IPRO 320 Fall 2006

Sustainability Planning of IIT Buildings

Problem Description

The objective of IPRO 320, Sustainability Planning of IIT Buildings, was to contribute to the problem solving process for the implementation of energy efficiency improvements at the IIT campus, both in existing buildings and to the central steam and electric systems. The key tasks involved to meet this objective were an analysis of energy facilities at three university campuses, including thermal imaging and analysis of individual buildings along with research of possible applications for emerging alternative energy sources.

Methodology and Tasks

The focus of the research conducted at the three university campuses, IIT, University of Chicago, and Loyola, was alternate possibilities for energy use in context with their building type and surroundings. The first step in this process was an analysis of buildings in a range of architectural styles at each campus with the intention of diagnosing efficiency inadequacies and their solutions. A research team was designated for each university, and three buildings at each were selected for analysis. Our methodology included taking thermal images of the buildings and computing R-values for typical walls.

Another research team was created to research the facilities systems at each university, and subsequently research alternative energy solutions to identify those that may be appropriate for implementation at IIT. The tasks for this research included tours of the facilities and meetings with utilities management. Data necessary to compute energy use and cost per square foot was gathered and compiled as part of the research as well. The focus of the research on alternative energy was geothermal and solar thermal systems. The University of Illinois at Chicago currently has a geothermal facility, which provided the basis for calculations to determine the size and payback period for a similar facility at IIT.

Obstacles Encountered

The predominant critical obstacle encountered during the course of the research was the absence of analogous data sets. Each university has its own system collecting and organizing energy and building data, leading to holes in the data sets and making it difficult to make comparisons between the campuses. Furthermore, the accuracy of the IIT steam readings was called into question by several team members upon analysis of the data. A significant barrier to completing our work consisted of waiting for responses from contacts within the universities.

Findings and Solutions

We found that efficiency problems in buildings consisted of heat loss from uninsulated pipes at the IIT campus, heat loss at entrances at Loyola, and heat loss from single paned windows at the University of Chicago. IIT's heat loss occurs in uninsulated pipes in both Main Building and buried pipes.

Our analysis of the energy data from the three universities finds that each of the universities has a different method of monitoring and regulating their steam use. While Loyola has a system in place that automatically monitors and regulates steam use, increasing efficiency by avoiding overloading

the system with unwanted steam, the University of Chicago does not monitor individual buildings at all. Their university has such a large campus and budget that individual monitoring of buildings is not something they have chosen to do. Rather, they pump an estimated amount of steam from the steam plant and regulate at each building manually. IIT is somewhere in the middle of the other two universities. While IIT does not have the automation that Loyola does, it also does not pump out steam at the rate that the University of Chicago does. IIT has improved its efficiency by taking far-lying buildings off the main steam line; this recently occurred at Keating Hall. We have found four possible solutions to making the quad sustainable. The first is a full capacity glycol/water geothermal field, which returns payment in 35 years. The second is a smaller glycol/water geothermal field, which returns payment in 29 years. Yet neither completely removes the quad from the steam system. One that does is a hybridization of the smaller geothermal field with a solar array, which pays back in 11.5 years. Another is a high tech geothermal field by Earth to Air systems which pays back in 12 years. Regardless, these should be considerations for IIT's long term sustainability plan.

Recommendations and Next Steps

The key recommendations for improving efficiency include a number of small steps that would all work in conjunction to form a sustainability plan for IIT. First, IIT should reduce heat loss by insulate the pipes in Main Building. The accuracy of steam readings could be improved; the first step would be checking for broken meters. A future IPRO could research a new method to measure steam at IIT, and possibly even try to build such a device. Automation of the steam system, similar to that at Loyola, would also improve energy efficiency. Running large processes at night when electricity is cheaper would lower costs for both IIT and Loyola. III should continue to take outlying buildings off the main steam line. Finally, burying steam lines further in the ground would reduce the amount of escaping heat from steam, as well as save the university from having to replace the grass that lies above these pipes every spring. We recommend that a long term sustainability plan include the consideration of alternative energy sources; our calculations indicate that a geothermal site could be implemented with a reasonable payback period.

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