy efficient retrofits was compelling enough to convince the owners and developers to take on Advanced Energy Retrofits (AERs). Some examples proved that even an average building could be turned into an ENERGY STAR building, after the installation of energy efficiency measures. Some retrofits have achieved substantial reductions in operating energy costs. These studies also proved that, if owners and developers were guided and well informed about; the type of retrofits, cost effectiveness and benefits of AERs, incentivized bonuses, and loan providing agencies, they were more willing to take on AER retrofitting in their existing buildings.

Among the different strategies used today to promote energy efficiency, the social intervention strategy is a path that commercial buildings could follow. Social Intervention strategies can result in direct savings benefits and increase capital investment. This strategy is a comprehensive approach to encouraging energy efficiency standards in office buildings, which involves interaction between different stakeholders such as the building owner, tenants, office workers, and facility staff. Building stakeholders shape energy consumption through their daily activities, and strong social intervention strategies can help educate them to conserve energy use.

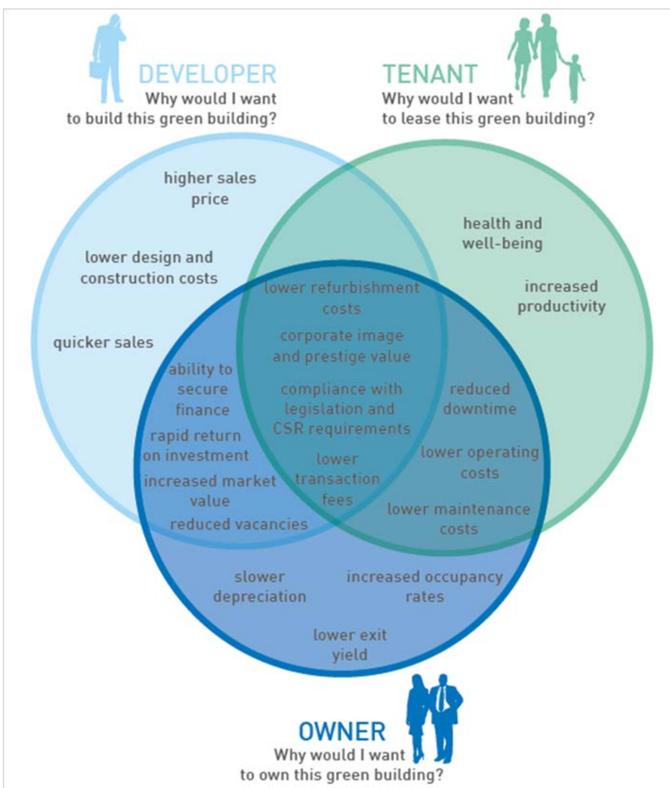


Credit: MIT Energy Efficiency Strategy Project, Unlocking efficiency in Office Districts (2012)

Figure 32 Social Intervention Strategies

Stages of **Social Intervention Strategies** include (Alschuler & Michaels 2012):

- **Education:** The office building stakeholders should be educated through seminars, webinars, and meetings about the benefits of energy conservation, and how it affects the health, wellbeing, and performance of building occupants.
- **Information feedback:** Gathering information on existing consumption through the installation of smart meters and creating a benchmark to gauge future reductions. It also helps identify areas of peaked energy consumption.
- **Personal motivation:** Programs which provide implementation assistance through incentives, recognition, and rewards should be introduced in order to help motivate individuals. Tracking systems should be set up to help stakeholders set energy efficiency goals and compare their progress with others.
- **Social Engagement:** By involving different office building stakeholders, the shared goals help stakeholders coordinate and establish combined efficiency. Friendly group competitions, green teams, and professional networks provide shared experience and support for actions.
- **Credible Metrics** (Brown 2008): A credible performance metric must be developed to determine whether to continue, change, or terminate a program. The performance metric should depend on the ultimate goal of the program. Thorough data collection will help stakeholders evaluate whether they should make changes or upgrades to their building(s).



Credit: worldgbc.org

Figure 33 Stakeholders involved in Social Intervention Strategies

We looked at a few supporting case studies that used social intervention strategies. The upcoming **'Smart Energy Now'** is a pilot program from Duke Energy, the largest electric power holding company in the United States, focused on social intervention in office buildings in Charlotte, NC (Smart Energy Now, n.d.) (Duke Energy, n.d.). This could be the framework for future social intervention programs. This program is focused on educating office stakeholders about simple changes that could be made in the daily routine to reduce energy usage. The Smart Energy Now is a digital smart grid infrastructure which collects building data for the participating office buildings in

Charlotte and tracks the energy usage of Uptown Charlotte. This includes information about real time usage, load factors, historical trends, and guide sheet about what those numbers mean. The Smart Energy Now program offers short, medium and long term benefits.

- In the short term, the program creates education and awareness regarding energy usage, and the available energy efficiency opportunities.
- In the medium term, the program produces changes to energy related routines and operations.
- In the long term, the program leads to a realization of positive changes in building automation and capital investment in energy efficiency.

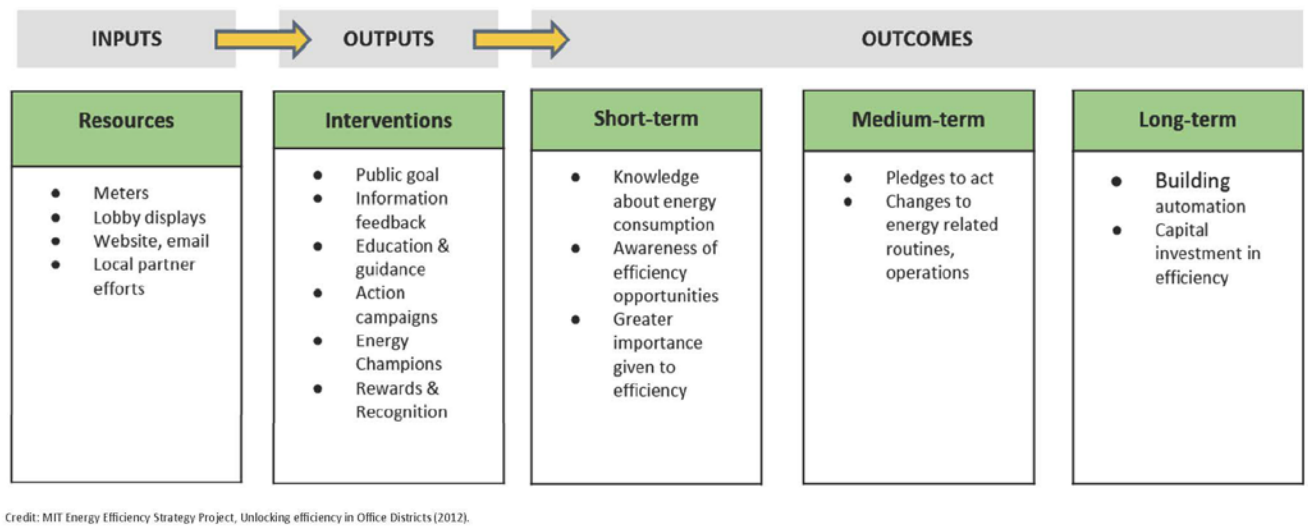


Figure 34 Smart Energy Now Pilot Program from Duke Energy

District Wide Solutions

For an office district, the broad strategies for incentivizing energy efficiency include plan-making and regulation (including comprehensive plans and zoning ordinances), the provision or streamlining of financing mechanisms, information sharing and technical assistance, and social intervention or outreach (Alschuler & Michaels 2012). Possible roles for the municipality in KOP include: promoting building material reuse and the reuse of existing buildings; incentivizing green roofs; encouraging energy audits and/or recommissioning; and developing incentives to attract green businesses (Pittsburgh Climate Action Plan 2012). In a business district like King of Prussia, appropriate incentives may include Floor Area Ratio (FAR) and density bonuses, expedited site plan review and permitting process, and reduced permitting fee (Alschuler & Michaels 2012).

The zoning code overhaul by Upper Merion Township incentivizes the inclusion of sustainable building practices in new construction by permitting density bonuses. It is tougher to incentivize similar practices as retrofits in existing buildings, since the zoning code has a limited application to those structures. One possible solution to complement the revised zoning code may be to create a stretch code in the municipal building code ordinance. A stretch code consists of more stringent energy standards for buildings, but would be voluntary. The Massachusetts Stretch Energy Code requires a 20% reduction in energy consumption below the base state code (Northeast Energy Efficiency Partnerships 2012). At the municipal level, Upper Merion can adopt an implement a stretch energy code on top of the existing statewide energy code. Buildings that undertake renovations that meet the stretch code would be able to get certain incentives from the municipality, particularly by expediting review of their building applications and waiving construction permit fees. According to Eric Goldstein from KOP-BID, time incentives like expedited project review and permit approval are strong motivators for developers, who seek to shorten the development timeframe wherever possible. Furthermore, property owners may also receive incentives from federal and state sources, and may recover the full costs of the renovation from future energy savings. For additional consistency, the stretch code can be incorporated into the new zoning ordinance as one of the tiers of sustainable practices that receive density bonuses.

In addition, social intervention strategies provide substantial benefits at the district scale. Such strategies coordinate stakeholders in the district, provide a credible and locally-embedded source of information delivery, and may create a culture of green behavior (Alschuler & Michaels 2012). The strong presence of a business community in King of Prussia, represented by the KOP-BID, is an asset to the district. In cities across the country, business communities are assuming a leadership role in encouraging energy efficient behavior and investments. A few possible roles for the business community in promoting energy efficiency includes: the establishment of neighborhood climate champions and a Business Climate Coalition; the creation of a green office challenge or similar programming; the creation of a green business climate award program; and the attempt to engage building managers in energy efficiency programs (Pittsburgh Climate Action Plan 2012).

The **Chicago Green Office Challenge** is an example of a scalable social intervention model that can successfully engage stakeholders across the office district. The City of Chicago identified energy efficiency as a core goal of its Climate Action Plan in 2008. It collaborated with ICLEI (Local Governments for Sustainability), who designed the program and provided technical assistance. Office Depot, who was the primary funder, also helped to design the competition. The program was launched in 2009. It was designed to unlock more efficient energy consumption in office districts, focusing on social interventions through a friendly competition for property managers and tenants. The intervention strategies included education, information feedback, benchmarking, implementation guidance, and public recognition (Alschuler & Michaels 2012). The program's reduction goal and recommended actions were aligned with Energy Star and LEED. Separate programs for property managers and tenants were developed, and over 150 property managers and tenant companies participated.

The program results indicated that in the first year of the program, the participants reduced energy savings by an average of 7.9%, and collectively saved over 72 million KWh of electricity. Overall, the Green Office Challenge resulted in $5.1 million in cost savings. The success of this program prompted ICLEI and Office Depot to work with local governments to implement programs in Charleston, NC; Nashville, TN; San Diego, CA; and Arlington County, VA.

Figure 35 Green Office Challenge Programs in various cities

In addition to these recommendations, the conversations with Mr. Goldstein led to the creation of a brief educational document that was designed to be featured on the KOP-BID website. The document highlights numerous behavioral changes that can help reduce energy consumption, with a strong focus on the amount of savings that can be achieved if these changes are adopted. The document brings together the educational component from the outreach strategies listed above, along with putting the benefits front and center, listing them as potential savings, which can be interpreted as potential profits for building operators.

Outreach

Fact Sheet: Energy Efficiency Strategies for Office Buildings

Benefits of Investing in Energy Efficiency

The average commercial building wastes 30% of the energy it consumes.[1] Energy represents 30 percent of the average office building's costs and is a property's largest operating expense.[2] Applying available technologies and solutions to existing buildings can deliver substantial economic and competitive benefits, including:

- Reduce operational costs. [3]
- Improve occupancy rates while attracting and retaining quality tenants. [3 4]
- Improve occupant comfort. [4]
- Achieve higher indoor environmental quality, and higher workplace productivity. [4]
- Extend equipment life. [4]
- Gain competitive advantage and differentiation.[3]

No-Cost/Low-Cost Strategies for Offices

No-cost and low-cost upgrades and/or behavioral shifts will save energy and money. These savings can then be invested into deeper advanced energy retrofits (AERs).

- *Minimize energy waste.* Use task-lighting and daylighting whereever possible, and remove unnecessary lighting. Use a power strip for electronics that can be turned off at the end of the day - and make sure to turn them off when possible.
- *Put computer to sleep.* Activate power management settings on your computer for an easy way to save $10-50 per computer each year.[5]
- *Saving water can lower your energy bill.* Use water-efficient faucets, showerheads, toilets, and urinals. WaterSense labeled products are independently tested and certified to ensure that they meet EPA's specifications for performance.
- *Communicate with occupants.* Plug loads – any device that is plugged into a building's electrical system – typically account for 30% of a building's energy usage.[6] Engage building occupants in the effort to reduce energy waste through education, reminders and updates, and/or incentives.
- *Reduce plug and process loads.* Identify occupants' actual equipment needs and meet those needs efficiently.[7]
- *Find low-risk, cost-effective investments.* One investment that may provide a quick return on investment is the installation of occupancy sensors to turn off the lights when the room is vacated.
- *Buy energy efficient products, from light bulbs to computers and printers.* ENERGY STAR qualified products help eliminate energy waste and are certified by independent organizations. Purchase all-in-one devices.

Additional Resources

ENERGY STAR for facility owners and managers
EPA WaterSense
National Renewable Energy Laboratory (NREL) Assessing and Reducing Plug Loads in Office Buildings
Alliance to Save Energy

[1] Energy Star (2010) [2] EPA [3] US DOE [4] USDOE, Advanced Energy Retrofit Guide for Office Buildings
[5] Energy Star [6] Energy Star [7] National Renewable Energy Laboratory (2012)
Image: Aerial view of KOP Business District, from the King of Prussia Business Improvement District

Figure 36 Educational Document to be included on KOP - BID's website

Recommendations

By creating a thorough inventory of existing buildings and energy consumption in the KOP-BID, the inventory can serve as a baseline estimate for energy consumption, from which any changes in energy consumption can be measured. Combined with an analysis of site specific and district wide solutions, this case study has illustrated many of the steps necessary to decrease energy consumption in the existing commercial building stock.

Throughout this study, the KOP-BID has been an invaluable resource in gathering information about existing conditions, as well as understanding the way to incentivize actions for commercial property owners. The major lesson from their involvement with this case study has been that existing organizations like Business Improvement Districts can be very influential in changing the behavior and thought process of their members. By making the BID a local champion for energy efficiency policy, as well as serving as an information outlet and expert on local and state incentive programs, the BID can make the case to its members more effectively than municipal governments because of the direct relationships with its members. Especially for district wide solutions, the BID is a key partner to encouraging the adoption of advanced energy retrofits.

The municipal role in encouraging advanced energy retrofits is slightly more complicated. Building codes (which have a greater impact on energy consumption) are generally set by the state government. The zoning code is the primary means for municipalities to add regulations to building uses. However, zoning codes apply most generally to new construction; existing buildings are typically only reviewed by zoning boards when the use of a structure is changed, or the property owner is seeking to add to the existing structure or replace it altogether. Therefore, proposed changes to the zoning code that incentivize energy efficient building practices will have limited impact on existing buildings.

In order to further the energy efficiency goals established in the zoning code, the municipality can enact other ordinances that complement the zoning and encourage similar upgrades as retrofits in existing buildings. A municipal stretch code can be enacted with incentives that appeal to existing property owners, such as expedited review processes and reduced fees for permit requests and applications, and the stretch code can also be incorporated into the zoning code as one means of obtaining density bonuses for new construction. Municipal ordinances can also be introduced that would require compliance with updated energy codes when existing buildings are sold. Upper Merion Township can undertake this comprehensive approach, which would encourage energy efficiency in the entirety of the building stock.

Conclusion

Meaningful improvements to building energy efficiency in the United States require a comprehensive, multi-faceted approach. While the building code is an excellent tool for regulating energy efficiency, this report demonstrates ways in which planners can employ additional tools to facilitate or incentivize energy efficiency. Through techniques and strategies such as benchmarking, linking efficiency with resiliency, education, outreach, inventories, and public private partnerships, local planners address the lack of information and understanding that creates a barrier to energy efficiency. These techniques help stakeholders understand the goals as well as the true costs and benefits, a key first step in implementing building energy efficiency.

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Appendices

Survey of Energy Efficiency in Commercial/Multifamily Buildings

This survey is being conducted as part of a graduate course at Rutgers University.[2]

Respondent Information (for purpose of follow-up questions, if needed)

Name: ________________________________

Title: _________________________________

Email: __________________________

Department: ___________________________

Municipality: ___________________________
State: _________________________________

Internal Capacity

1. Is there an individual in the municipality who is responsible for overseeing municipal activities related to energy use by commercial/multifamily building owners? If so, what is their title?
   - o Yes ____________________________________
   - o No
   - o I don't know

2. Has your municipality implemented projects intended to reduce energy use in your **municipal operations**?

	Yes-completed	In progress	Will start within a year	Under consideration	No – not being considered
Building upgrades					
Streetlight retrofits					
Traffic signal retrofits					
Other					

[2] Rutgers would like to thank the Delaware Valley Regional Planning Commission for assisting with the development of this survey.

Private Sector Initiatives

3. Please indicate the status of the development of initiatives to foster **private sector** energy efficiency efforts in your municipality:

	Yes-completed	In progress	Will start within a year	Under consideration	No – not being considered
Handouts/ information about state or federal energy efficiency programs					
Training about energy efficiency for commercial building owners and tenants					
Zoning changes or provides variances for energy efficient buildings					
Streamlined permitting for energy efficient buildings and/or upgrades					
Energy efficiency recognition program for builders/developers/property owners					
Special funding (grants, lower interest loans, Property Assessed Clean Energy Financing, etc.) to commercial and/or multifamily property owners for implementation of energy efficiency projects					
Other					

Please provide information on initiatives that have been very successful or very controversial/problematic:

____
____
____

4. In your opinion, what is the level of demand in your municipality for assistance from the municipality to pursue energy efficiency in their businesses/buildings?

No Demand High Demand

1 2 3 4 5

5. Please describe the level of actual demand taking into account such things as building permits

No Demand High Demand

1 2 3 4 5

6. Please check the types of energy efficiency projects that are common in commercial buildings in your municipality (check all that apply)?

   - Building upgrades
   - Lighting upgrades
   - HVAC upgrades
   - Other (please list) ____

POLICY/REGULATION

7. Does the municipality master plan set goals for energy efficiency in commercial and/or multifamily buildings?

   - Yes
   - No

If yes, what?
____
____

8. Has the municipality adopted any ordinances to promote energy efficiency in commercial and/or multifamily buildings?

    - Yes
    - No

   If no, please identify any barriers that prevented your municipality from adopting such ordinances:

____

____

____

9. Are you aware of any energy efficiency upgrade permit requests that were rejected because of existing zoning or design standards in your municipality?
   - Yes
   - No

   If yes, please explain:

   ____

   ____

   ____

10. Does your municipality support/encourage performance based pathways to complying with energy code (i.e., Whole Building Modeling Approach of ASHRAE 90.1, IECC performance-based compliance)?

   - Yes
   - No

If yes, which performance based pathway:

   ____

   ____

   ____

11. *(Applicable to PA municipalities only)* Has your jurisdiction "opted in" to locally amend and enforce the International Building Code, International Energy Conservation Code and the International Existing Building Code, or "opted out" allowing the Department of Labor and Industry to take over this role?

    - o "Opted In"
    - o "Opted Out"
    - o Don't know

    If answered "Opted In," list amendments, if any, made that have promoted energy efficiency in the private sector:

____

____

____

12. Please provide any additional comments related to energy efficiency in the commercial sector in your municipality:

____

____

____

2013 Energy Efficiency Survey Results	
Individual in the municipality responsible for overseeing municipal activities related to energy use by commercial/ multifamily building owners	29%
Implementation of energy efficiency upgrades in commercial buildings in municipality	
Building Upgrades	42%
Lighting Upgrades	56%
HVAC Upgrades	65%
Setting goals in municipality master plan for energy efficiency in commercial and/or multifamily buildings	10%
Adoption of any ordinances to promote energy efficiency in commercial and/or multifamily buildings	15%
Aware of any energy efficiency upgrade permit requests that were rejected because of existing zoning or design standards in municipality	2%
Municipality's support for performance based pathways to complying with energy code	25%
Has your jurisdiction "opted in" to locally amend and enforce the International Building Code, International Energy Conservation Code and the International Existing Building Code, or "opted out" allowing the Department of Labor and Industry to take over this role? (Applicable to PA municipalities only)	
Opted In	83%
Opted Out	11%
Doesn't know	6%

	1(No Demand)	2	3	4	5(High Demand)
Level of demand for assistance from the municipality to pursue energy efficiency in their businesses/buildings	50%	37%	6%	4%	4%
Level of demand taking into account such things as building permits	27%	42%	13%	8%	10%

	Completed	In Progress	Will Start Within Year	Under Consideration	Not Being Considered
Implementation of projects intended to reduce energy use in municipal operations					
Building Upgrades	48%	19%	4%	13%	15%
Streetlight retrofits	21%	19%	10%	23%	27%
Traffic Signal	52%	15%	2%	8%	23%
Other	6%	0%	0%	2%	92%
Development of initiatives to foster private sector energy efficiency efforts in municipality					
Handouts/ information about state or federal energy efficiency programs	21%	8%	2%	10%	60%
Training about energy efficiency for commercial building owners and tenants	4%	12%	0%	13%	71%
Zoning changes or provides variances for energy efficient buildings	17%	8%	0%	19%	56%
Streamlined Permitting for energy efficient buildings and/ or upgrades	8%	6%	0%	17%	69%
Energy efficiency recognition programs for builders/ developers/ property owners	6%	4%	0%	17%	73%
Special funding (grants, lower interest loans, property assessed clean energy financing, etc.) to commercial and/or multifamily property owners for implementation of energy efficiency projects	4%	2%	0%	8%	87%
Other	6%	0%	0%	0%	94%

Building By Year of Construction		
Year Built	Count	Percentages
Pre- 1900	1942	6.46%
1900 - 1909	2286	7.61%
1910 - 1919	2310	7.69%
1920 - 1929	3754	12.49%
1930 - 1939	1359	4.52%

1940 - 1949	1475	4.91%
1950 -1959	2546	8.47%
1960 - 1969	3048	10.14%
1970 - 1979	3280	10.91%
1980 - 1989	3435	11.43%
1990 - 1999	1951	6.49%
2000 - 2009	2366	7.87%
2010 - present	300	1.00%
Total	30052	

Use of Buildings Greater Than 50,000 SQ. FT		
Use Type	Count	
Flex	179	14.56%
General Retail	399	32.47%
Food Sales	20	1.63%
Food Service	1	0.08%
Regional Mall	35	2.85%
Office	595	48.41%
Total	1229	100.00%

Review of Draft Upper Merion Township, PA, Suburban Metropolitan District Ordinance regarding Impact on Energy Efficiency

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FROM: Stuart Meck, FAICP/ PP, Associate Research Professor

SUBJ: Review of Draft Upper Merion Township, PA, Suburban Metropolitan District Ordinance regarding Impact on Energy Efficiency

DATE: January 28, 2014

At your request, I have reviewed the draft Upper Merion Township Suburban Metropolitan (SM) District ordinance dated June 24, 2013, the January 2012 report, *Plans and Ordinances for the Route 202 and First Street Corridors*, prepared for the King of Prussia Business Improvement District by Looney Ricks Kiss, of Princeton, NJ, and Econosult of Philadelphia, PA., and the current SM district ordinance as well as a variety of research monographs and publications on sustainable zoning ordinances and practices throughout the U.S. These publications are listed in the reference section at the end of this memorandum.

The purpose of the review was to examine the clarity of the drafting of provisions on page 8 of the draft SM ordinance as they apply to energy efficiency and suggest improvements so that the ordinance can be more easily implemented. I identified some issues in other parts of the ordinance that need to be addressed. However, this is not a complete evaluation of the draft SM District ordinance or of the design standards that accompany it. Finally, I have provided language that could be incorporated in the Upper Merion Township zoning code that addresses the regulation of wind energy systems and electric vehicle charging stations.

(1) The draft ordinance would replace most of or the entire existing SM district in the Upper Merion Township zoning code, as Article XXIII of Chapter 165.[1] The draft SM ordinance contains a use table indicating which uses are permitted as of right, as a conditional use, or as a special exception, and table of dimensional requirements for lots of two, four, and six acres.

For this district and certain others, the board of supervisors must review and approve all development plans for the use and development of property before a building permit may be issued by the township building official (§§ 165-233 to 165.234), although it appears that the building official may issue a use and occupancy permit for uses permitted as of right (§ 165-243), including changes in existing permitted uses. The board of supervisors must also review and approve all conditional uses under standards and procedures established in § 165-219.1. Finally, applications for special exceptions are reviewed and approved and approved by the Zoning Hearing Board under Chapter 165, Article XXXV, particularly § 165-251, which contains the standards for special exceptions. In the proposed SM District, there is only one use that is treated as special exception, a helistop.

(2) The draft ordinance is structured so that all lots have by right a maximum building coverage percentage of 65 percent; however, when a developer demonstrates to the township board of supervisors that the project incorporates any five of ten sustainable practices (see below), the building coverage may be increased to 70 percent in what is known as "Tier A". By the incorporation of an addition of two of four possible sustainable practices—a total of seven sustainable practices– the building coverage may be increased to 75 percent in "Tier B."

[1] Township of Upper Merion, PA., *Code and Ordinances of Upper Merion Township*: http://ecode360.com/UP0975?needHash=true (accessed December 9, 2013).

Maximum building height is handled differently because there are different maximums depending on lot size. A two-acre lot has a maximum height of 50 feet, while four- and six-acre lots have a maximum height of 65 and 80 feet, respectively. If sustainable practices are implemented, maximum height may be raised by the board of supervisors to 80 and 120 feet in Tiers A and B, respectively.

The Tier A sustainable practices relating to energy efficiency include:

- Operable windows in all office, residential, and hotel/ motel spaces.
- Passive solar design techniques including "large"—a term left undefined--expanses of south facing walls, sky lights, window awnings, solar heat sinks, trees positioned to shade the building to reduce air conditioning loads, and "extraordinary" insulation levels ("extraordinary" is undefined), among others.
- Passive solar hot water heating for each residential or commercial unit.
- Photo-voltaic solar panels to generate at least 10 percent of the electrical power provided to the building.
- Installation of a "cool roof" employing a reflectance color or material endorsed by the Cool Roof Rating Council to reflect the sun's heat away from the building.

Tier B sustainable building practices relating to energy efficiency include:

- A vegetated roof that must cover at least 80 percent of the individual building roof surface.
- On-site use of geothermal heating and cooling systems in the entire building.
- Photovoltaic solar panels that generate at least 20 percent of the power provided to the building.

(2) A number of other renewable energy or energy-conserving measures are not mentioned in the draft ordinance as sustainable building practices. These include: small-scale wind turbines; heat island reduction for parking areas; and solar orientation of buildings, except to the vague reference to "large" expanses of southern facing facades in new buildings.

(3) The drafting conventions are somewhat different than other sections of the Upper Merion Township zoning code. For example, this would be the only use district with a statement of intent, which is a good thing. It would also be the only district with a use table and table of dimensional requirements, also good.

(4) I have redrafted the material offering incentives for energy efficiency in the ordinance to make it clearer and more objective, but have not addressed the practices involving water use and reuse and shared parking (I noted that the shared parking provisions do not describe how share parking is to be calculated). I have included a new definition and changed the phrase "tier" to "category," which is more precise.

The approach I have taken focuses on actions by the board of supervisors in the area of development review rather than review for compliance with a building code by the township's building official. In so doing, I have removed phrases like "extraordinary insulation levels" as a practice that would activate incentives because this is a complicated issue that is tied to the entire building code; the percentage of energy efficiency above code requirements in a building would require a building energy model to evaluate. Consequently, the incentives offered largely relate to measures taken outside the building rather than inside the building. Under the redraft, if sufficient energy-efficiency practices are incorporated into a project, then the height and building coverage bonuses would be given automatically. This will ensure more predictability and certainty for projects in the SM district.

•

Add to Definitions:

"Solar Reflectance Index" (SRI) means a measure of a surface's ability to reject solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. For example, the standard black has a temperature rise of 90 deg. F (50 deg. C) in full sun, and the standard white has a temperature rise of 14.6 deg. F (8.1 deg. C). Once the maximum temperature rise of a given material has been computed, the SRI can be computed by interpolating between the values for white and black.

XXX-XXX [Insert section numbers] The board of supervisors shall approve the following incentives for increased maximum building coverage of a lot and maximum height of a building in an SM District to encourage energy efficiency in buildings and site design as follows:

Development standard	Maximum allowed without the implementation of energy--efficient practices	Maximum allowed with 5 of the **Category A** energy-efficient practices	Maximum allowed with 5 of the **Category A** energy-efficient practices and 2 of the **Category B** energy-efficient practices
Maximum building coverage of lot	65%	70%	75%
Maximum building height	55 feet by right; 65 feet by conditional use	80 feet	120 feet

(a) Category A energy-efficient practices include, but are not limited to:

1. Operable windows in all parts of the building.

2. Incorporation of any of the following passive solar building design techniques, each of counts as one energy-efficient practice:

a. The provision of shade structures over windows and doors to minimize glare and unwanted solar heat gain. Structures may include awnings, screens, louvers, and similar devices.

b. Orientation of the building so that the longer axis is within 15 degrees of the geographical east/ west axis, giving it a southern orientation.

c. Installation of sky lights.

d. Installation of solar water heaters.

e. Installation of trees positioned to shade the building and reduce air conditioning loads.

3. Passive solar heating systems and solar heat sinks.

4. Provision of photo-voltaic solar panels with the capacity to generate at least 10 % of the electric power used by the building.

5. Use of roofing materials that have a solar reflectance index equal to or greater than 78 for low-sloped roofs (<2:12) or 29 for steep-sloped roofs (>2:12) for a minimum of 75 % of the roof surface of the building.

(b) Category B energy-efficient practices include:

1. Provision of a vegetative roof that covers at least 75 % of the individual building roof surface.

2. Use of geothermal heating and cooling systems for the entire building.

3. Use of an open grid pavement system that is at least 50% pervious.

4. Provision of photo-voltaic solar panels with the capacity to generate at least 20 % of the electrical power used by the building.

5. Use of paving materials with a solar reflectance index of at least 29.

•

(5) The draft ordinance states: "Failure to continue and maintain standards for sustainable building practices shall result in a zoning violation before the sustainable building bonus." One of the sustainable building practices will simply be impossible to enforce. For example, the practice of installing photovoltaic panels that will produce a certain percentage of the power provided to the building depends on the amount of sun. This would require constant monitoring of energy usage by someone. If the sun doesn't shine and the photovoltaic solar panels don't generate the required amount of power over the period of a year, how will the township determine this and how will it respond? Under the draft ordinance, the township would be obligated to issue a zoning citation if not enough energy is produced. I recommend eliminating this language and have done so. Consequently, the language above with respect to photo-voltaic panels has been modified and uses the phrase "with the capacity to generate."

(6) Using superscript references, as is done in the Table of Permitted Uses (which should probably be retitled "Table of Uses" since not all uses are permitted by right), is confusing, since it suggests to the reader that there will be a footnote. I recommend that another column be added to this table with the heading of "Special Conditions" and what is now a superscript be converted to a section number in the ordinance.

(7) How is net density for multi-family dwellings to be determined? There are no standards that identify the calculations for the number of dwelling units per net acre (the acreage of the site minus land that is to be dedicated for public use, such as streets and detention basins) for

1.102 Ground-mounted Systems

Ground!mounted*accessory*wind*energy*systems*are*allowed*as*an*accessory*use*in* all*zoning*districts*subject*to*compliance*with*the*following*regulations.*

1.102.A Regulations

All*ground!mounted*accessory*wind*energy*systems*are*subject*to*the* following*regulations:*

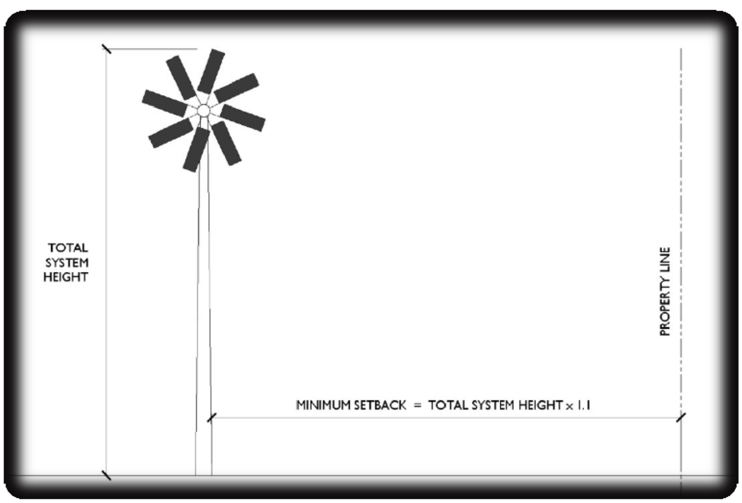
1.102.A.1 No*more*than*one*ground!mounted*accessory*wind* energy*system*is*permitted*per*lot.*

1.102.A.2 All*ground!mounted*accessory*wind*energy*systems*must* be*set*back*from*all*property*lines*a*distance*equivalent* to*at*least*110*percent*of*the*total*system*height.*

1.102.A.3 The*blade*tip*of*any*rotor*must,*at*its*lowest*point,*have* ground*clearance*of*at*least*15*feet.*

1.102.A.4 All*climbing*apparatus*must*be*located*at*least*15*feet* above*the*ground,*and*the*tower*must*be*designed*to* prevent*climbing*within*the*first*15*feet*from*the*top*of* foundation.*

1.102.A.5 Tower*structure*lighting*is*prohibited*unless*required*by* aviation*authorities.*



(10) Another energy measure that should be considered is set of standards for electric vehicle charging stations, which I believe will become common in the future (for example, the Barnes Foundation building in Philadelphia includes such stations in its parking lot). Below is

ing or other
problems are encountered.

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