Overview

- In 2008, PHS Utilities and Engineering was tasked to prepare a Strategic Energy Master Plan (SEMP) that encompasses its healthcare network. Overall, the intent of the SEMP is to establish a plan for all Partners HealthCare facilities enabling Partners HealthCare to achieve four major goals described below; This report only address the progress of MGH “Energy consumption Reduction Goal”.

1. **Energy Consumption Reduction**, decrease energy usage by 25% or more in a ten year period compared to 2008 baseline.
2. Identify Renewable Energy Sources, evaluate various renewable energy resources such as wind turbines, solar photovoltaic panels, hydroelectric and geothermal technology with the most promising being advanced for implementation.
3. Increase use of Cogeneration Systems, assess the use of CHP systems for implementation at facilities with suitable conditions.
4. Develop a capital plan, establish a 10 year plan outlining the annual investment of capital to achieve the projected savings and to progress the goals of SEMP.
MGH Progress Report

- The MGH SEMP progress report provides an indicator on how MGH performed based on funding level, % of energy reduction and utility cost reduction.
- The progress report is based on 2008 baseline and a projected annual 1.5% load growth. The projected load growth is based on 10 years historic data. If the hospital did not implement any energy conservation projects since 2008, MGH total energy consumption for 2013 would be 1,825,728 MMBTU compared to the actual energy consumption of 1,340,626 MMBTU a savings of 485,102 MMBTU.
- MGH consumed 32% less energy in 2013 compared to 2008 base line and 4% less than 2012. The implementation of energy conservation projects were the combination of ECMs indentified under SEMP study and MGH energy conservation team.
- MGH is establishing a new goal of 40% in energy consumption reduction by 2019 because as of FY13 the % of MGH actual energy reduction is already exceeded PHS Strategic Energy Master Plan (SEMP) goal of 25% energy reduction by 2019.
- In spite of 4% reduction in energy consumption in 2013, the MGH utility cost was up 5% from 2012 (from $31,652,574 to $33,284,539) because the overall utilities rate per MMBTU was up 8% from 2012.
- The accumulated savings from the combination of energy reduction and benefit from PHS utility procurement program since 2008 is more than $42 million. Total capital for the ECMs from 2008 to 2013 is $17.3M including more than $5M from utilities incentives programs.

MGH SEMP-Funding Level, Utilities Incentive, ECMs Implementation Cost and Savings from 2009 to 2013 (Accumulated)

- Massachusetts General Hospital (5,512,036 sq.ft.)-Approved Budget for 2008-2013
- Massachusetts General Hospital (5,512,036 sq.ft.)- Utilities Incentive from 2008-2013
- Massachusetts General Hospital (5,512,036 sq.ft.)- Actual Implementation Cost from 2008-2013
- Massachusetts General Hospital (5,512,036 sq.ft.)- Actual utilities cost saved (accumulated) from 2008-2013
Energy Conservation Measures (ECM’s) that yield significant savings in Medical/ Lab Facilities

- Building Occ/Unocc schedule setback
- Reduce minimum CFM set point
- Schedule Room Thermostat with Dead Band
- Fume Hoods modification
- Lighting retrofits
- Chillers Plant optimization
- Steam Traps
- Steam Condensate Heat recovery
- Low temperature Run-Around Heat Recovery
- Reset Pump DP set point
- Reset AHU Supply and Return Fans S.P set point
MGH and the Environment

Without the SEMP MGH total energy consumption for 2013 would be \textbf{1,825,728 MMBTU,} compared to the actual energy consumption of \textbf{1,340,626 MMBTU} this produces a savings of \textbf{485,102 MMBTU.}

Translated into a reduction in greenhouse gases this would be a \textbf{26,276 Metric Ton} reduction.

**What does that mean?**

When we reduce the energy consumption from energy sources such as fossil fuels (coal, natural gas and oil), we reduce the carbon dioxide production. Excess carbon dioxide is linked to global warming.

MGH Putting the Savings in Perspective

**How much is 485,102 MMBTU?**

In 2009 the average house used 90 MBTU’s to heat and cool annually, therefore our savings could supply \textbf{5,390 Homes}!!!

**OR**

According to the US Energy Information Administration the average large office building consumes 90 KBTU’s/ Sq Foot annually, with our savings we could condition an office building \textbf{5.4 Million Square Foot Building} !!!

Source: US Energy Information Administration
MGH - Actual Annual Utility Rate $/MMBtu

Simches Research Center
Ventilation Optimization & Exhaust Heat Recovery Projects

- Opened in 2005
- Gross Area: 405,900 Sq ft
- Minimum air change rates reduced throughout building
- Implemented occupied & unoccupied modes of operation
- Installed heat recovery system that reclaims tempered building air heat to preheat supply air to building.
Simches Existing Conditions

- Facility equipped with highly efficient central mechanical and electrical systems.
- Operating at its original, conservative design
  - High ventilation rates
  - Continuous HVAC Occupancy
  - Extended lighting occupancy
  - Excessive Hood Ventilation
  - No heat recovery

Laboratory Ventilation Rates

- Re-evaluate minimum air change requirements in both occupied and unoccupied modes of operation
- Generally, minimum occupied airflow setpoints were reduced from a range of 7.5 to 9 (Air Changes per Hour)ACH down to 6 ACH (where CV hoods allowed) in occupied labs & 3 ACH during unoccupied periods.
- Maintaining pressure relationships.
Air Changes for Offices

- Office minimum airflow setpoints were reduced from 50% down to 25% of max. design airflow setpoints.
- In unoccupied mode for offices, conference rooms, etc. terminal boxes go fully closed.
- In every case, min. box positions are overridden if higher airflows are required to maintain space setpoint, which is relaxed during unoccupied times.

HVAC and Lighting Schedules

- We implemented schedules for HVAC and Lighting, 7AM-7PM, Monday through Friday.
- Overrides at every thermostat, at the push of a button you get four hours of daytime setpoints.
Fume Hood Ventilation

- Existing hood opening approximately 6.5 square feet with a continuous flow of 650 CFM.
- Most hood velocities are between 80-120 feet per minute (FPM).
- We maintain 100 FPM.
Modified Fume Hood

• The only way to maintain the 100 FPM and reduce CFM is by reducing the face area of the hood.
• We modified the hood to effectively reduce the face area to less than half.
• The new exhaust is approx. 275 CFM at 100 FPM.
• The retrofitted hood will also provide additional protection when the movable glass door is positioned in front of a user.

Exhaust Heat Recovery

• We installed an exhaust heat recovery run-around loop.
• Recovery exhausted tempered air and pre-heat (or cools) the make up air.
• Installed coils in the intake and exhaust.
Simches Energy Consumption

- FY 2008: 487 kBtu/sq ft
- FY 2012: 252 kBtu/sq ft

Simches Energy Project Annual Savings

- Annual Energy Savings FY-08 vs FY-12
- 4,314,280 KWH/ Year
- 683,095 Therms/ Year
- $1,123,194.44 Electrical Cost Savings
- $592,626.65 Gas Cost Savings
- MMBtu Savings: Electric =14,720, Gas = 68,309
Lesson Learned

• The ECM’s such as Set point or Schedule setback can be altered unintentional by a mechanic.
• Continuous Commissioning must be implemented to insure the systems operate at peak efficiency over the life of the measure.
• Energy Alarms were developed to monitor the MEP system for equipment failures and/or operating out of the normal range.

What do Energy Alarms Look at?

• VAV Airflow
• VAV Heating Coil
• VAV Occupancy Hours
• HW HX Valve Leaking
• AHU Preheat Valve Leaking
• AHU CHW Valve Leaking
• AHU Simultaneous Heating & Cooling
• CHW Low Delta T
• CHW Economizer w/ Chiller(s) Running
• More than 79 different types of Energy Alarm are monitors
Thank You