United States Department of Energy

Better Buildings Case Study Competition

Energy Efficient Buildings Hub / One Montgomery Plaza Case Study

Team: Sustainable Solutions

Executive Summary

The One Montgomery Plaza case presents a unique opportunity to integrate building improvements with energy efficiency retrofits, while also providing an opportunity to create a replicable framework for future projects. The present case requires acknowledgment in the key areas of policy, finance, planning and social outreach, which all tie in to the value of the EEB Hub as a leader in the energy efficiency community of the future. Solutions for the EEB Hub's One Montgomery Plaza project lie in each of these core elements and address core issues by utilizing effective, fiscally prudent, politically feasible, and replicable methods.

The EEB Hub has many options with regard to defining its roles and responsibilities for the One Montgomery Plaza project, and for creating a unique niche for itself on future projects in the greater Philadelphia region. Our team has reviewed the options available to the EEB Hub and proposes four primary areas of engagement:

1. The EEB Hub can serve as the organizing entity for the Integrated Design Process (IDP) and continue this involvement through construction and post-occupancy building evaluation.

2. The EEB Hub can provide preliminary energy use benchmarking and work with local authorities to allow expedited plan review of deep retrofit projects.

3. The EEB Hub will provide leadership on financial incentives available for building owners engaging in deep energy retrofit projects, will coordinate the use of the federal EB-5 program to provide low-cost project financing, and will arrange the use of Carbon Credits to provide additional revenue for its activities.

4. By engaging in energy efficiency education at the level of building occupants, operators, and the general public, the EEB Hub will lock in the energy savings designed into projects and serve as an advocate and public resource for energy efficiency for the greater Philadelphia region.

Each of these approaches can be implemented under a branded "Hub Certification" program that helps the EEB Hub to establish a unique market identity. Ultimately, each of these solutions works together to create an integrated process throughout the design and construction cycle in order to increase energy efficiency and the economic viability of the retrofits. The integrated design process with the HUB as the focal point, streamlined building permits through the Hub Certification program, low cost of capital through EB-5, and an ongoing education platform will lead to a successful project at One Montgomery Plaza, and is a replicable model for future projects.

Introduction

The Philadelphia Energy Efficient Buildings Hub (EEB Hub) is at a unique point in the history of energy use and the built environment. As the preeminent entity created by the Federal Government to promote and realize energy efficiency retrofits, the EEB Hub is situated at the nexus of financial feasibility, policy mandate, economic development and construction industry technology and practices. As the largest and most visible example of Federal energy efficiency funding in the region, the EEB Hub has tremendous opportunity to begin to establish a positive track record of being a key player in the realization of high-performance deep energy retrofits, add value to the retrofit process for all stakeholders, and achieve higher levels of energy savings at lower cost than currently allowed by conventional practices of project delivery. The EEB Hub's relationships with cutting-edge industry experts through its connections to the regional academic community, its strong use of advanced visualization technology, and neutral status as a third-party advisor on projects creates the opportunity for the EEB Hub to add value and create a strong market presence for itself in four critical areas: providing guidance to owners (including public entities such as Montgomery County) on innovative and low-cost financing strategies; delivering technical expertise in energy efficient retrofits; identifying and promoting local policy incentives to encourage deep energy retrofits; and creating and conducting educational campaigns that will increase demand for energy-efficient construction as well as enable building users to maximize their energy savings. In addition to these core competencies, the EEB Hub can add substantial value to the project delivery process by acting as the facilitator for the Integrated Design Process and by acting as the conduit of best-practice information between building owners, design teams, and the research community. These innovations will benefit retrofit projects in the greater Philadelphia region, and are ready to be applied to the EEB Hub's first flagship project, One Montgomery Plaza.

The EEB Hub as Process Integrator

Throughout the construction industry it has been noted that simply intending to build energy and resource efficient buildings and assembling a skilled team to carry it out is not sufficient to guarantee a successful outcome. The *process* of design has been found to determine the success of a green building project as much as the design's technical factors of engineering and construction. The Integrated Design Process (IDP) as defined by the American National Standards Institute (ANSI) and The Institute for Market Transformation to Sustainability (MTS) in "ANSI/MTS 1.0 Whole Systems Integrated Process Guide (WISP)-2007 for Sustainable Buildings & Communities" is a design process that has been widely accepted by green building practitioners as an effective method of achieving high-performance buildings (WBDG, 2012). WISP-2007 notes that the purpose of Integrative Design is to, "…effectively manage the optimization of complex systems while pursuing sustainable practices in design and construction. To achieve cost effective and increasingly more effective environmental performance, it is necessary to shift from conventional linear design and delivery processes to the practice of interrelated systems integration" (WSIP, 2012). The IDP differs from conventional design process in several ways, including the fact that it is research driven from the very beginning. An IDP approach brings together all stakeholders early in the process and makes maximum benefit of the combined knowledge of all participants, including building owners, designers, builders, engineers, and others as needed. The IDP concentrates much of the decision-making of the

design process up front, and continues a collaborative approach until design is complete via a series of whole-team charrettes and smaller group meetings.

In its role as neutral advisor, energy consultant, and green-building expert, the EEB Hub is in an ideal position to act as the facilitator of the IDP. While architects are traditionally the leaders of the design effort, the EEB Hub can bring technical expertise to bear on projects in a way that most architects cannot. Architects will continue to lead the design process and the EEB Hub should not compete for primacy in that area. Rather, the EEB Hub can assist architects by bringing outside experts and user groups into the IDP sequence, at no cost to the design team. In the case of the Philadelphia EEB Hub, these outside experts consist of some of the nation's preeminent sustainable design researchers and government-sponsored laboratories and Institutions. The involvement of these experts in the design process will have a dual payback in that the project will benefit from cutting-edge ideas that may not yet be commercially available, and the researchers will be able to see their ideas implemented in real-world scenarios.

The EEB HUB's access to advanced visualization tools such as large-scale 3-and-4-dimensional modeling and energy analysis software can add to the IDP effort and make the Hub's physical resources (building and technology) indispensable in the design effort. Because most architects and construction firms do not have access to the sophisticated tools available to the EEB Hub, this also creates the possibility that the Hub can transition from the design stage and become the center of detailed building information modeling (BIM) and schedule coordination during the construction process. These tools and processes are complementary with the Lean Construction framework that is gaining momentum in the industry. This could be a for-profit service that adds value to a project by improving coordination, minimizing errors, and maximizing the effectiveness of any proposed energy reduction strategy. When combined with a library of building retrofit best practices, the EEB Hub truly becomes a valuable resource for designers, contractors, and building owners in Montgomery County.

Specific EEB Hub Value Propositions

In addition to its role at the center of the IDP, the EEB Hub can add value to deep-energy retrofit projects and create a market niche for itself in the Montgomery County market by creating baseline energy use profiles of potential retrofit projects and by creating an energy retrofit certification program for local firms. These services provide the opportunity for the EEB Hub to become a fully self-supporting enterprise following the expiration of DOE funding in 2016.

Establishing pre-renovation performance baselines for projects considering a deep-energy retrofit is a critical first step in evaluating potential strategies for the project. Such baselines can be used to identify appropriate targets for efficiency improvements that will yield maximum return on investment. Pre-renovation baselines also act as a measuring stick against which post-renovation energy usage may be compared, providing valuable feedback on the effectiveness of the chosen renovation strategies. Pre-renovation baselines may be created using by various approaches and at different scales, however for the purposes of the EEB Hub's involvement we propose a general approach of energy metering at the level of major building systems and major building areas. An example of this approach would be to monitor each major energy-using system (lighting, heating, cooling, and plug loads) at One Montgomery Plaza on a per-floor basis. The EEB Hub can collect and analyze this data and identify areas with opportunity for improvement. The appropriate level of metering and analysis will differ by project, and the EEB Hub can provide guidelines and implementation plans for each case. As the EEB Hub's library of

pre and post-renovation energy usage grows, the Hub will become a living library of best practices for deep-energy retrofits in the region, matching appropriate energy-savings strategies with the local building stock, regional climate, and construction expertise. Because this process will require the involvement of the EEB Hub prior to renovation projects entering the design phase, schedule-sensitive private developers may be unlikely to be interested in this service. To counter this we recommend policy proposals that require the creation of such energy baselines prior to a project's eligibility for local, state, or federal energy retrofit financing incentives. The time that will be added to a project's overall schedule as a result of this activity can be offset somewhat by expedited permitting incentives, as discussed later in this document.

Project Financing and Economics

Federal EB-5 Program

As the EEB Hub demonstrates to the public the effectiveness of its energy conservation measures and benefits of the IDP, financing and economic viability of the project can be a hurdle to the building owner seeking an energy retrofit to their property. Numerous options exist for raising capital to finance retrofit projects including federal energy efficiency loans, local, state and federal bond programs, private lending, and sale or lease-back of the property. Of the evaluated options, a financially prudent strategy for owners to raise the required financing will be to tap into the Federal EB-5 program. This program, in combination with carbon credit sales following the project, would make this economically sustainable for the County and for the EEB Hub, and is repeatable for other properties and retrofits in the future.

The EB-5 program states "foreign investors with a minimum of $1 million capital investment in a for-profit commercial enterprise, whereby the investment creates at least ten jobs for two years, can obtain their Green Card for permanent residency in the United States, as well as Green Cards for their spouses and unmarried children under 21" (US Citizenship and Immigration Services). Utilizing the EB-5 program presents the lowest cost of capital for the County and avoids significant costs from rising interest rates, thereby exponentially increasing the ROI of energy efficiency improvements. Additionally, this approach will help to boost the regional economy through local job creation in commissioning and retrofit contracts.

As applied to One Montgomery Plaza, the County should create a for-profit real estate holding company, similar to a REIT (Real Estate Investment Trust), for the OMP building, parking structures, and properties associated with the County's original purchase. In order to create a valuation for the holding company, the County's initial investment and the fair market value on the building will be factored in. This will subsequently be used to place a value on the master holding company and the price of a share of ownership in the company. The rental incomes and the fair market rent of the County's office space will be paid to the holding company. All expenses of the building will be paid from the holding company and all income after operating expenses will be disbursed to the stakeholders, in which the County will have the majority share and later regain complete ownership. After this initial step the Montgomery Plaza Holding Company can now qualify for investments through the EB-5 program.

Funding through the EB-5 program is an unmatched opportunity that will have demand from investors at a very low cost of capital and will be pleasing to all parties involved. The investor will receive a nominal share of the holding company based on their initial investment, and will receive a stated upfront yield on this investment, normally 2-3 percent. The investor will not receive dividends based on their ownership percentage, and the investment contract will include a buyout clause stating that the County is permitted to buy stakeholders out at any time

based on the current fair market value of the building and the individual investor's percentage of ownership. The County may also choose to buy a portion of the foreign investor's ownership percentage using a DRiP (dividend reinvestment program). Unlike bonds, the full face value will not be due at any specific time and the rate of return is lower. This drastically reduces the cost of capital to the County. In Figure 1, the EB-5 lending rate is compared against current bond rates and private lending rates.

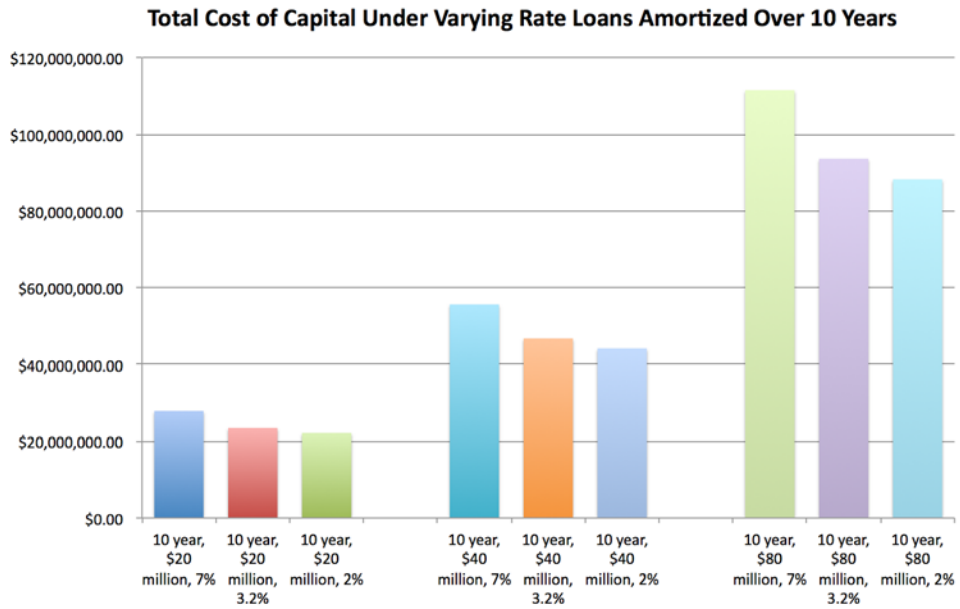

Figure 1. Total Cost of Capital Under Different Scenarios.

The purchase of these shares by foreign investors will fund the necessary upfront cost of the building improvements and energy efficiency retrofits. Then the Montgomery Plaza Holding Company will be able to recoup some of the expenses and increase its operating efficiency through improving energy efficiency and the subsequent lower utility costs, tax breaks, incentives, and rebates offered. In addition, educational components about energy efficiency through the Hub and analyzing the sub-metering data to effectively manage energy consumption will exponentially increase savings. Over time the County can use its distributions from the holding company, or other sources of income, to buy back the remaining outstanding shares if it desires.

Implementing EB-5 to raise capital for the desired building renovations will bring money into the regional economy. The EB-5 program mandates that at least ten jobs are created for each $1 million investment. Because the proposed financing needed for the repairs of OMP is $21-80 million dollars, use of this program will create a minimum of 210 jobs locally. The scale of the OMP project and anticipated project duration of approximately 24 months mean that this level of job creation can be readily obtained and verified. Participants in the EB-5 program will be investing money into the region and creating jobs, resulting in an exponential benefit for the local economy by the creation of additional local spending, increased wages to local employees, employment taxes, and sales tax revenue. Since the County will not be putting any money upfront, and solely spending investor's money from EB-5 on the building improvements and energy retrofits, we believe the County will likely return a positive return on investment (ROI) immediately after the retrofits are completed. The real estate holding company will also see an

immediate return based on the upfront costs coming from various new stakeholders and the minimal cost of capital, paired with energy savings from the deep energy retrofits, and the tax incentives and rebates. The use of the federal EB-5 program thus creates a win-win-win scenario for the local economy, building owners, and the EEB Hub, who can act in an advisory capacity to the implementation of this program.

Carbon Credits

In 2009, Pennsylvania farmers began selling carbon credits with the help of the Pennsylvania Farm Bureau (PFB). The EEB Hub can take advantage of this market and create a stream of revenue for itself based on the energy savings of each project it is involved with. The emissions savings generated by reduced energy use as a result of the deep energy retrofit can be entered into an aggregate vendor or registered with GEX (Global Emissions Exchange). In doing so, this will provide a template for future application in the region. We propose that in return for the EEB Hub's services, they receive the rights to the carbon offsets in perpetuity. They will then be able to aggregate them over their entire portfolio and raise partial funds to cover their operating expenses and grow their platform. The price of a carbon credit, which is equal to 1 metric ton of CO_2 or CO_2 equivalent, (Global Emissions Exchange) was $3 in 2009. These credits would increase in value if a carbon cap and trade scheme is implemented in Pennsylvania, as it has been in California. There is currently a demand for carbon offsets related to compliance and voluntary markets. We see this as an additional source of revenue for the EEB Hub that could bring in hundreds to several thousand dollars per year under current market conditions, depending on the energy retrofits chosen for the One Montgomery Plaza property alone. While this amount is admittedly small at present, aggregation and cost increases over time may make this a valuable resource for the EEB Hub. More importantly it provides a stream of income annually and in perpetuity, and further incentivizes the EEB Hub to find and implement incremental reductions in energy.

EEB Hub Policy Recommendations

Policy that influences the energy efficiency of buildings in the United States is a complex union of programs at the federal, state, and local level. The benefits of such laws are numerous and include improved air quality, reduced greenhouse gas emissions, and increased energy security and stability. Because the goal of the EEB Hub is to be at the leading edge of innovative building design, it must position itself as a contributor of new policies leading to the adoption of energy saving trends in the local construction market.

In Philadelphia, as well as other regions nationwide, legislation requiring the benchmarking and disclosure of energy has been enacted (Brown, 2012), reflecting the growing importance placed by policy makers on measurement and verification of building performance. Due to its unique expertise and position in the market, the EEB Hub should play an integral role in realizing these policies on deep energy retrofit projects.

Building owners, particularly private developers, may not be inclined to utilize an entity such as the EEB Hub to create such a benchmark as it may be seen as an unnecessary, time-consuming, and costly addition to the renovation process. Appropriate policy incentives can help to eliminate this reluctance and provide owners with sufficient motivation to take this important step.

The EEB Hub can pursue local policies that will allow for expedited building department plan review for any project for which the EEB Hub has created energy use baselines. Such an

incentive could eliminate owner concerns that the creation of such baselines will add to project duration and therefore cost. Eligibility for state or local financing related to energy efficiency projects could also be contingent upon the EEB Hub's involvement in the creation of such baselines, thus further incentivizing building owners.

Misalignment of incentives between building owners and policy creates a gap in achieving maximum potential of energy efficiency. By working to align the interests of building owners with that of local, state, and federal energy policy, the EEB Hub can aid in the market transformation to efficiency by working to create local policy incentives for deep energy retrofits.

Harnessing Energy Savings Through Education

According to research conducted by the Stanford University Precourt Institute for Energy Efficiency, successful building occupant education and behavior modification campaigns can yield between 10% and 15% reduction in energy use in buildings (Arnel, 2012). Achieving this savings on a societal basis will require that traditional notions of how we interface with the built environment and behave as building occupants evolve to reflect the new paradigm of green building design. A robust educational program targeted at building occupants, operators, and the general public can help achieve these aims and is a relatively low-cost approach to achieving large financial savings through reduced energy use. The EEB Hub can offer services that provide this training as part of a branded "Hub Certification" program that compliments the suite of for-profit services offered by the EEB Hub as part of a comprehensive deep-energy retrofit.

Educating Building Occupants / Operators

Upon completion of a deep energy retrofit, realization of energy savings occurs at the interface between building occupants, operators, and the completed project. In order to fully realize the energy savings designed into a project, the EEB Hub should begin an education program that informs building occupants and operators of the design features of their new workspace. The education program will be aimed at instructing personnel how to be stewards of the newly renovated building and how to maximize the energy saving measures that have been added to the site. Building users that are made aware of the fiscal and environmental benefits of energy efficiency and how their actions impact building operations are more likely to participate in energy-conserving behavior, thus reducing the chance that costly technological approaches implemented in the design phase are overridden. For example, one of the lessons may be an explanation of the concept of passive solar as it relates to their workspace, and how improper manipulation of window blinds can negatively affect passive daylighting and heat gain (or loss) in their portion of the building, which in turn creates impact on building lighting and mechanical systems.

The education program should not be thought of as a one size fits all approach; rather, it must be tailored specifically to the site undergoing renovation and the people utilizing the space. Additionally, the program should be included within a wider framework of an energy savings campaign, developed in conjunction with project site owners, that prescribes a set of clearly defined energy goals as well as a system of policies and procedures for personnel to follow to achieve those goals.

The EEB Hub's educational campaign can consist of five stages:

1) *Involvement of building user groups during the IDP.*
   a) Buy-in by building users during the initial stages of design will reinforce the importance of energy conservation and will help to foster a sense of ownership of the strategies chosen for implementation. The EEB can coordinate this effort with the building owners and the design team.

2) *Post-construction trainings with building user groups.*
   a) An effort to alert future building occupants and operators about the unique aspects of their new space will help achieve energy savings from day one. "Energy Champions" from each department or area of the building can be chosen to promote ongoing energy savings after the building is occupied.

3) *Written operating policies and procedures for use by operations personnel and occupants.*
   a) Prepared in conjunction with the design team, this document will supplement the Project Manual and provide simple, relevant information specific to energy efficient building operations.

4) *Post-Occupancy Evaluation, Adjustments, and Trainings.*
   a) Designed to occur prior to retro-commissioning efforts, post-occupancy evaluations involving surveys of building occupants, analysis of building energy usage, and appropriate follow-up trainings will help building occupants achieve continued energy savings.

5) *Use of technology to promote ongoing awareness.*
   a) The use of continuous, real-time energy use reporting can be implemented at relatively low cost via an energy use "dashboard" that is readily accessible to building users. The use of such devices is already encouraged by certification programs such as the USGBC's LEED program and the technology to implement this feature is easily compatible with energy metering devices that will be part of a standard deep energy retrofit project. This tool can be used to promote friendly competition amongst building occupants to maximize ongoing energy savings.

Providing Public Education

As the primary agency dedicated to energy efficiency within the Philadelphia region, the EEB Hub should create an education program for the wider community to be held at Navy Yard Building 661. Since the building, once completed, will be a living laboratory for energy efficiency it can serve as a live demonstration for community members to explore what it means to live in a sustainable fashion, and how they can incorporate aspects of energy efficiency into their own lives. Additionally, the online dashboard can be utilized in community outreach and education programs aimed at the youth of the Philadelphia region to help foster a culture of sustainable energy consumption practices that will lead to increased energy savings in the long term. This community outreach program will help to cement the EEB Hub's position as the leader in sustainable energy practices within the region.

HUB Certification Program

The ideas and approaches outlined above can be combined into a comprehensive suite of fee-based services provided by the EEB Hub. Acting as a "one-stop shop" for energy efficiency, the EEB Hub can become a valuable partner to building owners for the lifetime of their project, not just during the design or construction phase. Providing a full range of services related to energy efficiency will take advantage of the EEB Hub's wide expertise and deep knowledge base and will help to advance understandings of best-practice approaches to deep energy retrofits in the Philadelphia region and beyond. We intend that these services will be provided on a fee-based structure scaled to match the level of the EEB Hub's activity on a given project. Fees will be well justified by establishing the ROI that is possible with the EEB Hub's no-cost involvement on the first several of it's projects, including the OMP project.

The creation of a branded, publically recognizable certification program can advance the market presence of the EEB Hub, provide structure for its various offerings, and help to create market demand for EEB Hub services once established. We envision local advertising campaigns and publicity events targeted at the commercial real estate and construction industries to help bolster this effort. Upon completion of all phases of the EEB Hub's services, a project can be "Hub Certified." This certification will help identify a project as cutting-edge and can give credibility not only to a project's energy efficiency, but also to its positive impact on the local economy and innovative educational efforts.

One Montgomery Plaza

One Montgomery Plaza will undergo a major retrofit to be facilitated by the EEB Hub. If the decision is made to move forward with the renewal of OMP, a significant cost will be incurred to perform necessary improvements to the structural components of the building. In working with the EEB Hub, OMP is seeking a solution to offset the cost of needed repairs by achieving improved energy efficiency during the retrofit process. Energy retrofits, when combined with EEB Hub's previously implemented sensor network and technical expertise, can increase performance while adding minimal cost to the expense of the rennovation.

Based on the engineering assessment of OMP, the heating, ventilation, and air conditioning (HVAC) system components have been replaced in the last decade and require no additional consideration. Additionally, the repair of OMP's façade will correct structural deficiencies, but will also positively impact the thermal characteristics of the building. These two factors will improve performance, however since a building has on the order of hundreds to thousands of adjustable parameters in its operation (Eisenhower 2012), efficient management of the building's systems is also critical to reduce energy consumption. To facilitate this, a building automation system (BAS) must be installed. Using advanced functionality provided by building automation, HVAC components can be effectively controlled allowing OMP the ability to minimize the inefficient operation of equipment.

Using recorded OMP energy demand and consumption data, a regression analysis was performed to better understand the building's performance, taking into account changes in weather for the time periods being compared. Figure 2 illustrates the influence of weather on the building's measured energy consumption.

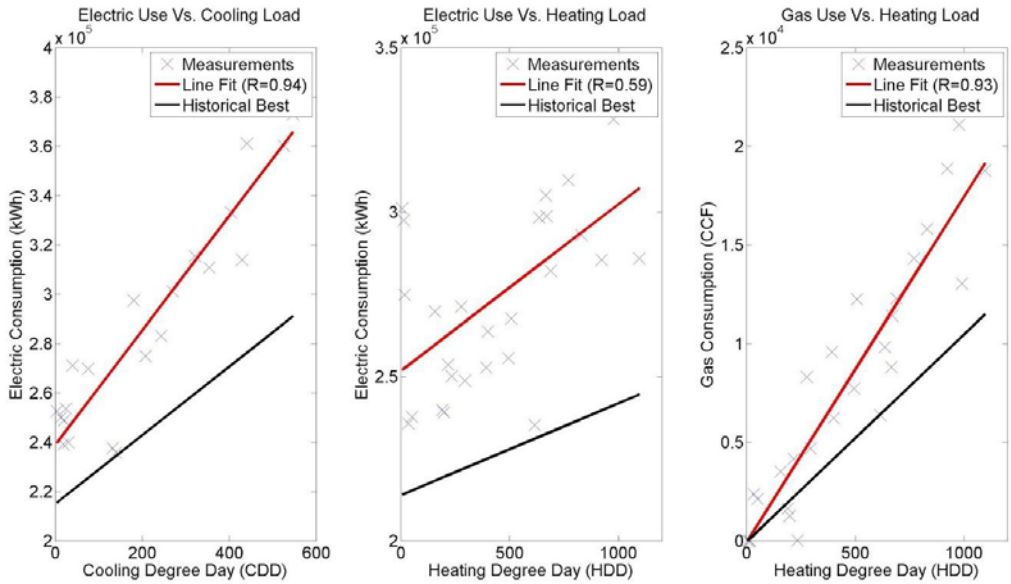

Figure 2. Regression analysis of the relationship between measured building utility consumption and weather. Red line is least squares fit to measured data. Black line is extrapolated performance if building is operated at best measured efficiency.

For this analysis a 3-year window of data was sampled. The analysis shows that under similar weather conditions, the energy consumption of OMP can vary dramatically. The engineering assessment of OMP indicates that operation is manually controlled and performed ad-hoc. Installation of a BAS can help eliminate this variance and allow OMP to operate more efficiency at levels that have already been demonstrated from measurement.

If OMP were to operate at its demonstrated potential prior to any repairs, its annual energy consumption would be reduced by an estimated 25 percent. This improvement is on par with savings claims for retrofits of other existing buildings (Kneifel 2013). If repairs are performed to the building structure, this may be a conservative estimate since the nature of the repairs may have additional benefits to the thermal characteristics of the building allowing even greater energy savings.

Although the cost of installing a BAS is difficult to predict, since an HVAC system already exists in OMP and many systems are currently being monitored by the EEB Hub, installation of a BAS would primarily involve obtainment and implementation of software. Since EEB Hub is developing advanced techniques for building analysis, the EEB Hub can potentially develop its own version of a BAS for OMP. Assuming that the integration of the BAS to OMP adds minimal additional cost to the building renovation, the predicted improvement to building performance will save approximately $85,000 annually or $7.8 million (roughly 33% the cost of the repair) over the 50-year lifetime of the new façade, when including adjustments for analyst forecasts of future energy costs (EIA 2013).

Summary

The timing of the One Montgomery Plaza building retrofit presents significant opportunity for the EEB Hub to define a unique market position for itself as a key player in energy efficient design and construction. The EEB Hub's involvement can extend well beyond technical expertise in building design and can include leadership roles in project delivery and financing, education, and acting as a policy advocate. The EEB Hub's financial support from the federal government will allow the organization to create a track record of project involvement prior to the necessity of being financially self-sufficient. This competitive advantage will allow the EEB Hub to offer services that may not be currently available in the region, and in so doing create a market for itself that will grow as the rate of energy retrofit projects accelerates.

The proposals we have outlined are intended to schematic-level outlines of roles and responsibilities that the EEB Hub could undertake in the future. While we acknowledge that additional study is needed into each of these areas, we are certain that a mixture of the concepts provided will provide the EEB Hub with a viable model for it's own financial sustainability, and will have a positive impact on the building and design community of Montgomery County. The model proposed for the Philadelphia EEB Hub could ultimately be replicated in other regional centers, making maximum advantage of the learning and expertise that has developed as part of the EEB Hub concept. We look forward to bearing witness to this.

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