MICHIGAN TECH

BRIGHT IDEAS REVIEW 9-25-02

Facilities Management appreciates the fact that numerous individuals from our campus took the time to make suggestions to the Staff Council on how to improve our systems and save money. Generally the ideas that were submitted fell into one of several general categories. The following is a review by category:

1. TURNING OFF LIGHTS AND COMPUTERS. P018, P040, P081, P093.

Taken together, these suggestions point out that a significant amount of money is wasted by lights and computers which are left on when no one is using them. One suggestion is that if individual departments had to pay for energy that this would not happen. Another feels that a directive from the 5th floor is needed to eliminate this waste. Facilities Management has encouraged the campus community to take advantage of this opportunity by a series of articles in the Tech Topics and in information on the Energy Management web site. The potential is truly in the hundred of thousands of dollars. Some resistance has been encountered by those who feel that computer life will be degraded by turning them off and on. IT also would like computers to stay running so that computer maintenance can be performed in off hours and are now doing this on Wednesday evenings.

The Environmental Sustainability Committee is also supportive of these efforts and as recently as 9/18/02 had a piece in the Lode which cited a report by the Lawrence Berkeley National Laboratory which concluded that shutting off computers was not detrimental and could actually extend the life of computers.

Perhaps an analogy could be found if we take a look at what happens when lighting is turned off when not needed as opposed to keeping it on 24/7. A typical fluorescent lamp has a rated life of 20,000 hours when it is left on 4 hours at a time and about 30,000 hours if it is left on 24 hours at a time. We can't see it on the curve, but let's assume that if a light is left on all the time, that it will last for 35,000 hours. So if a typical office or classroom has it's lights left on 24/7 the lamps will last for 4 years. However if an area has it's lights turned on at 8am, off at noon, on at 1pm and off at 5 pm the lamps will last for almost 10 years. Not only do the lamps last 2 ½ times as long but a heap of energy is saved in the process. A single 40 watt lamp operating 24/7 consumes about $21.00 in electricity in a year whereas a lamp that is used 40 hours a week takes only $5.00 worth of electrical energy. If we apply those figures to the approximately 5,200 lamps that have traditionally been left on every night here on campus that could be shut off, the difference between 24/7 and 40 hours per week is $83,000 annually.

Last year we hired a student to go around after hours and shut off lights. At first he found about 5,200 lamps left on each night as previously mentioned that could have been shut off. As the awareness of energy conservation increased this number was reduced down to about 2,500 per night. This has reduced the wasted energy from $83,000 down to about $40,000 per year. While this is a tremendous improvement, we really don't want to tell the taxpayers of the State of Michigan that we are still leaving that many lights burning every night that could be shut off. Because some are forgetful or perhaps unconcerned, we will again be hiring a student to go around and turn off lights in the evenings. One suggestion was to put "turn me off" stickers on the light switches and we have tried these in the past. Generally they have little effect and are not noted after a few days. We can feel good about putting the stickers on, but we are not convinced that the message is getting through in this fashion. They do have a lot of merit in areas where it might be unclear as to what light switches could be shut off and so we will be looking for those situations again.

In the articles sent out to the campus last year, we pointed out that there are probably at least 7,000 computers running on this campus. While energy use varies from one machine to the next, we had estimated an average of 90 watts per machine. If left on 24/7 the energy bill for these computers comes out to $370,000. If all but 600 of them were operated on average 12 hours a day and off on weekends the bill would be reduced to $132,000. Thus the potential for savings is around $238,000 annually.

It is our feeling that many in the campus community are now turning their computers off at night. However there are still many that are getting left on that could be shut off. It is perhaps difficult for individuals to perceive that saving a few bucks here and there makes any dent at all. However our experience in energy conservation can be summed up this way: Energy Conservation is the sum total of a lot of small things that produce a significant impact.

While the ideas submitted by these individuals are not new ones, the renewed enthusiasm to save energy in these ways is refreshing and hopefully will catch on all over campus.

2. LIGHTING IMPROVEMENTS P042, P045, P080, P092

P042 suggested that we install motion sensors in the bathrooms to turn off lights when the area is unoccupied. Facilities Management has been installing motion sensors over the years. In the early 80's, quite a few were put in the larger classrooms. Last winter additional sensors were installed in classrooms. Our plan is to do the biggest areas first such as classrooms and computer labs as funding permits and work our way down to the smaller areas. Bathrooms are the among the last on the list because the number of lights effected is the least. Some of our buildings have them already and it may pay to expand on this once the other areas are completed.

P045 suggested we reduce lighting in non-safety areas. P080 suggested that we remove fluorescent bulbs from light fixtures in halls and offices. Perhaps this alludes to some areas being over lit that could be reduced. Back in 1980 we set standards for lighting levels and then sent a crew around to apply those standards. As a result a total of 7,000 lamps were removed. We also set standards for new construction with the hopes of reigning in the amount of over lighting that designers typically like to put in their projects. Since the use of many areas have changed and numerous new facilities have been added we have talked about sending out a crew again to evaluate each space individually again and make adjustments as needed.

P092 suggested that we plan for more efficient buildings citing the Rosza Center as having inefficient lighting. We are not sure what the specific comment refers to but in general we are trying to get as much of the new lighting technologies into our facilities as budgets will permit. We are also gradually converting our existing fluorescent systems over to the new types which are more efficient and have a better quality of light. Perhaps in the Rozsa the driving force was the proper rendering and color of lighting and not so much efficiency. Lighting efficiency is less of an issue in the Rosza because of the relatively low amount of hours in the year during which the full lighting is utilized. The Rosza is very efficient in other ways with it's mass and heavy insulation which holds it's heat quite well and allows us to keep the heating system air handlers off most of the time. Because of the infrequent use of the toilet rooms an energy saving and creative solution was found so we could eliminate the domestic hot water recirculation lines all the way from the mechanical room as well as the circulating pump and instead use point source electric water heaters for the short time that it's needed.

3. SPACE TEMPERATURES P044, P094.

Both suggestions concerned turning down the heat. Last winter, Facilities set temperature standards for offices at 70 degrees; at 68 degrees for classrooms, labs and lecture halls; and at 65 degrees for hallways, stairwells and atriums. We also encouraged anyone with heating system complaints to contact Bill Mitchell (wmitchel@mtu.edu). These suggestions which support this effort are valuable because every 1 degree in temperature reduction reduces the heating bill by about 3%. While it is not possible to maintain temperatures at any given setting right on the dot, the elimination of overheating not only saves money but improves occupant comfort. We continue to encourage individuals to report specific areas to Bill Mitchell so his crew can address those areas of concern.

4. DOMESTIC HOT WATER TEMPERATURES P064, W012.

Both of these suggested that domestic hot water temperatures could be reduced in certain buildings. While some buildings may have specific areas that require a higher

temperature it is worthwhile re-visiting the issue again as lower temperatures not only save energy but are safer. At one time we were trying to get this down to 105 degrees as recommended by the Feds during the energy crunch. There may be some concerns that bacteria could grow if the temperature is too low. We will investigate to see what the current thinking is and try to implement it in our buildings on campus taking into account any other requirements on each system.

5. WATER CONSERVING FIXTURES P043, P046.

This was suggested in regard to labs and bathrooms. Auto shutoff fixtures were also mentioned. First of all we should point out where the bulk of our water is used. 51% of the water on campus is used in residential housing and 49% in the teaching and research buildings. Of that 49%, the vast majority is used for specific research and cooling equipment. As a result most of the emphasis in water conservation has been placed on residential housing usage as well as research and cooling needs.

The Residence Halls have installed low flow showerheads in all areas and have also eliminated most of the automatic flush urinals which ran 24/7. Daniell Heights has also installed 2.5 gpm adjustable heads many years ago and report good customer satisfaction with them. They also have changed over about one half of the water closets to the new 1.5 gallon flush type. The remainder of the units have a quart displacement container in the tank. All sinks in the Heights also have aerators with flow restrictors. That leaves the water closets in the dormitories as a possibility for water conserving retrofits which would have the highest usage and after that the water closets in the general fund buildings. Any low flow retrofits in the dorms would have to be accompanied by an educational campaign to teach our students not to throw pens, pencils, combs, apples and oranges into the toilets. At the moment the higher water flow rates help move some of this material through the system.

On the general fund side of the ledger, most of our water consumption is for research and cooling needs. The Building Attendants have been checking to make sure that water isn't left flowing where it is no longer needed and we have appealed to the users to check their equipment. For example, a small flow of water at 2 gallons per minute amounts to over 1 million gallons per year at a cost of $8,850.

Facilities just completed a retrofit project on the process cooling system this past July in the M&M Building which is projected to save about 22 million gallons and $150,000 per year. The once thru cooling system was converted over to a loop system which was connected to some available capacity in the Dow Building chiller. The process water is recirculated and chilled by mechanical equipment eliminating the large quantities being discharged down the drain.

Low cost reduced flow retrofits to existing water closets in the general fund buildings may also prove to have some merit if they are effective in transporting waste properly. The suggestion is certainly worth considering and should be tried in a pilot project first.

On a macro level, in considering water conserving options, we need to keep in mind certain facts about what we are really paying for when we purchase water and sewage services. A large majority of the costs of the water and sewage systems are for paying off the bonds for capital construction and for the cost of operators at the plants. Reducing water consumption will not affect either of these two items, although it could be argued that if we reduced our consumption here at MTU we could force the re-allocation of more of these fixed costs upon other customers in the local area. If they in turn reduce their consumption, nothing is accomplished as far as being able to reduce the major cost items. Reducing water consumption would save pumping and chemical costs but again these are a small part of the bill. From an environmental perspective, little is gained as well. There is no shortage of water in our local area as the normal hydrological cycles have continued to supply us with abundant water. If the goal is to reduce the flow into the sewage plant, much more could be gained by the City reducing the groundwater leaks into the sewage system. Currently about 1 million gallons of water is pumped each day from local water supplies but 2 million gallons of water flows into the sewage treatment plant each day. These leaks are far greater than the amount of water that potentially could be reduced by low flow toilets. The City is continuing to work to reduce these leaks. The bottom line is that the capital costs of the sewage plant and infrastructure needs to be paid off and the plant operators need to remain on the job.

6. BIO-MASSED BASED CO-GENERATION. P047.

The suggestion was that we convert one of our boilers to biomass firing and utilize waste wood from the local forest industry and then put in a steam turbine and sell excess power back to the power company.

Facilities started looking at this in the mid 80's and secured $250,000 in grants to help pay for the conversion costs. About that time, the natural gas industry was de-regulated which allowed us to begin purchasing gas from the wellhead rather than from the utility. The drop in natural gas prices took the economics out of biomass then and we have been purchasing gas in this manner since 1986. Natural gas has seen some higher spikes recently and so we have again started to evaluate this possibility. We have assessed the amount of material available from nearby mills and from the woodlands. Currently we are working on a potential design and determination of capital costs. Such a system will produce about 20% of our power requirements so there will not be any excess to sell to the Power Company.

We are also evaluating the potential for a gas turbine based cogeneration system. These systems could produce 50-90% of our power depending on the economics. The third option in the area of power is discussed in the next item.

7. POWER COST NEGOTIATIONS. P048

The suggestion was made to re-negotiate power costs with UPPCO. MTU has been involved in intensive negotiations with UPPCO for more than 20 years. UPPCO has again filed for a rate increase and have included rate schedules which recognize that MTU is a transmission level customer and not a distribution system customer which will reduce the level of subsidization of other customer classes. They have also included options for switching to interruptible power. If this option becomes favorable as a result of the rate case, MTU could install on-site diesel generators which would operate during peak times. MTU power would not be interrupted but the diesel generators would augment the system during peaks. In return MTU could purchase power at a significantly discounted price. Facilities is actively involved in the current rate case to protect our interests and to lobby for better pricing and options.

8. ALTERNATIVE ENERGY SOURCES. P049, P052.

It was suggested that MTU take a look at using heat pumps to extract heat from the canal and to examine solar and wind options.

First let's take a look at the cost of heat pump energy. We currently pay about 6 cents per kwh for power. Suppose we could get this down to 4 cents with a new rate with UPPCO.

Our entire campus infrastructure is setup to utilize water in the re-heat coils and radiators in the range of 120 to 180 degrees. The main coils in the air handlers are steam coils which need steam at 220 degrees. In order to get good performance from a heat pump the temperature difference between the source (the lake) and the load must be as close as possible. However the existing infrastructure requires this differential temperature to be very wide which lowers the co-efficient of performance (COP). Perhaps the average COP using as much of the existing infrastructure as possible might be about 2.0 This puts the price of heat pump energy at $5.85 per million BTUs (Assuming we could get power at 4 cents). For FY 02/03 we are projecting a burner tip price of natural gas and fuel oil at $4.40. Since the overall system is about 72% efficient delivered to the buildings, that gives us a price of energy at $6.28. Theoretically heat pumps could save us about $93,000 per year at 4 cents power. However there isn't enough difference to work with here to pay for the huge capital investment required to make heat pump technology work. It's any interesting idea and it's fun to run the numbers. This consideration does strengthen the case for utilizing the existing steam system and convert to a cheaper fuel (biomass) and generate some power at the same time.

In our view solar energy is worth considering as part of a passive heating system in residential housing. However applications to large central systems are uneconomical. As solar power technology develops, we may see the day where photovoltaic cells become as cheap as roofing and it's cost of produced power approaches the cost of a central utility plant. It might become common to see such cells being added to the roofs of homes and businesses. Now if we could only do something about that lake effect that prevents us from seeing the sun during the bulk of the winter months.

Wind power is nifty since it harnesses the forces of nature. However the cost of wind turbines have not reached the point of being competitive with purchased power from a large utility company. Many utilities are installing wind generators, not because they are cost effective, but because it helps them meet the small quota of green power mandated by their governing bodies. Perhaps as technology improves this picture might change in the future.

Another idea that was considered, was to use lake water for cooling and eliminate electrical driven chillers in our buildings. However it was found that in the summer the water temperature in the canal is much too warm to do any cooling.

9. AIR CONDITIONING FOR THE ADMIN BUILDING. P079.

This is a building that could use some better cooling in the summer. One scheme that we have considered is to see if we could justify cooling as part of a biomass fueled cogeneration option. By adding steam absorption chilling to the building it would increase the summer steam load which in turn would enable us to generate more cheap power in the cogen mode. Converting other buildings over from electrical driven chillers to steam absorption would also improve our balance between heat and electrical loads and will be looked at as an option.

10. AIR CLEANERS TO REDUCE POLLUTION. P015.

The suggestion was made that air cleaners be installed in areas of high people concentration such as the Library and MUB. Specifically they referred to those suffering from asthma and other respiratory conditions and their sensitivity to indoor pollution such as perfumes. While it might be very difficult to make air cleaners work on this scale it does bring up the subject of indoor air pollution and how it's controlled . In general most of our buildings have central air supply systems which bring a varying percentage of fresh air to each space in the building. A typical system runs at 20% fresh air in the dead of winter to 100% in the summer. The percentage decreases with temperature because the steam coils have a limited capacity to heat outside air without freezing up.

However even in the worse case scenario in the coldest part of the winter there is still a considerable amount of fresh air being supplied to the occupants of our buildings. A typical system might turn the air over 8 to 10 times every hour. Even at 20% fresh air, this means that the air is completely changed with fresh air twice every hour. Our suggestion is that any occupants having breathing problems advise Bill Mitchell so that the system and controls supplying that space can be looked at for problems.

SUMMARY: BRIGHT IDEAS TO CONTINUE PROMOTING AND TO EXPLORE FURTHER

1. Continue to encourage the campus to turn off lights if leaving for more than 10 minutes.

2. Continue to encourage the campus to turn off computers at the end of the day and utilize energy saving modes during the work day.

3. Resume the program of hiring students to go around after hours to turn off lights that have been left on.

4. Utilize "turn me off" stickers in areas where it might be unclear as to what switches should be operated.

5. Continue to install more motion sensor operated lighting controls as funding permits.

6. Evaluate lighting and requirements in all campus spaces and adjust according to established light levels.

7. Encourage the campus to report overheating situations, lack of heat or ventilation problems to Facilities Operations.

8. Facilities Management will maintain established temperature standards.

9. Reduce domestic hot water temperatures to the lowest and safest levels.

10. Evalute low cost low flow retrofit kits for water closets.

11. Evaluate conversion of the Central Heating Plant to cogeneration using biomass and a steam turbine generator along with chiller retrofits to steam absorption.

12. Evaluate gas turbine based cogeneration at the Central Heating Plant

13. Evaluate interruptible power options for the campus.

14. Continue to be actively involved in utility rate cases seeking improved rates and tariffs.

15. Keep abreast of alternative energy solutions.

CONCLUSION.

Facilities Management appreciates the suggestions forwarded. Many have served to re-enforce the efforts that are currently underway. We also see some items to review, improve upon or consider again. This review of the ideas submitted also gives us a chance to convey to the campus community where we are at in some of these areas.

SUGGESTION FOR FUTURE BRIGHT IDEAS.

Many of the suggestions have been at the macro level. Perhaps many feel that it's not worth mentioning what seems to be a small potatoes item. However we would like to encourage more small ideas. In fact, the bulk of our energy conservation program is made up of many small ideas which when added together have produced a significant result. Even something like putting in another light switch here or there so all the lights don't have to be turned on would be worthwhile. No one is in a better position than individual members of the campus community to notice little things in their area that could be improved. Hopefully we will see more little bright ideas in the future.

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