Welcome to The Better Buildings Case Competition

Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

White House Campus, Washington, D.C.
Friday, March 2, 2012

Department of Energy
Washington, DC 20585

January 30, 2012

Dear Better Buildings Case Competition Participants,

On behalf of the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), I am pleased to officially welcome you and your school to the Better Buildings Case Competition.

Your participation in the Competition demonstrates your dedication to reducing the energy footprint of the U.S. commercial building stock. Your efforts will help demonstrate to the marketplace and the American public that implementing energy efficiency not only reduces energy use, but also saves money and bolsters the nation's economy while protecting our natural environment—a win-win outcome for all involved.

As you know, the Better Buildings Case Competition supports President Obama's Better Buildings Challenge—an effort to reduce the energy consumption of commercial buildings by 20 percent by 2020. Additionally, the Better Building Challenge aims to catalyze private-sector investment and innovation in the buildings efficiency sector. In doing so, the Department of Energy and its Challenge Partners are developing "models for success"—market-ready implementation models comprised of scalable and replicable solutions to the barriers faced by building owners as they adopt energy efficient practices in their commercial building stocks. We are all excited to learn of your ideas and solutions to these barriers at the Competition's final workshop on March 2, 2012.

I share Secretary Chu's confidence that we have employed our nation's best and brightest in tackling some of the most stubborn barriers to energy efficiency adoption and investment. Again, thank you for your commitment and for your leadership. Best of luck to all of you.

Sincerely,

Kathleen Hogan
Deputy Assistant Secretary for Energy Efficiency
U.S. Department of Energy

THE BETTER BUILDINGS CASE COMPETITION
White House Campus, Washington, D.C.
Friday, March 2, 2012

Table of Contents

THE BETTER BUILDINGS CASE COMPETITION
White House Campus, Washington, D.C.
Friday, March 2, 2012

RESOURCES & REMINDERS

Please review the materials available online at the Better Buildings Case Competition website once more, and circulate those materials as well as this document with all interested students immediately—time sensitive materials regarding your team's membership and Workshop attendance are due Monday, February 6, 2012. Some of this information may take time to gather.

As a reminder, each team is allowed one faculty/staff adviser as well as one external (non-Federal) adviser. Team members and advisers may not contact any case entity directly, and advisers may not be an active member of the team nor produce or contribute to any submitted competition materials. Additionally, teams may consist of 3-10 currently enrolled, full-time students from any school or department within the university (see online materials for additional recommendations). Teams decide how many and which students attend and present their assigned cases at the Workshop. Please note that private and public proposals will be presented at different times at the Workshop. Therefore, any and all team members may present both cases as determined by the team. Teacher's Assistants (TAs) may participate as students rather than faculty/staff advisers. Student members may not be actively working on a professional level on any DOE project or program, but students working on DOE-funded research may participate.

Please remember that the information contained in the cases is confidential and may not be shared beyond the team members and faculty/staff adviser. External experts may assist with general questions regarding barriers and business practices but cannot learn of or consult on any specific data shared in the cases.

IMPORTANT NOTICES

Communicating with the DOE

The DOE is only sharing this document with the current Energy Club Team Leads as reported on Preliminary Registration Forms. Therefore, Team Leads are responsible for distributing these documents to interested students. As explained in previous communications, Final Registration Forms will be due by all teams on

Monday, February 6, 2012. This Form can be found in Appendix A and asks the name and contact information of the Final Team Lead. Beginning Monday, February 6, 2012, all DOE correspondence from that day forward will be with the (potentially new) Energy Club Team Leads only. Again, Team Leads will be responsible for circulating any and all DOE e-mails and documents.

Anonymous Judging Process

The judges participating at the final Workshop of the Better Buildings Case Competition will evaluate proposals anonymously. Therefore, it is imperative that teams follow the guidelines presented in this document to ensure anonymity. Written proposals (both public and private) must be submitted with a Proposal Cover Sheet (provided by DOE, see Appendix B).

Each team is asked to create and submit a Team Alias on the Final Registration Form. Aside from each case's Proposal Cover Sheet, all materials must only include the Team Alias: Executive Summaries, all proposal texts, and all presentation materials must not contain any real identifying information other than team member names. Identifying information may include, institution and/or department names, colors or logos, energy club names, and names of advisers. Students may not refer to their institution or disclose any identifying information when presenting their proposals or while in the presence of the judges.

Three Necessary Registration Steps

The DOE is asking for two registration documents from each team. Additionally, every member attending the final Workshop in D.C. must individually register for the (optional) networking event on the evening of Thursday, March 1, 2012 by directly visiting the events website (see "Networking Opportunities" below).

The first form that the DOE will collect is the Final Registration Form (see Appendix A). This form includes information about team composition and Workshop attendance, as well as R.S.V.P. information for activities Thursday through Saturday, March 1-3 (see "Networking Opportunities" below). This form is due by February 6, 2012. Once submitted, the information in this form can only be changed via deletions (i.e. removing members from D.C. attendance).

The second form that the DOE will collect is the WAVES Excel file delivered alongside this document (as a template). The WAVES document is required strictly for participant clearance to the White House Campus on Friday, March 2, 2012. It is imperative that every team member attending the final Workshop provides his or her complete information on this spreadsheet: full name, DOB, SSN, gender, citizenship, place of birth, and city and state of residency. The DOE must receive this information by February 6, 2012 as any later submissions may not satisfy the timing requirements for clearance by the day of the final Workshop. Please review the instructions provided in the WAVES Excel template before inserting information—special formatting of information is required in some instances. Please also notice the naming conventions provided in separate sheets within the template. When

saving and naming this Excel document, please be sure to use the .xls filename only, and include only the simple name of your institution—for example, "WAVES_USC.xls" or "WAVES_Babson.xls."

REPORTED TEAM COMPOSITION & CASE ASSIGNMENTS

A remarkable group of 19 institutions from all over the United States are participating in the Competition. When registering via the Preliminary Registration Form on the Competition website, most teams reported a mix of business and engineering students, half of the teams reported an additional mix of policy and planning/design students, and a subset of teams reported additional membership from the fields of environment, law, and finance. Half of the teams reported the inclusion of undergraduate students in their membership. Most teams reported an adviser from their institution's engineering department/school. The universities and their assigned cases are listed below.

University	Public Case	Private Case
Georgetown University	Houston	Hotel
The George Washington University	Houston	Office Building
Georgia Institute of Technology	Walter Reed	Office Building
Tufts University	Houston	Hotel
Harvard University	Walter Reed	Office Building
Babson College	Houston	Hotel
Massachusetts Institute of Technology	Walter Reed	Office Building
Dartmouth College	Walter Reed	Hotel
Yale University	Houston	Office Building
Columbia University	Houston	Hotel
Duke University	Walter Reed	Hotel
Carnegie Mellon University	Walter Reed	Office Building
University of California, Berkeley	Houston	Hotel
University of Southern California	Walter Reed	Office Building
University of California, Irvine	Houston	Hotel
University of Colorado, Denver	Walter Reed	Hotel
University of Michigan, Ann Arbor	Houston	Office Building
Vanderbilt University	Houston	Office Building
Texas A&M University	Walter Reed	Hotel

PRE-WORKSHOP QUESTION COLLECTION PROCESS

After thoroughly reviewing all materials and assigned cases, teams are welcome to submit any and all questions to the DOE. At the discretion of the DOE, case-specific questions will be sent to Better Buildings Challenge Partners for their review. Also at the discretion of the DOE, selected answers will be shared with all teams. Please

submit all questions to Patrick DiCiaccio, patrick.diciaccio@ee.doe.gov, by Friday, February 10, 2012.

CASE PROPOSAL REQUIREMENTS & DEADLINES

Teams are asked to submit a written proposal for each of their two cases and will present both proposals to the judges in oral format using Power Point slides. The following requirements are per case and proposals will be presented separately to two different judging panels. Please take note of the submission deadlines—these dates are not flexible. Once materials are submitted, they cannot be edited.

Please remember that presentations will be judged anonymously—only the DOE will be able to identify teams aside from Team Aliases. Please review the next sections closely to be sure that your team adheres to this judging structure. The judges will be familiar with the details of each case before the presentation begins. When presenting, please do not repeat the case details.

Written Proposals (one per case)

- APA style and proper in-text citations
- Appropriate headings and subheadings (as determined by the team)
- MS Word document with one inch margins on all sides, and page numbers at the bottom of every page except the Title Page
- Times New Roman, size 12 font
- One-page, stand-alone Executive Summary (with no identifying information except Team Alias)
- Proposal Cover Sheet (Appendix B)
- Ten pages maximum including all appendices and Executive Summary (excluding Proposal Cover Sheet)
- Due by Friday, February 24, 2012, submitted via e-mail to patrick.diciaccio@ee.doe.gov

Power Point Presentations

- Ten minutes maximum and up to five minutes for questions from the judges
- Power Point slides (submitted as a PDF, with no identifying information except Team Alias)
- Due by Thursday, March 1, 2012, submitted via e-mail to patrick.diciaccio@ee.doe.gov

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COMPETITION JUDGING

The Better Buildings Case Competition is about idea generation and creating "models for success." Teams are encouraged to devise innovative solutions to the

barriers presented by the cases and demonstrate that their solutions are realistic and implementable. Though there are no prescriptive guidelines for the proposals, teams will be judged partly on how well they convince the judges that their solutions are effective and impactful. Teams should consider any and all ideas and solutions regarding the cases, utilizing the diverse talents of its members. Case-specific guidance is provided within each case document, and additional considerations are listed below.

General Considerations

- Real world issues are properly defined, discussed, and understood
- Team has taken an interdisciplinary approach to problem solving, showing consideration of policy, finance, business strategy, program design, etc.
- Technological inventions are included as appropriate, but are not the main focus of the solution

Proposed Plan of Action

- Proposals are realistic, scalable, and implementable
- Addresses all issues/problems presented in the case and prioritizes significant issues ahead of less significant issues
- Well-constructed arguments that acknowledge and explain any and all assumptions made
- Provides a convincing evaluation of all recommended activities
- Considers all stakeholders
- Considers and explains any potential timeline/phasing of the proposed plan

Team Research and Review of Literature

- Understands the community/organization and its structure – politically, economically, socially, etc.
- Properly situates the case data and context with outside information
- References are used to provide evidence for the team's solutions

Discussion/Conclusion

- A full understanding of the implications of the proposal, both positive and negative, as well as potential outcomes
- Uses case-specific and external information to provide evidence of the successful proposal
- Clearly and accurately explains the roles and responsibilities of all actors given the proposed plan, as well as the likelihood of their success

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WORKSHOP DETAILS

The final Workshop will be held on Friday, March 2, 2012 on the White House Campus. Proposal presentations will occur in several breakout rooms of the Campus in two different rounds. Judges will deliberate over lunch, and the

Competition will then reconvene for proposal feedback and the announcement of superlative awards. The day will end with an exciting panel of experts discussing topics suggested by teams in their Preliminary Registration Forms. Though not yet certain, the day may also begin with a White House tour. Please be sure to submit registration forms by the February 6, 2012 deadline so that the proper clearance can be secured. The judges and panelists will be announced at a later date.

NETWORKING OPPORTUNITIES

Beginning at 6:30pm on Thursday, March 1, 2012, students may participate for free at an exciting event at the National Building Museum in downtown Washington, D.C. The event is titled "Making Performance Public: Mandatory Disclosure of Energy Use in Buildings," and will feature experts from around the country. To attend this event, students must record their attendance on their teams Final Registration Form as well as individually R.S.V.P. online by visiting the event's website: http://go.nbm.org/site/Calendar/822540085?view=Detail&id=112082

There is a potential opportunity for an event with one of our Challenge Partners in the morning/early day of Saturday, March 3, 2012. Please indicate each member's interest on the Final Registration Form.

AVAILABLE FUNDING & LOGISTICS

The DOE is expecting to provide teams with some level of funding for participation in the Better Buildings Case Competition. Given that not all teams have non-profit status, the DOE is unable to send funds directly to any institution. Instead, the DOE will afford other arrangements. This information is not yet determined; please do not make travel arrangements just yet.

Appendix A

The Better Buildings Case Competition
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

FINAL TEAM REGISTRATION FORM

Institution Name:
Energy Club Name:
Team Alias:
Final Faculty/Staff Adviser:
Adviser Department:
Adviser E-mail:
Final Team Lead (Member 1):
Final Team Lead E-mail:
Final Team Lead Cell Phone:
External Adviser (optional):

	National Building Museum*, Thurs. March 1	Workshop March 2	Potential early-day event Sat. March 3
Team Lead Name:			
Team Member 2 Name:			
Team Member 3 Name:			
Team Member 4 (optional) Name:			
Team Member 5 (optional) Name:			
Team Member 6 (optional) Name:			
Team Member 7 (optional) Name:			
Team Member 8 (optional) Name:			
Team Member 9 (optional) Name:			
Team Member 10 (optional) Name:			

***please also register students for National Building Museum at event website**

Appendix B

The Better Buildings Case Competition
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

PROPOSAL COVER SHEET
(one per case)

Case Name:
(list one: Houston, Walter Reed, Office Building, Hotel)

Institution Name:
Energy Club Name:
Team Alias (as reported on Final Registration Form):

Final Team Lead (Member 1):
Final Team Lead E-mail:
Final Team Lead Cell Phone:

Team Member 2:

Team Member 3:

Team Member 4 (optional):

Team Member 5 (optional):

Team Member 6 (optional):

Team Member 7 (optional):

Team Member 8 (optional):

Team Member 9 (optional):

Team Member 10 (optional):

****Please mark all presenting team members by writing "presenter" after typed first and last name****

City of Houston

The Better Buildings Case Competition
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

The U.S. Department of Energy would like to thank Laura Spanjian and Lisa Lin of the City of Houston and Brian Yeoman from the Clinton Climate Initiative for their assistance with this case. As a partner of the Better Buildings Challenge, Houston is demonstrating its leadership and commitment to advancing energy efficiency.

The City of Houston has achieved high rankings on recent United States Environmental Protection Agency's list of cities with the most energy efficient buildings, and Mayor Annise Parker was recognized by the US Conference of Mayors with the 2011 Climate Protection Award. The City is in the process of retrofitting its entire city-owned building stock as well as the entire Houston Independent School District to improve energy efficiency and to reduce greenhouse gas emissions.

In recent years, the city government has launched several programs encouraging and supporting private building owners to upgrade their buildings for energy efficiency, but, like elsewhere, this has not had as widespread impact as hoped, particularly in the commercial market. You are a consultant making recommendations to decision makers in Houston city government regarding how the City can build upon its existing policies and programs to create an even more effective environment that will spur greater investment in energy efficiency in its commercial building stock. Solutions can include new policies and programs as well as changes to existing policies and programs. Solutions may be proposed at the municipal, state or federal level but it must be clear how the City would achieve the recommendation and how the recommended policies would support the goal of more commercial building energy efficiency retrofits. Solutions can include utilities or other stakeholders as well.

Solutions will be judged on:

- Alignment with the Mayor's goals and any existing plans
- Creativity
- Impact and effectiveness at achieving the goals
- Ability to be implemented
- Funding needs and strategy

Overview

The City of Houston is the fourth-largest city in the United States and the largest city in Texas. The city has the country's largest petrochemical and refining complex, second largest port, a significant number of large buildings and development patterns that require significant on-road travel, leading to significant energy consumption and greenhouse gas emissions -- almost two million tons per year, according to Houston's 2008 Emissions Reduction Plan.[1] Houston has been focused on aggressively reducing greenhouse gas emissions and improving air quality for over a decade.

Mayor Annise Parker, whose first term began in 2010, has continued to focus on sustainability, clean energy and energy efficiency. In 2011, Mayor Parker won the U.S. Conference of Mayors' Climate Protection Award for her administration's innovative and comprehensive approach to reducing energy use in the commercial building stock and retrofitting municipal buildings.

The Houston metropolitan area has been on the Environmental Protection Agency's annual "Top 10 List," which ranks U.S. cities with the most ENERGY STAR certified buildings each of the three years that the ranking has been available. In 2010, Houston was ranked number seven, with 175 rated large buildings compared to Los Angeles, which ranks number one with 510 rated large buildings. The City has plans to benchmark a large number of their municipally-owned buildings in 2012 using the EPA's Portfolio Manager to determine their Energy Star score. Mayor Parker has announced a goal to make Houston number one in the country for ENERGY STAR certified buildings.

The City of Houston is striving to be number one in LEED Certified Buildings as well. With over 1800 LEED Accredited Professionals in the greater Houston area, green building is a growing industry in city. Currently, the Houston region ranks fifth in the nation for LEED Certified projects. By 2011, the region had 163 LEED Certified buildings, eight of which achieved Platinum certification. In overall registered and certified LEED projects, Houston ranks fourth with 518 LEED projects compared to Washington D.C. which ranks number one with 799 LEED projects.[2]

Houston is the nation's largest municipal purchaser of renewable power, including a long-term contract which would allow Houston to provide up to 50% of its power needs from wind generation. The Department of Energy has designated Houston as a Solar City, and has provided grant funds to create an implementation strategy for citywide solar infrastructure.

Commercial Building Market

Almost 20 percent of Houston's greenhouse gas emissions is generated by the operation of commercial buildings. According to the 2009 community inventory that used 2007 data, the

[1] http://www.greenhoustontx.gov/reports/emissionreduction20080909.pdf
[2] http://content.usatoday.com/communities/greenhouse/post/2011/03/us-cities-states-leed-green-building/1

small and large commercial sectors accounted for 39% of the natural gas emissions in the city. Small commercial, large commercial and industrial sectors accounted for over 47% of the electricity emissions equating to over 14,000,000,000 kWh consumed. No data can be extracted to reflect just commercial electricity use due to the inventory method used in 2009. Houston has a central business district but also has many other business districts scattered around the city that constitute a large number of its commercial building stock. Overall, the city has over 266 million square feet of commercial office space.

Metro Houston's commercial real estate market began to rebound from the global recession more quickly than many other markets, with positive net absorption in Class A space in the first and second quarters of 2011.

Energy Efficiency Landscape

Houston has a number of policies and programs in place to encourage the reduction of energy use in the commercial building sector. As of September 2011, commercial buildings in Houston had to comply with ASHRAE 90.1-2007 or 2009 IECC commercial energy code. The City has also passed a mandatory cool roof requirement for new construction and roof replacements.

Houston also has a number of tax incentives available for new construction and renewable energy installation. In 2008, Harris County adopted guidelines for partial tax abatements for new construction of LEED-certified commercial buildings. In 2009 Houston adopted a similar measure, the City of Houston Tax Abatement Program. In addition, the State of Texas property tax code allows an exemption of the amount of the appraised property value for the cost of installing a solar or wind generation system.

The City has a robust energy efficiency performance contracting program and has adopted a Green Building Resolution, which set a target of LEED Silver certification for new construction and major renovations of City of Houston-owned buildings. The City is taking a holistic approach to energy consumption by implementing energy performance contracting, demand response programs, retro-commissioning programs and behavioral change management programs. Also, the city has set forth a multi-year agenda to retrofit all 262 city-owned buildings, including fire and police stations, libraries and performance halls. These improvements are expected to reduce energy use by 30 percent. As of 2011, nearly 80 buildings have been retrofitted, representing over 5.2 million square feet.

To date, the City has completed 17 LEED certified projects and has another 11 projects that will be LEED certified in 2012. The City recently opened its first LEED Gold Fire Station and also opened a LEED Gold one-stop permitting center for Houston. In 2009, the City established a Green Building Resource Center with over 40 educational displays about how to become LEED or Energy Star certified and has a program director who offers advice and support for green building issues.

In 2010, the city launched the Houston Green Office Challenge[3], a voluntary program which encourages property management companies, building owners and tenants to sign up to green their operations through energy efficiency building retrofits or behavior changes within the office. The program provides training and resources to both facility managers and tenants who sign up for the Challenge and gives recognition to those firms that achieve specific metrics. Management firms are measured on improvements in energy, water, waste and tenant engagement, while office tenants are measured on outreach to employees, energy conservation, waste reduction, cleaner transportation choices, and property management engagement. This program focuses on six business districts - Downtown, Greenspoint, Upper Kirby/Greenway, Uptown Houston, Westchase, and the Energy Corridor – and seeks to reach multiple stakeholders in the commercial real estate market.

Figure 1: Green Office Challenge Goals

Management Firms

Challenge Goals	Base Goals	Stretch Goals
Energy Use Reduction (Electric and Natural Gas)*	10%	30%
Waste Reduction	30%	50%
Water Use Reduction	10%	20%
Tenant Engagement	25%	50%

* Properties that have earned an ENERGY STAR rating of 75 or higher automatically achieve the energy use reduction stretch goal.

Tenants

Tier	Points Required
Platinum	76-100
Gold	51-75
Silver	26-50
Bronze	15-25

As of January of 2012, the Green Office Challenge has 184 registered properties, and 188 tenant spaces equaling an estimated 70 million square feet. Calculations for the first year of the Challenge are currently being analyzed.

In January of 2011, Houston launched the Energy Efficiency Incentive Program (EEIP)[4] to support energy efficiency retrofits. Under the EEIP, the City provides funding to offset 20 percent of the up-front implementation costs (labor and materials) of energy reduction projects that make permanent improvements to reduce utility expenses and greenhouse gases. The reimbursement ranges from $20,000 minimum to $200,000 maximum per building (project sizes $100,000 to $1,000,000) and is provided when the project is complete. The program is open to Green Office Challenge participants who may apply for up to three buildings. Each building must include at least 7,500 square feet of office space. At least 60% of the total incentive funds

[3] http://www.houstongoc.org/
[4] http://www.houstongoc.org/?q=node/47

are set aside for projects under $500,000 and at least 50% of the funds are set aside for Class B and C buildings.

Applicants must have an energy audit from a certified energy manager (C.E.M.) or Professional Engineer (PE) that includes energy conservation measures that provide at least a 15 percent reduction in energy use to qualify. The program encourages a stretch goal of at least 30 percent reduction, in line with the goals of the Green Office Challenge. As part of the program, the City requires measurement and disclosure of the ongoing energy savings through the end of the grant period.

The City funded the EEIP through the Department of Energy with approximately $3 million from Houston's Energy Efficiency Conservation Block Grant (EECBG) award. All provisions and reporting requirements of the American Recovery and Reinvestment apply.

The program's goal is a reduction of at least 100,000 metric tons of greenhouse gas emissions and to make Houston number one in the country for Energy Star and LEED certified buildings. With no previous City-led program like the Houston Green Office Challenge in place before, the City has already realized initial success with it being the largest Green Office Challenge program in the nation.

Houston has won awards for its green building initiatives, including the Houston Green Office Challenge, Energy Efficiency Incentive Program and Municipal Energy Efficiency Program.

Utility Landscape

The City of Houston's electricity needs are provided by Reliant Energy and CenterPoint Energy (natural gas.) The CenterPoint Energy parent company is also the transmission and distribution utility which remains a regulated utility. As such it must achieve at least a 20 percent reduction in its annual growth in demand by 2011 (68.7 MWh) and a 25 percent reduction (82.9MWh) by the end of 2012. CenterPoint Energy has a number of programs underway targeting commercial buildings, including incentives for technologies, retrocommissioning and retrofits.

Walter Reed Army Medical Center Redevelopment

The Better Buildings Case Competition
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

The U.S. Department of Energy would like to thank Brandon Mitchell of the Office of the Deputy Mayor for Planning & Economic Development of the District of Columbia for his assistance with this case. As a partner of the Better Buildings Challenge, the District of Columbia is demonstrating its leadership and commitment to advancing energy efficiency.

The Federal Government is allowing the District of Columbia, through a Local Redevelopment Authority (LRA), to plan for the redevelopment the former Walter Reed Army Medical Center (WRAMC). The District has a number of sustainability goals for the site and is considering options for achieving and maintaining those goals before the site is released to a master developer for reuse. There is some question whether the District has the ability and power to establish and maintain high levels of sustainable performance on the site once the property is sold.

You are a consultant suggesting a package of policy, financial and other tools that the District can and should apply to the site or more broadly throughout the District in order to most effectively ensure that the redevelopment will achieve and maintain the District's goals for *energy and water efficiency*.[1] You are presenting your recommendations to the LRA for inclusion in their redevelopment plan, but your suggestions must work with the regulatory framework of the District, as the LRA is a short-term body with no regulatory authority. Solutions can include new policies and programs as well as changes to existing policies and programs. Solutions may be proposed just on the site or at the District level but the mechanism by which the District would achieve the recommendation and how the recommended policies would support the energy and water efficiency goals on the site must be clear.

As well as policy tools, the District will consider other ways to influence the development of the site. For example, the District will consider a variety of options for how to manage ownership of the site. The District will also consider proposals to change utility services to the site, including new mechanisms for utility service that will advance the goals for water and energy efficiency, or provide an innovative way to finance or implement the project.

The District will also consider specific energy and water savings technologies that might be appropriate for consideration on the site, and the mechanisms for developing and financing these recommendations.

Solutions will be judged on the demonstration of:

- Alignment with the District's goals regarding energy and water efficiency
- Creativity
- Impact and effectiveness in achieving the goals
- Ability to be implemented
- Funding needs and strategy

[1] For the purposes of this competition, the other sustainability goals are beyond the scope.

Overview

The Walter Reed campus represents a rare opportunity to create an environmentally sustainable development at a large scale on an existing urban site. In May of 2005, after a Base Realignment and Closure recommendation to realign Walter Reed Army Medical Center (WRAMC) from active military use, the Federal Government declared approximately 113 acres on the main post as surplus property.[2]

The District of Columbia established a central agency, the Local Redevelopment Authority (LRA), to plan for the conveyance and reuse of the WRAMC site. The mission of the LRA is to coordinate the development, create guidelines, and set benchmarks to ensure that the goals of the District are being met.

The District has established a series of sustainability goals and specific commitments that they would like to be met and maintained on the site, and the LRA is responsible for making recommendations on mechanisms that should be used by the District to achieve these goals. Before the site is released for redevelopment by the Federal Government, the LRA must develop a plan for the reuse of the site that is supported by the local community, the District, and the Federal Government.

Governance

The WRAMC site is currently owned by the Federal Government, and is exempt from local regulation. However, the site lies within the jurisdiction of the District of Columbia and once it is transferred, it will be subject to local laws and regulations concerning zoning, permitting, taxation, etc.

The LRA is a temporary agency tasked with developing a plan for the WRAMC reuse and overseeing the conveyance of the site. The LRA was convened by the District government, but plays an advisory role and does not have regulatory or other powers of municipal government. The mission of the LRA is to create the redevelopment plan, make suggestions to the District for how to achieve the goals, consult on the selection of a Master Developer and negotiate the conveyance of the site from the Federal Government to the Master Developer.

Sustainability Goals and Principals

The District has established a series of aspirational sustainability goals for the redevelopment, along with specific commitments for the property in several areas. More details are included in the attachment. The District is also interested in requiring that one (or more) of several existing

[2] The site is divided between two parcels – about 67 acres owned by the Army, and 46 owned by the Department of State. For the purposes of this competition, consider the site as one 113 acre parcel owned by the Federal Government. Specific details about the motivations and operations of the different owners are beyond the scope of this competition.

sustainability standards such as LEED, the Living Building Challenge, or Net Zero Carbon, be used for new and renovated buildings on the site.

Site Details

The site is about 113 acres[3]. located in northern District of Columbia near the Maryland border. See Appendix A for the site plan and location. The site has numerous existing buildings, comprising several million square feet of various uses, some of which have historic significance. This site also contains the central heating and cooling plants that service the campus.

The WRAMC site is surrounded by medium density residential neighborhoods and on the west side by Rock Creek Park, a major open space for the area and region. The site is convenient to public transit, approximately ten minutes' walking distance from a Metro station, which provides easy access to downtown Washington, D.C. and the rest of the region.

Utilities

The main incoming electrical service to the campus is provided by the local electric power utility, PEPCO. All campus power originates from a main electrical substation building that contains site service utility meters and the primary distribution switchgear that allows power to be distributed throughout the campus. Each switchgear unit contains multiple breakers that connect the campus' buildings to the PEPCO service. Each breaker may serve multiple buildings, and each building is served by a building-adjacent transformer. The buildings are not individually metered. As WRAMC, this service was owned and operated by the Army, serving as a central power distribution and maintenance function to the entire campus.

Verizon provides main incoming communications service to the campus. Service enters the campus from a Verizon manhole and terminates within a central building, with copper distributed to the rest of the site for telephone and fiber for data from that building.

The campus is served by central heating and chiller plants that provide steam and chilled water throughout the campus. Most of the buildings use heat exchangers to generate their own heating water which is pumped to the building's heating coils. The chilled water is distributed to the cooling coils in each building by secondary pumps. There is no campus-wide energy management system, and chilled water and steam to the buildings are not metered, so actual energy usage per building is not known.

The main heating plant, built in 1918 and containing 25,000 square feet, is a high pressure steam plant generating steam for heating. There are two fuels available to fire the steam boilers: natural gas and fuel oil. Fuel switching is possible, although natural gas has been used as the primary fuel with fuel oil as the backup fuel. The gas service is an interruptible service provided by Washington Gas Company. This plant contains four dual fuel water tube boilers - two

[3] In actuality, two of the three sites are controlled by different entities, with negotiations about their disposal ongoing. But, for the purposes of this case, consider this one site, with one owner and disposal/conveyance process with the District of Columbia.

generate 60,000 lbs/hr., and the other two generate 100,000 lbs/hr., for a total plant capacity of approximately 320,000 lbs/hr. The maximum capacity currently required for the campus is typically a total required steam output of approximately 160,000 lbs/hr. The average daily loads are around 2,500,000 lbs/day. During the cooling months, one boiler typically handled the load of the hospital operations. Steam is distributed throughout the campus through a series of steam tunnels, trenches, and in a direct buried installation.

A dedicated central chiller plant, built in 1961, and containing 16,637 square feet, provides cooling for most of the buildings. The plant contains the seven centrifugal chillers with 9700 tons cooling capacity, chilled water pumps, cooling towers, and associated accessories that deliver 45 degree F chilled water at a water pressure of 81 to 88 PSIG leaving the plant.

The water, sanitary sewer, and storm drain systems on the site do not meet the current design requirements stipulated by the District of Columbia. The age of the infrastructure and the materials of construction are near the end of their expected use and will likely need replacement. WRAMC has a private water system connected to the District of Columbia Water and Sewer Authority public system at several locations around the perimeter of the property. At each connection location, a master meter is present. The sanitary sewer system outfalls and connects to the maintained public system.

Washington DC Policy Context

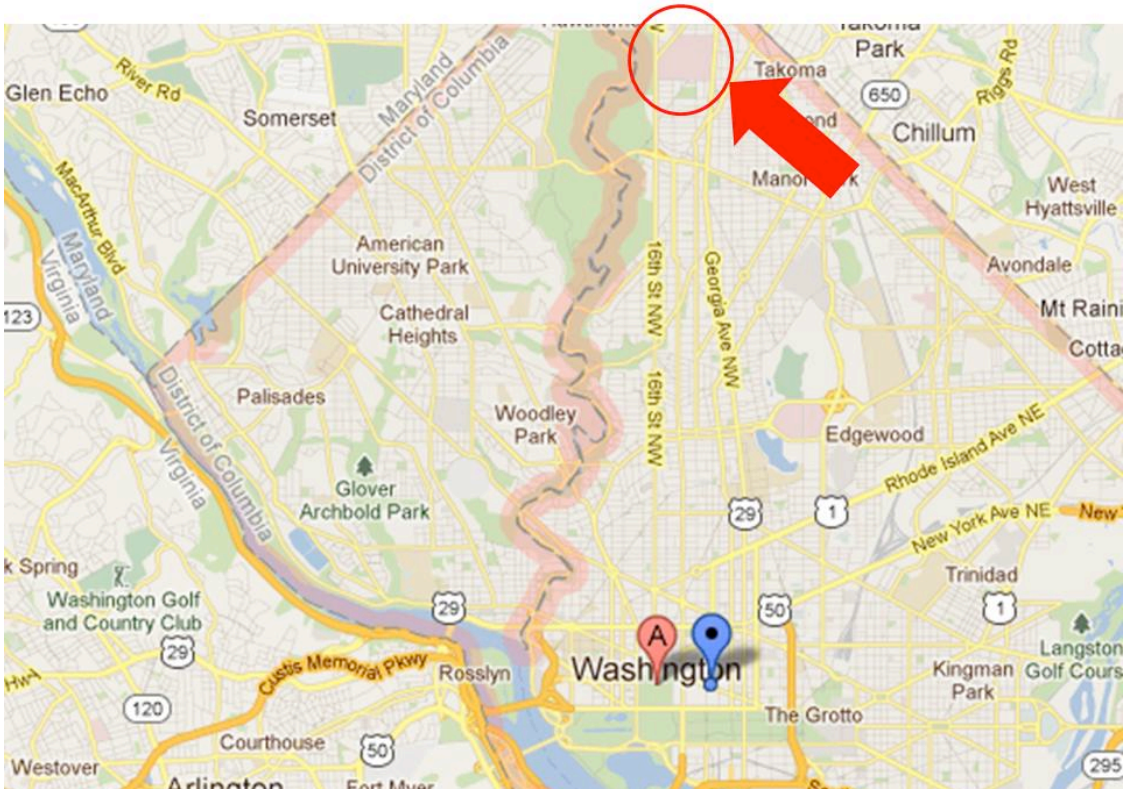
The District is in the process of developing a broad sustainability plan, which will consist of new goals and programs, as well as the prioritization and integration of existing programs and policies. The plan will be unveiled in April of 2012. This plan is supported by a number of innovative existing policy tools, such as the Clean and Affordable Energy Act of 2008, which requires benchmarking and disclosure for commercial buildings, the DC SEU, a sustainable energy utility, and an approved PACE financing mechanism.

At present, the District is developing an ambitious new stormwater regime designed to comply with higher stormwater retention mandates imposed by the federal Environmental Protection Agency. The Walter Reed project provides opportunities to develop with low impact strategies, and to implement a Green Area Ratio initiative that would set standards for landscaping and site design to reduce runoff, improve air quality and the urban heat island effect. Further, the District's Department of the Environment (DDOE) is developing a credit trading regime that would allow the site to earn credits from DDOE in exchange retaining and treating higher volumes of water to compensate for dense downtown properties unable to comply with the new EPA standards.

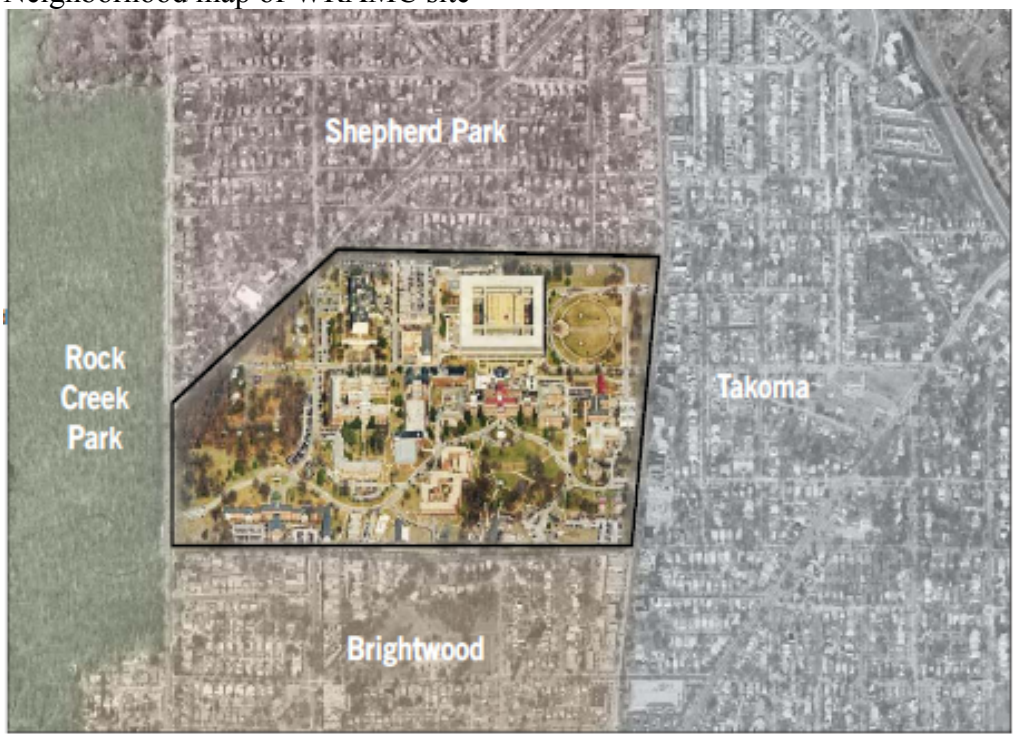
The District is developing a comprehensive energy plan, to reduce energy consumption in both the private and public sectors. The District is currently the top-ranked Green Power Community. The District's Green Power Challenge is an effort to retain its leadership by continuing to increase the overall percentage of District energy purchased from clean renewable sources. Moreover, the District is exploring partnerships with private sector providers of energy infrastructure systems in order to capture efficiencies, long-term maintenance and facilities training contracts, as well as investments in large-scale projects such as Walter Reed.

APPENDIX A: SITE MAP AND PLAN

WRAMC location within Washington DC



Neighborhood map of WRAMC site



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Sustainability Principles and Preferred Utilities Plan Summary

Final Draft - 05-12-2011

WRAMC Infrastructure	Sustainable Principles and Goal	Commitment			Challenges	Opportunities	Recommended Strategy and Plan	Timing/Phasing	Issues that need resolution during planning	Long term technology changes
		Site/Building	Component	Commitment						
ENERGY	Net zero by 2030 – Net Positive by 2040	Site	Power	100% Renewable Energy	> Efficiently serve buildings on campus while achieving Net Positive by 2040; > Reuse (when possible) existing infrastructure to reduce costs; > Develop a system attractive for developer investment	> Existing central heating/cooling plant and distribution infrastructure; > Technology, Cost, no best practices & Innovation	> Central Utility Plant; > Renewable Energy; > Energy efficiency/conservation standards	Plant and New Infrastructure will preferably be built during Phase I of redevelopment	> Location of Central Utility Plant & will it serve DoS ICC?; > Renewable energy source(s), i.e. biomass, trash); > Storage of energy source, i.e. batteries, biomass; > Transport of fuel to site	> Fuel Cells & Photovoltaics as a better alternative source for energy > Beyond Carbon Neutral by 2050
		Building	***Power***	> Existing Buildings shall meet ASHRAE 90.1 + 30% by 2015; > All new buildings shall meet ASHRAE 90.1 + 34%	> Existing historic buildings with outdated energy systems	> Adaptive reuse; > 50% of redevelopment is new space	Entergy Intensity guidelines	New energy systems in existing buildings in Phase I	Building densities and final uses	
WATER	Capture, treat and reuse stormwater & greywater and achieve full water reuse by 2050	Site	***Stormwater***	Eliminate runoff from a 15-year storm event	No SWM system on campus currently	> Extensive open space/gardens to help treat water on site; > Reduce down stream costs	Bio-retention pond bottom of Rose Garden, rain gardens, curbside bioretention areas	Most of bio-retention areas developed during Phase I	> Final Street/landscape/roof garden layout; > Will it need to account for DoS ICC?	
			Black Water	Blackwater treatment by 2030	No black water treatment	Potential space for Central System	Continue to connect to District's system			
		Building	***Grey Water***	100% grey water reuse by 2020	> Water/Sewer systems configured for single user; > Infrastructure at the end of life-cycle; > No grey water treatment	> Adaptive reuse required for historic buildings; > Approximately 50% of space in new buildings; > Treatment in building/Cisterns	Grey water treatment in each building	Grey water treatments included in building renovations and new buildings	Installation of grey water drainage and supply piping, storage & treatment systems in existing buildings	Waterless & Grey water treatment equipment/technologies
TRANSPORT	Reduce the need to travel and impact on environment with low to zero carbon modes of transportation	Site	**> Mass Transit; > Pedestrian/Bicycle Paths; > Connect to Capital Bike Paths & Sharing Program > Parking**	> Prioritize pedestrian-friend environment; > Multimodal transportation system on site (reduced trip generation); > Maximize shared parking opportunities and reduce future parking demand	> Site is barrier for east-west, north-south local circulation ; > Substandard sidewalks ; > Changes in topography; > Earlier phases of development will require higher parking ratios	> Site located 1/2 mile from Metro; > Streetcar line planned along Georgia Ave; > Pedestrian facilities provide good walking environment; > Close to Rock Creek Park and bicycle routes > Close to Rock Creek Park and bicycle routes; > Existing parking on-site	> Increased East-West, north-south connectivity; > Transit-Oriented-Development with a streetcar stop on site; > Pedestrian/bicycle trails cross site > Phased reduction in parking ratios	> New roads, pedestrian/bicycle facilities and tracks for streetcar developed during Phase I; > Streetcar stop and additional bicycle facilities during Phase II	> Streetcar stop location, DoS ICC service and easements, program/densities; > Identifying suitable parking ratios	Cell fuel powered streetcar
		Building	***Bicycle Facilities***		> Site and buildings are not connected to bicycle route system; > Existing buildings do not have bicycle facilities	Existing buildings are ADA accessible	Buildings to include bicycle parking facilities and alternative fuel connections	As buildings are renovated/built	Program/Densities	
WASTE	A future where resources are used efficiently, waste levels are close to zero and ultimately zero waste to land	Site		> 100% food and yard waste composted on site or within 30 Miles; > 100% recyclable material is recycled; > 50% landfill waste reduction by 2020; > 100% zero waste by 2030	No waste treatment on site	Locate waste management plant on site that can serve campus and nearby communities	> Potential for curbside composting program > Liquefied Natural Gas from decomposition of trash > Biogas to Energy through anaerobic digestion - biodigester > Recycling Program	Partially implemented in Phase I, as program is implemented	> Coordination with Food composting program and large-scale facilities; > Provide services on site?	Large-scale composting technologies in nearby locations
		Building			No waste treatment in buildings/site	Existing buildings are ADA accessible	Buildings to include food waste recycling ducts / collection	As buildings are renovated / built	How will buildings tie into the system?	Waste treatment technologies in buildings
MATERIALS	All goods and materials used for construction or consumer goods are made from renewable resources with low embodied energy and sourced locally	Site		> 100% green business certification for all companies; > Business commitment to waste = food materials	Business culture and development community investment traditional practices	Changing business environment and government regulations that promote green operations				

Office Building

The Better Buildings Case Competition
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

The Department of Energy would like to thank Evan K. Tyroler, Lee J. Dunfee and Michael D. Alexander of Cassidy Turley for their assistance with this case.

You represent the company that manages a multi-tenant Class A office building in the Chelsea neighborhood of Manhattan. In response to a recent municipal regulation, the building has undergone an energy audit, which shows that this building has a significant opportunity to reduce energy consumption; lower operating costs and brings additional benefits to the property. However, there are barriers that are preventing the owner from agreeing to fund and implement the project.

You are presenting to the owners of the building in order to convince them to approve the project. Your suggestion should include implementation, technical, financial, phasing, leasing/contracting or other solutions that address the barriers that the owner can use to pay for and implement the most effective package of energy efficiency measures in the optimal way.

Solutions will be judged on the demonstration of:

- Understanding of the barriers and motivations of multiple stakeholders
- Realism and ability to be implemented
- Effectiveness in achieving the goals
- Strength and accuracy of analysis supporting the recommendations
- Creativity

Overview

This property is a stable, multi-tenant Class A office building in the Chelsea neighborhood of Manhattan, New York City. This property weathered the downturn of 2008-2009 well, and occupancy is stable. The owner, a family trust, has owned the building since 2003 and your firm has been managing it since 2004.

In response to the New York City Greener, Greater Buildings regulation and its requirement to audit, disclose, and upgrade energy performance, the owner tasked you—the management firm– with undertaking an energy audit and US Green Building Council's LEED for Existing Buildings: Operations & Maintenance (EBOM) gap analysis (see Appendix A). An ASHRAE Level I & II Energy Audit for LEED-EBOM Energy and Atmosphere (EA) Credits 2.1-2.2 was completed, and showed that some capital investments would improve the energy performance of the building, lower operating costs, and help the building achieve LEED and ENERGY STAR certification.

With these promising technical and financial results, the owner would like to proceed with the project. However, the recommendations require investment to achieve the results and the owner wants to ensure that whatever capital is invested in the project meets their business goals – providing competitive financial returns. With the current lease arrangements, the owner does not see a path forward to implement the projects in a way that the owner would be able to participate in the benefits. As the management company, you have been tasked with proposing a solution.

Building Details

The building is a 12-story commercial high-rise building consisting of 300,000[1] square feet located in the Chelsea neighborhood of Manhattan. The building is a brick, concrete facade and glass structure originally built in 1963. The building underwent an $8 million interior and exterior renovation in 2004, which involved a mechanical system renovation, but did not focus on energy efficiency or LEED certification.

The building has five tenants – a law firm which occupies 65% of the space, and four retail tenants and one empty space that comprise the other 35%, on the first and second floors. The building has a daily occupancy of approximately 500 workers. The building operates on a typical 55 hours/week schedule, from 7am-6pm Mon-Fri with most occupants arriving at 8am.

The HVAC system at the building is a variable air-volume fan-powered perimeter terminal box with hot water reheat and core terminal boxes with no fan or reheat. The primary cooling/heating is manifested by a 4-pipe hot water/chilled water fan coil air handler delivery. A central plant creates the chilled water and hot water is converted from steam generated by steam boilers, both of which are located in the basement. Air handlers that serve each floor are equipped with

[1] All of the numbers in this case have been altered. The exact numbers are not the focus of the case, although if specific numbers impact your solution, please ask the DOE for clarification.

variable frequency drives that allow them to adjust their fan speed, based on a static pressure sensor and set point, to meet the airflow needs of each floor and the terminal boxes.

The central cooling plant located in the basement is served by three, 176 ton forced draft BAC cooling towers, a 300 ton York centrifugal chiller, and a 200 ton Trane screw-driven chiller. Air handlers that serve each floor are equipped with variable frequency drives that allow them to adjust their fan speed—based on a static pressure sensor and set point—to meet the airflow needs of each floor and the terminal boxes.

The building has a hot water reheat system along the perimeter. This hot water system functions to serve the variable air volume (VAV) boxes on each floor by four climate-control zones, one for each side of the building. Hot water for the air handler fan coils and VAV reheat system is supplied by two 100 hp Superior boilers. The boilers generate steam, which is converted to hot water for the reheat system. A VAV system supplies conditioned air to the tenant space on each floor.

The building's entire HVAC system is controlled by an energy management system (EMS) via building computer and off-site modem access. The EMS is capable of monitoring and adjusting set points, alarms, start up and shut down of equipment, and optimizing performance of the system.

The building is wired with a single master connection to Con Ed. From there, the landlord distributes electricity to the tenants and records their usage, in the case of the law firm, with submeters.

Lighting in the building consists of approximately 10% fluorescent (T8s and T5s), 85% dimmable incandescent, and 5% high intensity discharge metal halide. The tenant spaces primarily consist of T8 and T5 mixes with fluorescent biaxial can lights. The elevator lobby and hallway areas are primarily high intensity metal halide augmented by can lights and 2' x 2' fluorescent fixtures that are controlled by switch. Office spaces have overhead lighting and most individual tenants' workstations have task lighting to control the light at their workspace to adjust for the task being performed. Building common areas, such as hallways, are controlled by the EMS.

Ownership Structure

The owner is a family trust. They acquired the building in 2003 and plan to hold the building for the foreseeable future. The family has no particular interest in sustainability or green buildings, but realize the need to comply with the New York City regulation could be an opportunity to differentiate the building in the market by achieving ENERGY STAR or LEED certification as there are few office buildings in the Chelsea area of Manhattan with these certifications and this would differentiate their building. However, the owners will not pursue this path if it does not make financial sense.

The building has been managed by the same company since 2004, and has been tasked with compliance with the regulation as well as exploring the opportunity for ENERGY STAR or LEED certification.

Leasing Details

This multi-tenant office building is almost fully occupied. Of the rentable square feet, a law firm occupies 65%, and the other 35% is occupied by four small retail tenants and one vacant space. Lease negotiations for a fifth retail tenant are just beginning. The law firm is twelve years into a lease with a 15-year term, while the other tenants use the same lease structure and are at different points on leases with rolling five-year terms. Some key provisions of both leases can be found in Appendix B.

The law firm has expressed interest in being in a LEED and/or ENERGY STAR certified building. The retail tenants have been silent on the issue.

New York City Context

The building is subject to New York City's Greener, Greater Buildings Plan, including the requirements for benchmarking and disclosure of energy use, auditing, and retro-commissioning. More information about this regulation can be found at:
http://www.nyc.gov/html/planyc2030/html/about/ggbp.shtml

City and state (NYSERDA) incentives for energy efficiency or green renovation may apply.

Energy Efficiency Opportunity

Currently, the building has an energy use intensity (EUI) of 104 kBtu per square foot. The current building ENERGY STAR score is 62 out of 100.

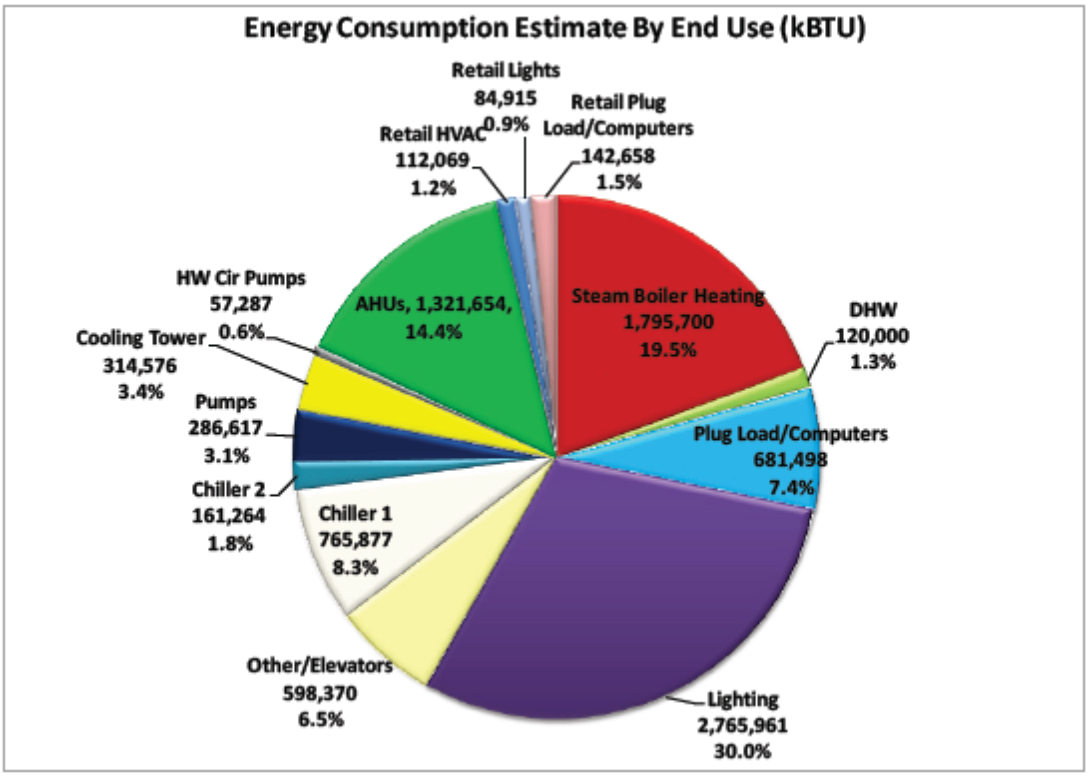
HVAC components and lighting dominate the majority of the energy use and cost in the building, with elevators, data/server rooms, plug loads, and other equipment that are intermittent or difficult to quantify comprising the rest of the use.

The main building utilities are electricity and steam. The total Annual Utility Spend equates to $3.77 per square foot per year to run the building. This breaks down into:
Electricity $3.55
Steam $0.22

In the course of the audit, 19 energy conservation measures (ECMs) were identified with implementation costs and annual savings estimates. The annualized savings estimations of all recommendations total $37,653 (at 2011 energy prices) with an average simple payback period

of 5.3 years. All of these measures should yield worthwhile energy savings and foster better operational control of the building. See Appendix A for more details.

Figure 1: Energy consumption by end use



Appendix A: Energy Audit / LEED Gap Analysis

		Savings			
	Cost	kWh	Therms	$/year	simple payback (years)
No/Low Cost ECMs					
Replace OA Temperature/Humidity Sensor	$ 550	56,639	-	$ 6,798	0.1
Insulate hot water pipes	$ 80	508	28	$ 96	0.8
Utilize timer on DHW Circulator Pump	$ 150	2,440	-	$ 294	0.5
Optimal Start Stop Control	$ 900	37,323	233	$ 2,270	0.4
Lower hot water temperature from 125F to 120F	$ 10	-	24	$ 25	0.4
Add Fitness Center Occupancy Sensor lighting controls	$ 500	5,766	-	$ 693	0.7
Hot water heater schedule modification	$ -	-	31	$ 32	0.0
Install occupancy sensors in rooms	$ 40	2,523	-	$ 304	0.1
Turn off extra lighting in stairwell	$ -	7,446	-	$ 895	0.0
Modifications to use air side economizer	$ -	68,253	-	$ 819	0.0
Capital Cost ECMs					
Replace filters with higher efficiency models	$ 3,500	11,086	-	$ 2,612	1.3
Retrofit lighting in elevators to LED	$ 1,800	6,377	-	$ 767	2.3
Supply Air Temperature Reset on Return/Outside Air	$ 8,200	3,800	3,229	$ 4,492	1.8
Retrofit lighting in lobbies to CFL	$ 6,480	16,617	-	$ 1,995	3.2
Enable automatic chilled water temperature reset	$ 2,400	29,586	-	$ 3,550	0.7
Replace older CHW/CW motors with efficient models	$ 3,800	1,627	-	$ 435	8.7
Fitness center lighting retrofit	$ 1,900	830	-	$ 161	11.8
Steam boiler to HW boiler	$ 156,000	-	6,200	$ 9,349	16.7
VFD on CHW pump and variable bypass controls	$ 11,500	17,204	-	$ 2,066	5.6
TOTAL	**$ 197,810**	**268,025**	**9,745**	**$ 37,653**	**5.3**

Replace OA Temperature/Humidity Sensor

The automation system utilizes this temperature/humidity sensor for many energy management and automatic energy savings programs such as the waterside economizer, airside economizer control, and cooling tower control. Currently, the sensor is incorrectly reading the ambient temperature and humidity. This sensor should be replaced and relocated so that it does not pick up solar load or radiant heat from the wall it is mounted on. This should allow these systems to function properly. It should also allow for more hours of free waterside and airside cooling instead of mechanical cooling. The best location for this critical sensor is a weather-protected shaded area. Another good strategy to ensure proper system operation is to install two sensors and compare them against each other, generating an alarm when there is any significant variation. The calibration of this sensor should be verified at least every 6 months to ensure proper operation of all energy saving systems.

Insulate Hot Water Pipes

There are two portions of copper hot water circulation pipe that are not insulated. One section is located in the engineering office and the other in the fitness center. Apply 3" insulation to the pipes. This should reduce cooling loads slightly and save natural gas at the hot water heater.

Utilize Timer on DHW Circulator Pump

The hot water heater circulation pump is in operation continuously. Install timers that limit operation and consumption of these devices to occupied hours.

Optimal Start

The floor-by-floor AHUs and rest of system that support them start between 5:00 and 5:30 am. Program to automatically set the start time so that adequate space temperatures are achieved right before occupants arrive. Alternatively manually program shorter lead start times and observe the time for the space to reach temperature. This will reduce the total number of hours and thereby consumption of the overall system.

Lower hot water temperatures from 125°F to 120°F

Lower the hot water temperature from 125 to 120°F.

Fitness center occupancy sensor to control the HVAC and lighting

Lighting in the fitness center is controlled by switch, and HVAC is controlled by wall-mounted thermostat and enabled by the control system. Install an occupancy sensor to control the lighting and set the delay to 30 minutes.

Hot water heater schedule modified from 6am-6pm to 7:30-1:30

The hot water heater schedule was set to 6am to 6pm. Modify the schedule for the hot water heater to operate only during core hours of the occupied day.

Install Occupancy Sensors in Rooms B1 and B2

The lighting control for the basement elevator lobbies are controlled by switch. Installed dual technology occupancy sensors to control elevator lobby lighting and set for 10 minute delay.

Turn Off Extra Lighting in Stairwell
There is more lighting than needed in the stairwell, which is on 24-7. Turn off the unnecessary lighting.

Modifications to Use Airside Economizer Instead of Waterside/Mechanical
Repair the airside economizer dampers & controls to allow for less mechanical cooling. Complications with dampers and controls settings had waterside economizer operating along with mechanical cooling and no airside economizer. Correcting damper installation issues and changing the control methodology to take advantage of free airside cooling allows for other mechanical equipment to be turned off.

Replace Filters with High Efficiency Dual 2" MERV-13
The air handlers utilized at 2" MERV 11 pleated pre filter and a final bank of 4" pleated final filters. The filter configuration was changed from two banks of filters to one bank of dual 2" MERV 13 filters. The total static drop across the new configuration is less than the original, resulting in fan energy savings. New AHU filter bank in place

Retrofit (52) MR-16s In Elevators to LED
The elevators are outfitted with 20W halogen MR-16s that are operational continuously. Replace elevator lighting with 6W LEDs, which consume less and last longer.

Supply Air Temperature Reset on Return/Outside Air Temperature
Reset the supply air temperature from 55F-62F based on return 70F-74F or outside air temperature 30F-60F. The supply air temperature delivered by the air handlers is maintained at a constant 55°F unless manually adjusted. Employ new programming and sensors to reset the supply air temperature from 55°F-62°F based on 70°F-74°F or outside air temperatures from 30°F-60°F. Resetting the supply air temperature should reduce the amount of reheat needed on the perimeter zones and allow the chilled water and cooling load to be reduced at other times.

Retrofit 70W MH to 23W CF in lobbies & hallways
The building has 83 high intensity discharge 70W lights used in the lobby, elevator lobbies, and hallways. Remove the ballasts and replace these lights with 23W compact fluorescents

Chilled Water Temperature Reset
Enable automatic chilled water supply temperature reset 44°F-54°F based on outside air temperatures. The operational chilled water temperature is normally 45°F and is manually reset by the engineer at times to 55°F. While a manual temperature reset is an excellent energy conservation procedure in the winter, calibrated automatic reset has been shown to nearly double the energy savings.
Recommendation: The Trane 200 ton helical rotary chiller has an automatic chilled water reset program existing but currently disabled. To implement this ECM, this programming needs to be enabled and adjusted to the desired parameters. For this analysis, a variety of reset range settings were examined. After several iterations, a reset range of 44°F to 54°F relative to outdoor temps of 50°F to 85°F produced the best results. Similar results may be achieved with 45°F to 55°F relative outdoor temps 40°F to 90°F, which is built into the chiller controls. Since the outside air

temperature is not a direct indicator of building load, this range may require adjustment, or the reset can be driven on building load driven chilled water return temp. This can also be accomplished through the chiller controls. The annual hourly analysis graphic below shows the chiller consumption with and without the reset strategy. The green that can be seen is displayed as the energy savings.

Replace 2 Older CHW/CW Motors With New Higher Efficiency Motors

Replace CHW and CW pump motors nearing failure with higher efficiency motors. The chilled water and condenser water pump motors P1 and P3 appear to be 15-20 years old and 91% efficient. During operation they are running hotter than normal, above 145°F, which may be an indicator of imminent complications or failure. These motors should be replaced regardless of financial energy savings. Replacing these motors with new, reliable, high efficiency equipment is worth the incremental cost difference of several hundred dollars. New 93% efficient motors will save energy during operation, provide lower maintenance costs, and enhanced reliability.
Impact on Equipment Service Life: Replacing the equipment will mean a longer service life.
Impact on Health, Comfort, & Safety: No anticipated impact on health, comfort, and safety.

Fitness center retrofit (19) MR-16s 20W to 6W to LED

The building has 19 halogen 20W MR-16s for lighting the fitness center. Replace the halogen MR-16s with 6W LEDs.

Retrofit steam boiler system to high efficiency hot water boilers with temperature reset

The building heating is generated by two, 1962 steam boilers with newer burners. The steam is transmitted from the basement to the penthouse where it is converted to hot water for AHU fan coil heating and VAV reheat system. Replace the current steam boilers with several 97% efficient modulating condensing boilers with variable turndown and outside air reset.

VFD on CHW Pump 3 & Variable Primary Bypass Controls

Utilize a VFD on CHW pump 3 & variable primary bypass controls to reduce pump consumption. The chilled water is delivered from the chiller to the air handlers by a constant speed pump. The Trane 200 ton helical rotary chiller has a CH530 controller. This controller allows the chiller to handle variable primary flow up to a limit of 70% of rated. The system currently operates with two-way valves at the air handlers and a bypass in the mechanical room to maintain a constant flow through the chiller. To implement this ECM, precise valve control and flow sensors would need to be put into place at the bypass and on the return line prior to the bypass. As the two-way valves at the air handlers close the primary chilled water pump would be able to slow down in response. Once the lower flow limit to the chiller is reached the pump speed would need to be maintained. The bypass would be allowed to open in this lower range to ensure that the chiller minimum flow (70% of design) is steadily maintained.

Appendix B: Critical Lease Terms

Law Firm

Start Year: 2000
Term: 15 years
Base rent: $75 per rentable square foot (net of electric)
Square Feet: 195,000 (65% of total)

Operating Expense Pass-Through/Escalation: The lease stipulates that the only expenses that can be passed-through are utilities (non-electrical), maintenance, cleaning, and security. The lease also contains a protocol through which the cost increases can be audited.

Electricity: The law firm's space is submetered. The management company reads the submeters monthly and bills the firm, adding an increase of 12%, which is the negotiated maximum in the lease.

Retail Tenants (4) and Vacant Space (1)

Start Year: various (see table below)
Term: 5 year, renewable

Operating Expense Pass-Through/Escalation: These leases use a fixed index formula with a fixed percentage of 3% each year.

Electricity: all of these leases use a Rent Inclusion

	Base Year	% of building	Square Footage	Base Rent	Electricity Rent Inclusion (per sf)
Law Firm	2000	65	195,000	$75.00	N/A
Tenant A	2008	5	15,000	$65.00	$2.75
Tenant B	2008	5	15,000	$63.50	$3.00
Tenant C	2010	7	21,000	$66.50	$2.90
Tenant D	2012	8	24,000	$73.00	$3.15
Open	In negotiation	10	30,000	TBD	TBD

Hotel

The Better Buildings Case Competition
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

The Department of Energy would like to thank Bob Holesko of HEI Hotels & Resorts for his assistance with this case. As a partner of the Better Buildings Challenge, HEI is demonstrating its leadership and commitment to advancing energy efficiency in the commercial real estate industry.

You are the franchisee owner and operator of two Marriott hotels in New Jersey. One of the hotels has a significant opportunity to reduce energy consumption, lowering operating costs and bringing additional benefits to the property, but you have no internal capital available to invest and limited ability to take out a loan for the project.

You are presenting a solution to a decision maker at Marriott to convince them to support the project (partially or wholly.) The solution should include a combination of financing, contracting, timing, franchise agreement changes and other analysis that will be persuasive in convincing the franchisor to move forward with your plan. Other means of financing and implementing the project should be considered to maximize the chance that your solution will be supported by the franchisor.

Solutions will be judged on the demonstration of:

- Effectiveness in achieving the goals
- Realism and ability to be implemented
- Strength and accuracy of analysis
- Creativity
- Funding needs and strategy

Overview

You own two hotels in New Jersey. You bought one in 2009 and the second last year. Your hotels recently underwent energy audits. The results of the audits indicated that one of the hotels has significant opportunity to improve energy and operational cost performance by installing a number of energy efficiency measures. However, with business still improving from the slump in 2008 and 2009, and your recent purchase of a second hotel, you have no capital available to pay for in the energy efficiency improvements, and little ability to borrow money for the project. You plan to approach the brand/franchisor of the hotel with a proposal for them to support and/or fund the energy project.

Ownership Structure

As with over three-quarters of hotels in the United States, the hotel is owned in a franchise relationship. In 2009, you the owner, or franchisee, paid an up-front fee to purchase the right to operate the property under the brand and business model of the franchisor. You pay an ongoing royalty fee amounting to a percent of the gross revenues of the property each month, and ongoing fees to use the franchisor's centralized services such as branding and marketing support, booking, loyalty program, and training and professional development programs. Details of the franchise agreement can be found in Appendix C.

The license granted by the franchise agreement has a duration of 10 years and may be renewed by mutual agreement for another 10 years after that. The agreement cannot be cancelled prematurely without substantial penalty.

The franchise agreement defines standards for operation including use of logos and trademarks, color and style of staff uniforms, and most importantly, requirements to operate the hotel to specific performance levels. For example, the agreement defines certain product improvement plans (PIPs) that require the upgrade of the property according to a specific time table.

In the course of the franchise agreement negotiation, the franchisor agreed to waive the PIP fee as long as the franchisor-defined PIP was agreed to by the franchisee. This PIP, which was agreed to and incorporated into the agreement, stipulates:

- Property would undergo an energy and operations audit within 12 months
- Property would undertake all approved measures to improve guest comfort within 24 months
- Property would upgrade lighting maintaining brand approved foot candle levels through-out facility within 36 months
- Property would retrofit or replace the chiller plant to extend its operational lifecycle by at least 15 years within five years

The franchisor has a growing interest in sustainability and has been increasingly linking the brand to environmental stewardship. In 2009 the company released a sustainability statement which included the following goals:

- Reducing energy and water use across all properties, owned and franchised, by 20% by 2020, from a 2009 baseline
- Registering for the U.S. Green Building Council's LEED® (Leadership in Energy and Environmental Design) Volume Program, which allows any hotel to easily and cost efficiently become LEED certified
- Building new hotels as LEED certified wherever possible, providing a green hotel prototype design and creating green construction standards for developers
- Green our multibillion dollar supply chain
- Enhance the waste & recycling programs taking full advantage of all single stream recycling locations
- Providing education to all franchisees and staff on sustainability practices and guides engineering and other property leaders through an energy audit process to help achieve energy and water reduction goals.
- Requiring every property to have an up-to-date Energy and Environmental Action Plan
- Providing online best practices and tools, for example a desktop energy audit process to help identify energy and water reduction opportunities

Property Details

The property is a 260,000 square foot full-service suburban hotel with 353 rooms, 20,000 square feet of meeting space, two restaurants, a lobby bar, a fitness center and a business center. There is a large surface parking lot. It was built in 1986.

HVAC: The hotel has a water-cooled central plant that is original to the hotel. It contains two 425 ton Carrier centrifugal R-11 Chillers with primary-only pumping, a water-side economizer and new Baltimore Air Coil (BAC) cooling towers. The chillers are past their useful life and are R-11 refrigerant machines which have been discontinued. There are low pressure hot water boilers also original to the hotel with hot water pumping distribution and a Honeywell outdoor air reset controller. Guest Rooms have four-pipe fan coil units with two two-position, two-way valves and digital thermostats, which the common and meeting space has four-pipe air handling units with constant volume return and 100% makeup air units. 100% of the property space is heated and 90% is cooled

Domestic Hot Water: Two high efficiency (86% efficient) boilers with three storage tanks. The majority of the toilets are 3 gallon flush.

There is a building automation system with pneumatic end devices/DDC Front End. The food services include six commercial refrigerator units and cooking facilities

Energy Efficiency Opportunity

Under its previous owner, energy efficiency was not a priority and the hotel's energy and water consumption has much room for improvement. Many aspects of the hotel's original design are extremely energy and water intensive; however a retrocommissioning study done in 2010

identified numerous energy efficiency opportunities. All of the no cost measures were implemented (See Appendix A) bringing energy and water use down to the current levels, but to capture the additional opportunities, capital investment is required.

The current site energy use intensity for the past 12 months was 144 kBtu/sf. The national average for similar buildings is 97 kBtu/sf, and the property scored 11 out of 100 in ENERGY STAR Portfolio Manager. The hotel produces almost 3,000 tons of CO2 per year.

The property spends $1.3 million on utilities per year, broken down into electricity (64%), gas (19%), water (9%) and sewer (8%). Annually, utilities (including water and sewer) are $6.99 per square foot, or about $16.70 per occupied room. According to ENERGY STAR, a 10 percent reduction in energy costs is equivalent to increasing revenue per available room by more than $2.00 for full-service hotels. In addition, energy management can and increase guest comfort and satisfaction.

The facility's total electrical consumption remains relatively constant all year, increasing slightly during the summer months, which can be attributed to the operation of the electric chillers. This consumption profile indicates that lighting, fan and pump motor loads throughout the facility remain relatively constant.

The hotel is not participating in any demand response programs.

Appendix A: Low and No Cost Measures Implemented

After a 2010 retrocommissioning study, the following measures were implemented.

- Automate Condenser Water Pump Operations: Reestablish automatic controls for condenser water pumps, which were found both online in manual operation.
- Implement Condenser Water Temperature Reset: Automatically resetting the condenser water supply temperature set point to achieve optimum condenser water temperature based on the outside air wet-bulb from the manual setting of 80 degrees.
- Pre-Heat Valve Leak-By: Repairing and replacing leaky pre-heat coil control valves.
- Install Low Flow Sink Aerators, Shower Heads & Pre-Rinse Spray Nozzles with high-efficiency units
- Optimize Chilled Water Temperature Reset: Reset the BAS so that the chilled water temperature set point is reset based on the outside air enthalpy rather than based on the outside air temperature.
- Clean dirty Filters & Pre-heat Coils: clean pre-heat coils on AHUs and change the filters

Appendix B: Proposed Energy Efficiency Measures

Proposed Energy Projects

Item	Budget	Estimated Annual Savings		Simple Pay Back	
Lighting	$ 40,000	$ 18,000	electric	2.2	
Room Thermostats	$ 160,000	$ 30,000 $ 15,000	electric gas	3.2	
VFDs & Motors	$ 50,000	$ 15,000		3.3	
Kitchen Equipment pilot retrofits	$ 10,000	$ 5,000	electric	2.0	
Variable to constant volume conversions	$ 11,000	$ 3,000 $ 2,000	electric gas	2.2	
Chiller plant upgrade	$ 188,000	$ 20,000 $ 2,000	electric gas	8.5	
TOTAL	$ 459,000	$ 110,000		4.2	years

Lighting Controls & Fixture Upgrades

Numerous areas could benefit from the installation of occupancy sensors to automatically turn off lights. These areas include, but are not limited to:

- Offices
- Banquet Storage rooms
- Guest Vending Machine rooms
- Break rooms

Upgrade / replace fixtures or bulbs throughout the facility, including:

- Parking Lots utilize HID bulbs – upgrade to induction lighting
- Banquet Storage rooms utilize T12 fixtures – replace with T8 fixtures
- Pub restaurant utilizes incandescent fixtures/bulbs – install CFL or LED bulbs
- Pool area is equipped with sconce fixtures that utilize incandescent bulbs – install CFL or LED bulbs
- Passenger elevators currently utilize incandescent bulbs – install CFL or LED bulbs

Guest Room Occupancy-Based Thermostats

There are approximately 350 Fan Coil Units (FCUs) that serve the guest rooms. Each FCU is equipped with a 2-speed fan, a heating coil and a cooling coil that are supplied from the central heating and cooling plant. Each of these FCUs currently utilize local manual controls to maintain occupant comfort, resulting in the FCU often remaining in operation during unoccupied periods, which include when the guests are out of their rooms.

Install occupancy-based guest room FCU thermostats. These controllers utilize occupancy sensors to automatically reset the space temperature, which turns the FCU off. Additional features such as connection to a central monitoring station at the front desk or the BMS are available.

Install VFDs on Cooling Tower Fans

The cooling tower fans are currently equipped with constant speed fans. The condenser water temperature set point is maintained by staging and cycling of the cooling tower fans. Installing VFDs on the cooling tower fans will reduce the cooling tower fan energy consumption and provide very stable condenser water temperature control, improving chiller operation.

Premium Efficiency Motor Upgrades

The main heating hot water, chilled water and condenser water pumps are approximately 26 years old and their motors have lower rated efficiencies (i.e. 88%) when compared to premium efficiency motors (i.e. 93%). Replacing the motors with premium efficiency motors will reduce electrical energy consumption. Consider evaluating the feasibility of utilizing the existing emergency generator for an on-site cogeneration system. Additional analysis would be required to identify how the waste heat could be effectively utilized; however, significant cost savings could be achieved. Additional cogeneration technology options that could also be evaluated include micro-Turbines and fuel cells.

Conversion of Kitchen Equipment Gas Pilot Lights to Electronic Ignition

There are several pieces of kitchen equipment that are equipped with gas pilot lights that remain on 24/7. Converting these units to utilize electronic ignition will reduce the facility's gas consumption.

Constant Volume Chilled Water System Conversion to Variable Volume

The chilled water system is equipped with 3-way chilled water control valves at the AHUs and 2-way control valves at the FCUs. This configuration results in increased pumping energy as the maximum quantity of water is pumped at all times, regardless of the actual cooling demands. This configuration also results in a very low chilled water differential temperature (dT) across the chiller, indicating that the chilled water is not being utilized efficiently and could be attributed to poor heat transfer at coils or short-circuits, in addition to the 3-way valves. Convert the chilled water distribution system to utilize a variable primary flow configuration (in conjunction with new chillers capable of variable primary flow) with VFDs on the primary pumps and install pressure-independent 2-way control valves at the AHUs.

Constant Volume Hot Water System Conversion to Variable Volume

Similar to the chilled water system, the hot water system is equipped with 3-way hot water control valves on the AHU's and 2-way control valves at the FCUs. This configuration results in increased pumping energy as the maximum quantity of water is pumped at all times, regardless of the actual heating demands. Convert the hot water distribution system to a primary/secondary loop configuration to utilize VFDs on the secondary hot water pumps and 2-way hot water control valves in place of the 3-way control valves.

Conversion of Constant Volume AHUs to Variable Volume

The majority of the AHUs are of the constant volume recirculation type. This type of configuration for the building's application with highly variable occupancy loads is inefficient and is reflected in the facility's energy consumption profiles. However, as most of the AHUs serve open areas, conversion to variable volume is possible with the installation of VFDs, CO2 sensors and controls programming.

Chiller Plant Upgrades

The existing electric centrifugal chillers are 26 years old, at/near the end of their useful service life, utilize R-11 which is no longer manufactured and are not equipped with VFDs. Replacing these chillers will be necessary in the near future. While this represents a significant capital investment, it also represents a significant opportunity to greatly reduce the annual operating costs. Replace the two 425 ton chillers with three new 285 ton electric centrifugal chillers that are equipped with VFDs. Utilizing smaller chillers will provide the following benefits:

- More efficient staging, operation & redundancy
- Smaller foot-prints should make installation easier – (i.e. boiler removal may not be necessary)
- Greater financial incentives are available

Appendix C: Key Terms of Franchise Agreement

Term
Start year: 2009
Duration: 10 years
Termination: Franchisee/owner - no termination without substantial fees. Franchisor – termination allowed if owner breaches contract terms.

Fees
All fees are paid monthly.

Royalty Fee: 4.5% of gross room revenue and 2.5% of gross food and beverage sales.
Advertising, marketing, training, and other miscellaneous fees: 3.0% of gross room revenue
Reservation fees: 1.0% of gross room revenue
Loyalty program fees: $4.00 per room occupied by a program member.

Key Clauses

Property Improvement Plan (PIP) – The usual PIP fee was waived on the condition that franchisee accepted the PIP plan proposed by the franchisor, as described above.

Performance Clause – the franchise agreements stipulates that the hotel maintain at least 50% average annual occupancy.