

LIGHTING THE WAY/PATH TOWARDS SUSTAINABILITY
Student Sustainability Proposal for WMRC
Oct 14, 2007

I. SUMMARY

Funding Requested	\$21,340
Annual Energy Reduction	59,976 kWh
Annual Savings to University	\$4,820

II. CONTACT INFORMATION

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III. INTRODUCTION

The goal of this project is to reduce the energy consumption and greenhouse gas emissions at the Waste Management & Research Center's (WMRC) building on the UIUC Campus. This is a key step towards WMRC's goal of making this facility a model of green and energy efficiency for the campus. On a per square foot basis this buildings ranks as the 56th most wasteful in energy consumption of over 600 buildings on the UIUC campus. There are many opportunities in this facility to reduce energy consumption and test state-of-the-art technologies for the campus. Our goal is to become the most sustainable research facility on campus and to transfer what we learn to other units by working with Facilities and Services, student organizations and the administration.

In September, WMRC adopted a carbon emissions reduction policy for all our operations including facilities, transportation and research. Under this policy WMRC is committed to reduce green house gas emissions and our carbon footprint through reduced energy consumption, increased use of renewable energy, and managing the environmental impact of the Center's activities while maintaining high standards of research, technical assistance and public service. As far as is practical the Center will:

- Develop and implement a local energy/carbon strategy and action plan including specific targets based on State of Illinois policy (i.e. 1990 levels by 2020; 60% below 1990 levels by 2050)
- Operate in an energy efficient way
- Invest in energy/carbon efficiency strategies as feasible from a budgetary standpoint

- Include energy in the procurement evaluation process
- Educate staff and clients on green house gas emission issues.
- Consider the needs to clients, visitors and staff
- Continually improve

IV. DETAILED PROJECT DESCRIPTION

For this specific project, WMRC is seeking to replace the lights in the office and laboratory areas with more energy efficient ones. This is the first step towards making our operations sustainable. We are committed to making the changes and finding the funding necessary to be a world leader in sustainability in this facility and in the ways we accomplish our mission.

The WMRC Building is located at 1 Hazelwood Drive, in the Southwest portion of the campus adjacent to the Research Park. WMRC's mission statement is to make Illinois sustainable. To accomplish this WMRC's scientists and engineers help business and organizations reduce wastes and conserve energy and natural resources. WMRC conducts scientific research, develops innovative technologies and provides direct technical assistance to their businesses, citizens and government agencies throughout Illinois. WMRC plans to take the lessons learned in becoming sustainable and share them with students, their business clients and government officials.

This facility, completed in 1990, has about 45,000 gross square feet with about half comprised of office space, library and meeting rooms. The other half has analytical research laboratories, engineering technology testing laboratories and support facilities. The WMRC building well represents the main types of rooms and operations in most university buildings.

This initial lighting project will not only reduce energy costs and greenhouse gas emissions, but also demonstrate leadership in energy efficiency. Lighting improvements can be excellent investments in many buildings. Unlike many other energy efficiency projects, lighting improvements are relatively easy to implement¹. The University of Illinois has over 600 buildings, many of which have inefficient lights. The lighting strategies used at WMRC can be reapplied at other buildings and cut energy usage across campus.

Several technologies will be used to reduce energy consumption and greenhouse gas emissions.

- (1) Replace T12 lights and magnetic ballasts with T8 bulbs and electronic ballasts. T8 bulbs and electronic ballasts have the highest efficiency of any bulb and use approximately 33% less energy than T12 bulbs and magnetic ballasts. The WMRC building has 250 T12 fixtures. Most fixtures have four lamps and a few have two or one lamps.

With the conversion to T8 light bulbs, the number of light bulbs per fixture can be reduced. T8 bulbs have a slightly higher lumen output than T12 bulbs. In the offices and corridors, 4 bulb fixtures will be reduced to 2 bulbs. Many of the offices in the building receive high levels of natural light and, therefore, do not require all of artificial light that is currently

¹ Capehart, Barney L., Wayne C. Turner and William J. Kennedy, *Guide to Energy Management*, Fairmont Press, Inc.: Lilburn, GA, 2003.

provided. In the laboratories, 4 bulb fixtures will be reduced to 3 or 2 bulbs. The laboratory fixtures will have to be replaced to allow for a 3-bulb configuration. The addition of reflectors and diffusers in some areas will help with the transition to fewer bulbs

- (2) Replace inefficient metal halides with fluorescent light fixtures. This could reduce energy consumption in these fixtures by 60%. The WMRC building has 14 metal halide fixtures in the pilot lab and library.
- (3) Replace the incandescent light bulbs with compact fluorescent lights (CFL). The WMRC conference room has 37 incandescent light bulbs that can be replaced with dimmable CFL's. This could reduce energy consumption by over 70%.
- (4) Install occupancy sensors in areas that are not used continuously.

The technical details of the current and proposed light fixtures are listed in Table 1. Overall, WMRC is proposing to replace the light bulbs and ballasts in 250 fixtures. This project will save the university over \$4,800 in energy savings and maintenance per year (Table 2). Energy savings will account for \$4,300 of savings.

It is assumed that the lifetime of this project will be 10 years. Over the life cycle of this project, there will be little change in maintenance costs. T8 and T12 light bulbs have approximately the same life (20,000 hours). Both magnetic and electric ballasts are replaced very infrequently. Because the WMRC building will have fewer light bulbs, replacement costs will be reduced by \$350 per year.

WMRC has had preliminary discussions with Carl Wegel and Terry Ruprecht of Facilities & Services. They would support this project and WMRC's goal to be a model of energy efficiency in anyway that they could. Over the next year WMRC will be working with the Smart Energy Center and F&S to:

- Create a model of our facility in order to evaluate various options including installation of a green roof, solar panels, wind energy and other options
- Work with F&S technicians to fine-tune the operation of our HVAC system
- Conduct a fume hood survey and identify both equipment improvements and operational changes needed to reduce their energy use
- Install an anemometer on our roof to collect wind data for this part of campus
- Determine the carbon footprint of our operations (baseline and specific milestones to meet our goals)
- Determine and evaluate options to reduce our carbon footprint including transportation
- Measure, document, verify and publicize our accomplishments and lessons learned.

Table 1: Current Light Fixtures and Proposed Replacements

	Operating Hours (hrs / yr)	# of Fixtures	Current				Proposed			
			Fixture Type	Watts per fixture	Demand (kW)	Energy Usage (kwhr/yr)	Fixture Type	Watts per fixture	Demand (kW)	Energy Usage (kwhr/yr)
Individual Offices	2080	83	T12 4 Lamps	150	12.5	25,896	T8 2 Lamps	44	3.7	7,596
Lab	2340	1	T12 2 Lamps	71	0.1	166	T8 2 Lamps	44	0.0	103
	2340	129	T12 4 Lamps	150	19.4	45,279	T8 3 Lamps	73	9.4	22,036
Corridor	2600	3	T12 2 Lamps	71	0.2	554	T8 1 Lamp	24	0.1	187
	2600	23	T12 4 Lamps	150	3.5	8,970	T8 2 Lamps	44	1.0	2,631
Restroom	2080	10	T12 1 Lamp	34	0.3	707	T8 1 Lamp	24	0.2	499
	2080	1	T12 2 Lamps	71	0.1	148	T8 2 Lamps	44	0.0	92
Main Conference	1000	37	Incan 150W	150	5.6	5,550	Dim CFL	25	0.9	925
Pilot Lab	1500	8	400 W MH	454	3.6	5,448	HB T8 8 lamps	176	1.4	2,112
Library	2600	6	175 W MH	213	1.3	3,323	HB T8 4 lamps	88	0.5	1,373
Exit Signs	8760	34	FL Exit	8	0.3	2,383	LED Exit	3	0.1	894
Totals		335			47	98,423			17	38,447

Table 2: Estimated Energy Reductions and Cost Savings by Area

	# of Fixtures	Annual Energy Savings			Annual Bulb Savings		Total Savings
		Energy Usage (kwhr/yr)	% Reduction	Energy Savings (\$/yr)	Current # of bulbs	Proposed # of Bulbs	
Individual Offices	83	18,300	71%	\$1,318	332	166	\$1,404
Lab	130	23,306	51%	\$1,678	518	389	\$1,754
Corridor	26	6,705	70%	\$483	98	49	\$515
Restroom	11	264	31%	\$19	12	12	\$19
Main Conference	37	4,625	83%	\$333	37	37	\$487
Pilot Lab	8	3,336	61%	\$240			\$394
Library	6	1,950	59%	\$140			\$140
Exit Signs	34	1,489	63%	\$107			\$107
Totals	335	59,976	61%	\$4,318			\$4,820
							\$348

V. BUDGET & FUNDRAISING

1. Detailed budget costs

It is estimated that this will project will cost \$26,250 including materials and labor costs. The estimate assumes that an outside contractor will complete installation. However, Facilities and Services may decide to complete this project using their own personnel. The break down of these costs is shown below in Table 3. The estimated costs for each area of the building are shown in Table 4. With annual savings of \$4,820, this project has annual return on investment of 18% and simple payback period of 5.4 years.

Table 3: Project Cost Summary

Costs	
Lamps	\$6,715
Ballasts	\$6,950
Fixtures	\$6,685
Labor	\$6,685
Total Costs	\$26,250

If the Student Sustainability Committee does not full the full amount requested then the project would move forward on a limited or partial basis. WMRC will use the \$4,800 appropriated by the Illinois Department of Natural Resources (IDNR), partial funds appropriated by the Committee and money or in-kind services received from Facilities and Service to replace as many lights as possible. WMRC will retrofit lights in the section of the buildings that have the greatest potential for energy savings.

2. Fundraising

WMRC has received \$4,800 from the IDNR for this project. Some of these funds are targeted to replace 34 exit lights in the building with LED lights and the occupancy sensors. WMRC is requesting the remainder of the needed funds for the lighting upgrades from the Student Energy Committee.

Table 5: Fundraising Summary

Funding Source	
IDNR	\$4,800
Student Sustainability Committee	\$21,450
Total Funds Requested	\$26,250

III. Timeline

It is estimated the project will take 6 months to complete from project funding. The project will be broken down as follows.

- Engineering and bid document preparation (2 months)
- Selecting electrical contractor (2 months)

- Lighting retrofit completion (2 months)

Table 4: Estimated Project Costs and Return on Investment

	# of Fixtures	Estimated Costs				Payback (yr)	Return on Investment	
		Lamps	Ballasts	Fixtures	Labor			Total
Individual Offices	18299.84	\$830	\$2,075	\$415	\$1,494	\$4,814	3.4	29%
Lab	23306.4	\$1,945	\$3,250	\$2,585	\$2,340	\$10,120	5.8	17%
Corridor	6705.4	\$245	\$650	\$130	\$468	\$1,493	2.9	34%
Restroom	264.16	\$60	\$275	\$55	\$198	\$588	30.9	3%
Main Conference	4625	\$925	\$0	\$0	\$0	\$925	1.9	53%
Pilot Lab	3336	\$320	\$400	\$2,000	\$800	\$3,520	8.9	11%
Library	1950	\$180	\$300	\$1,500	\$600	\$2,580	18.4	5%
Exit Signs	1489.2	\$2,210	\$0	\$0	\$0	\$2,210	20.6	5%
Totals	59,976	\$6,715	\$6,950	\$6,685	\$5,900	\$26,250	5.4	18%

VI. ENERGY AND ENVIRONMENTAL IMPACT

This project will save 59,976 kWh of electricity and \$4,820 per year. Over the 10-year lifetime of this project, the university will save \$48,200 and reduced its energy usage by 599,760 kWh per year. The overall environmental impacts are shown below in Table 5.

Table 5: Environmental Impact

	Net Reductions (lbs/yr)	Project Lifetime (lbs)
CO₂	116,114	1,161,140
SO₂	115	1,150
NO₂	381	3,810

The replaced light bulbs and ballast will generate some waste. These light bulbs and ballasts will still have some useful life left. These light bulbs and ballasts will be retained by Facilities and Services for use in other buildings. This will reduce not only waste generation but also reduce costs of the University. If appropriate homes cannot be found for the light bulbs and ballasts then they will be disposed of in accordance with all applicable Universal waste regulations. In this case, Facilities and Services may incur a small, one time cost to dispose of light bulbs and ballasts.

VII. OUTREACH AND EDUCATION

WMRC is committed to sharing our sustainability successes and failures with the entire University community, throughout Illinois and beyond. Our track record in this area is strong. For example, we have been working with the Engineers without Borders and Facilities and Services to implement the biodiesel project. WMRC employs students in various research projects, gives lectures to a number of classes on sustainability or pollution prevention, and hosts numerous meetings in our popular conference room.

For this effort to make our facility and operations sustainable, we will work with interested student groups, F&S and the administration to document our progress and lessons learned. We have accumulated utility data for the past 5 years from F&S. In addition, we are tracking vehicle use and air mileage to begin qualifying our carbon footprint. These data will be prominently posted in our facility for all visitors to see and on our web site (www.wmrc.uiuc.edu). We will also create a display near our entrance of the technology changes we have employed. This display will be used to educate our staff and visitors. We also will offer to host an annual meeting of interested student groups including Engineers Without Borders, American Institute of Architecture Students, and Students for Environmental Concerns. A part of this meeting could include presentations on our sustainability efforts, discussion of plans for this facility and others on campus, and a tour.

Each year WMRC hosts a number of outside visitors. One group is chemistry students from Parkland. We will use this opportunity to educate those students about Green Chemistry and our energy efficiency efforts.

WMRC also has instituted a Sustainability Lecture Series to stimulate discussion and collaboration on this topic. In our outreach efforts we assist hundreds of Illinois businesses each year with compliance, waste reduction and energy efficiency projects. We will use the lessons learned in our operations to help these businesses adopt similar technologies and practices.

Also, WMRC operates the Great Lakes Regional Pollution Prevention Roundtable (see www.glrppr.org), is part of the Pollution Prevention Resource Exchange (see www.p2rx.org) and is active in the National Pollution Prevention Roundtable (see www.p2.org). Staff also make technical presentations at professional conferences and publish in various journals. For example, in March 2008 we will be making a presentation at the National Environmental Health and Safety Conference for the Graphic Arts Industry on how to conduct a carbon emissions footprint and on what to do to reduce it. We will use our experiences and plans as a basis for this presentation. A collaborator on this panel is the environmental manager for the Wall Street Journal. Through this and other collaborations we will learn of what others are doing and will get the word out about the great things that are happening at the University of Illinois to make it sustainable.