The Intern Solution

Ways to use student interns to reduce the costs of energy and environmental surveys

The Intern Solution

by
Lynn K. Chamberlin
and Kirk Conger, PE

April 1995

The Nebraska Energy Office is grateful for the information and assistance provided by

Marc Ross, Bonneville Power Administration
Jerry Bingold, North American Energy Services
Sarah Hammond Creighton, Tufts University
Danny Orlando, U.S. Environmental Protection Agency, Region 4
Cassie McKay, Hermitage Lighting
Mark Johnson, Idaho Department of Water Resources
Peter Weisberg and Debra Johnson, ICF, Inc.

Table of Contents

Intro-Duction

This section describes the problem in detail, explains why the Nebraska Energy Office chose to use interns and gives a general idea of the costs and benefits of using interns. Readers should be able to recognize similar opportunities in their own organization and ascertain whether interns might be part of the solution.

The Lighting Survey Problem

Amidst great ceremony and with the best intentions, the State of Nebraska signed the GreenLights Memorandum of Understanding in March of 1992, becoming the eighth state government to enlist as a partner. A respected regional lighting vendor agreed to survey lights in state-owned buildings, the state would make cost-effective improvements, facility costs would decrease, tax money would become available for more important uses and the air would get cleaner. Twelve months later, nothing had happened.

This is not an unusual scenario. Most state government partners interviewed said that little progress had been made in their GreenLights efforts so far.

What went wrong?

The Environmental Protection Agency introduced its GreenLights program in 1991. In a radical departure from traditional “command and control” regulatory programs, GreenLights stresses voluntary, profit-driven cooperation between the agency and private sector partners. A company becomes a partner by agreeing to identify and install all cost-effective lighting improvements in its facilities. The identification and installation is financed by the partner, but the partner enjoys a high level of confidence in the predicted energy savings — something usually found in professional engineering studies. The EPA provides technical and programmatic support as a part of the GreenLights effort. Upgrading the lighting system reduces electricity waste and ultimately prevents pollution by decreasing power plant emissions into the atmosphere.

The key to confident identification of cost-effective lighting upgrades is the “lighting survey” — an inventory of the actual lighting equipment installed in each facility and an accurate analysis of the electricity and maintenance cost savings which could result if changes were made enhancing energy efficiency. The GreenLights Memorandum of Understanding treats surveys as low-cost items — EPA will provide training for the partners’ staff to do their own surveys or provide a list of EPA-trained “surveyor allies” in the partner’s geographic area. In Nebraska’s experience, it is true that lighting surveys are a small percentage of the actual installation cost of the lighting upgrades, but that does not mean that the cost of surveys is easily financed. Staff time and commitment to receive training and begin surveying lighting systems may cost three to five cents per square foot. Lighting surveys are generally not something the maintenance department can do when there are a few free hours at the end of the week. If the partner chooses to hire a surveyor ally or other energy or lighting professional, costs may be as high as 12 cents per square foot.

In recognition of this problem, Nebraska turned to college student interns to survey lighting systems. A workshop and this manual, *The Intern Solution*, were developed to train other government, institutional, educational and non-profit organizations to use interns for similar tasks. The second chapter will provide sufficient information to determine whether the intern solution is appropriate for your organization. The remaining chapters discuss different aspects of an intern program in greater detail, describing the major steps necessary to begin and operate such an effort and some pitfalls to avoid.

History of Nebraska's Intern Program

In 1992, the Nebraska Energy Office received a grant from the U.S. Department of Energy to perform lighting surveys in public and private schools. One of the requirements of the grant was that work experience be provided for college and university students in technical disciplines. During that summer, the Energy Office hired six third- and fourth-year students from the University of Nebraska's College of Architecture and trained them to perform walk-through lighting surveys. These were not comprehensive surveys; interns only recorded data on lighting equipment which appeared to have good energy-savings potential. Nevertheless, over 1,500 lighting efficiency improvements with an average simple payback of 5.1 years were recommended in 270 school buildings.

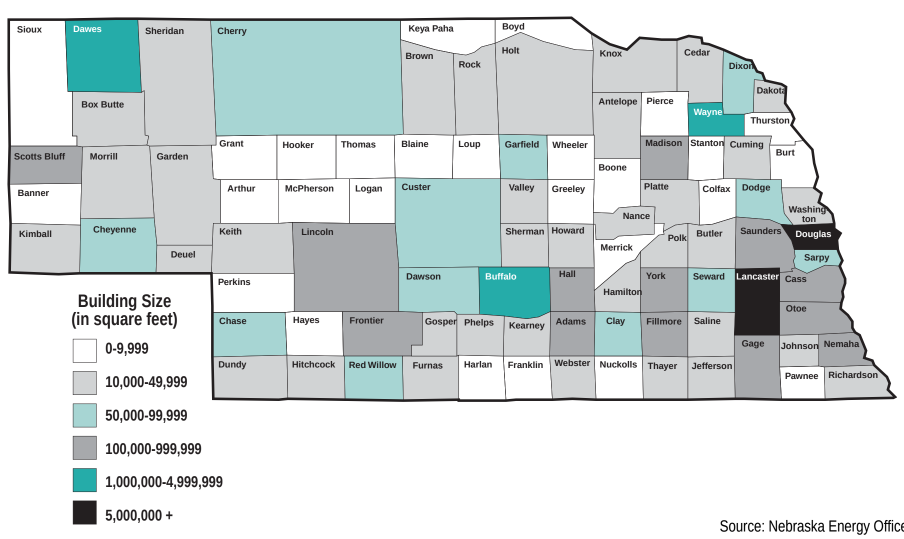
Perhaps more importantly, it was discovered that students at the university were anxious for summer jobs where they could get real world experience in the building sciences. For architecture and engineering students, summer jobs rarely offer significant learning opportunities because by the time students learn an office system, their summer is over. The narrow focus of this program, lighting retrofits in public buildings, allowed sufficient training in a fairly short time period. Interns could then spend most of their summer surveying the buildings. The salary was competitive with most summer jobs and the work gave interns a chance to apply their education, develop a new area of expertise and experience the consulting engineering or architecture field first hand. Finally, the energy efficiency and environmental stewardship ethic of the program connected with students' natural idealism. The experience taught them to critique lighting and even building designs from an energy and environmental point of view. It is believed that at least some of this ethic will carry over into these students' future design and consulting work.

The Intern Solution

In the Spring of 1993, an EPA contractor came to Nebraska to try to get the stalled GreenLights effort moving. Representatives from many state agencies attended the "mobilization meeting" and one point quickly became apparent: none of the agencies believed that they had either the human or financial resources to make GreenLights work. Even the offer of free training and software did not convince representatives that their staff had time to devote to lighting surveys and everybody knew that there was no money to hire outside consultants for the surveys. During the course of the meeting, some deals were made. The Energy Office agreed to survey 500 state buildings at its expense and provide the reports to the various agencies. The agencies would then be responsible for completing surveys on the remaining, mostly smaller buildings and installing the recommended upgrades.

At the time of this meeting, the Energy Office had been preparing for a second summer of lighting surveys, patterned after the school building surveys of 1992, but targeting local government buildings. The program had already been advertised at the university and prospective interns had been interviewed. This preparation allowed the GreenLights surveys to begin within two months because the only work left was to develop the database of state buildings, select those to be surveyed and learn how to use the GreenLights modeling and calculation software.

Distribution of Nebraska State Buildings



Source: Nebraska Energy Office

During the summer of 1993, six interns were hired to perform comprehensive lighting surveys on 240 state buildings. These were not all the largest buildings because it was considered important to provide surveys as evenly as possible among the state's 49 legislative districts. The next summer, six more interns were hired with program funds and assigned to complete surveys on the largest state buildings. Five additional interns were hired under contract with five state agencies. These agencies had contacted the Energy Office and asked the energy staff to train and supervise interns whose time would then be dedicated to buildings owned by the contracting agencies.

After three years of program operation, interns had completed surveys on 1,364 buildings covering 37.6 million square feet. The lighting upgrades recommended in these surveys are expected to cost $18.3 million and generate annual savings of

Buildings Surveyed, 1992-1994

Building Area in Square Feet	Number of Buildings Surveyed 1992	1993	1994	Total
Less than 499	1	16	173	190
500 to 999	4	22	185	211
1,000 to 4,999	15	65	168	248
5,000 to 9,999	24	44	79	147
10,000 to 49,999	146	48	158	352
50,000 to 99,999	67	35	77	179
100,000 or More	13	10	14	37
TOTALS	**270**	**240**	**854**	**1,364**

Source: Nebraska Energy Office

$1.94 million in electric savings[1] and another $645,000 in maintenance savings — a total of $2.58 million.

The total cost for three years of interns' wages, supplies, expenses and administrative costs for supervision and technical review (including contract costs in the third year) was $131,702. This averages $0.0035 per square foot surveyed or $97 per building. This is much less than the cost of detailing permanent employees to survey lighting systems in their free time or hiring a professional surveyor. Of course, professional assistance will still be needed for redesigning some of the more complex lighting systems, but lighting upgrades in most buildings can be completed without significant further design work.

Summary

The initial data collection, in this case lighting surveys, in a voluntary program represents a hurdle which is often underestimated. It is true that the costs of this phase are small in relation to the overall costs of the improvements to be made. However, it is easy for managers to treat these up-front costs as negligible. To the individuals assigned to complete the work, lack of reliable surveys is a major barrier to getting the program underway, making any improvements and realizing savings.

The facility manager usually has two choices: either dedicate staff time to both training and conducting the surveys or hire a professional surveyor. Both these options can be viewed as too expensive. Lighting surveys are not simple enough that an existing staff member can take the training course and then do an occasional survey when there is an afternoon free. Consequently, staff get trained, but never seem to have the time to do the surveys. The other option is to hire an outside consultant to do the surveys. There is a growing group of individuals who are trained to do lighting surveys, but costs may be high for a product which does not always require a professional consultant.

Therefore, the program sits unimplemented while cost-effective energy saving and pollution prevention opportunities sit unidentified and unexploited due to a lack

[1] The savings figures for the second and third years are skewed toward longer payback projects because these represent all potential lighting upgrades identified by the interns, not just those that appeared to be cost-effective. The second and third year surveys were also on state buildings with an average electric cost of $0.031 per kilowatt-hour.

of low-cost, reliable lighting surveys. This is especially difficult for non-profit, governmental and quasi-governmental agencies which operate on contributions or tax revenues. These groups are less likely to be able to dedicate staff time or afford consultants, yet might benefit most from reducing their operating overhead because they do not have a means of passing their operating cost on to their "customers."

Interns can fill this gap. They are, by their very nature, temporary employees who work cheaply because some of the benefit they derive from the position is in the job experience itself. An intern brought into an organization is able to start fresh, without commitments to other programs, and concentrate on accomplishing the survey task. Finally, interns can bring a higher level of technical understanding to the job than many maintenance people. What interns lack in practical experience can be provided sufficiently in a week of training because the purpose of the survey is only to explore and identify the possible savings.

By spending less time and money on the lighting surveys, organizations will have more of both to spend on implementing recommendations — actually installing the improvements which will save energy, money and prevent pollution.

Additional Information on Nebraska's Lighting Survey Programs

1992 Program: Public and Private K-12 Schools

During the summer of 1992, the program targeted public and private school buildings throughout the state. Surveys were requested for 401 buildings and 270 received surveys. Priority was based on historic electricity use (per square foot) and percentage of lighting provided by incandescents. The buildings were large with fairly complex plans. A comprehensive inventory was not required so interns only recorded data on the most inefficient fixtures observed. Calculations were done by hand. Buildings were well dispersed geographically, so travel costs were high. They might have been higher, but three interns were placed in remote offices in their hometowns and were assigned buildings in those areas. Office space was donated by Omaha Public Power District and the City of Hebron. One half-time intern reviewed the completed reports for accuracy and completeness and entered results into the program data base.

This initial survey program, which was funded by a $28,000 grant from the U.S. Department of Energy, was supposed to accomplish the twin goals of helping schools reduce their lighting electricity use and provide an introduction to energy issues for college students in the building sciences. Nebraska also used this program to market loans at zero and five percent interest and the Institutional Conservation Program to the schools. To date, lighting upgrades totaling $414,000 identified by the interns have been financed.

1993 Program: State Buildings

In 1993, the program was revised to fulfill the State of Nebraska's commitment to the GreenLights program. Oil overcharge trust funds were used to hire interns to survey state-owned buildings. The buildings ranged in size from over 500,000 square feet to less than 100 square feet and the plans varied widely in complexity. Although the largest office and classroom buildings were initially targeted, the need to survey equal numbers of buildings in each of the state's 49 legislative districts meant that most of the largest buildings did not receive surveys. Surveying buildings in each legislative district also produced a wide geographic dispersion, requiring high travel costs for the Lincoln-based interns. These surveys included a comprehensive inventory of lighting equipment. Most analysis was done using GreenLights' Decision Support Software.

Inadequate planning for technical review produced a backlog of reports at the end of the summer. The reports were not delivered to the agencies which owned the buildings until March 1994, which delayed inclusion of upgrades in agency budgets.

1994 Program: State Buildings

The 1994 program was a continuation of the 1993 GreenLights effort. Eleven interns were hired, six with oil overcharge trust funds and five under contracts with various state agencies. The Energy Office targeted the state's largest buildings this summer. Contract interns worked on buildings owned by the various agencies. Some buildings, such as those owned by the Game and Parks department, were very small, but extremely numerous. Other contracts for state colleges and state hospitals targeted larger buildings.

Two of the interns returned from the summer of 1993. They were given some administrative and technical review responsibilities which greatly reduced the backlog of reports at summer's end. All reports were delivered to the agencies in September 1994.

Deciding on an Intern Program

This section describes the factors to consider in whether to start an intern program. Readers will learn the potential barriers and various costs which should be considered and be able to create a program budget.

Organizational Commitment

It is possible to fit one or two interns into a typical office without affecting anyone other than their supervisor. However, if a full-scale lighting survey program with numerous interns is being considered, it is going to have an effect on the dynamics of your office environment. There is great value in building a team mentality in which the interns start to view themselves as lighting survey "special forces," but that attitude and the overall enthusiasm and energy that interns bring to their work sometimes manifests itself in a jovial camaraderie that may be disruptive. Interns may keep unusual hours, require extra office space and supplies and use up computer resources. None of these are major problems, as long as there is a general commitment to the survey program throughout the office and especially in the upper levels of office management.

Interns need to be aware of potential conflicts as well. They need to realize that there are long-term professionals in the office who have nothing to do with the survey program, derive no benefit from it and consider it something of an imposition on their normally placid schedule and work environment. A little common sense coupled with an awareness of potential problems will go a long way toward minimizing conflict.

Program Supervisor

Managing a group of interns for a survey program can be a lot of fun or it can run you ragged — or both — depending on the attitude you bring to the job. Interns bring an excitement and enthusiasm which is refreshing and infectious in the normal office environment. Since internships are usually short-term, the survey program supervisor will probably be overseeing this program in addition to other normal, full-time assignments. That means that the supervisor must delegate as much day-to-day responsibility to the interns as they can handle. It may be advisable to designate one or two interns to handle certain administrative tasks such as reviewing timesheets or tracking status and progress of building surveys.

Someone must be available to provide technical assistance as well. This person must be able to solve computer problems, advise on appropriate lighting upgrades, correct technical misunderstandings and provide additional training as necessary to avoid future mistakes. Finally, this person must be able to provide technical review of the completed survey reports to verify that the estimated savings are reasonable and that lighting upgrades are appropriate for the buildings and spaces where they are recommended. The supervisor and technical advisor may be the same person, or these duties may be divided among a small team.

Interns appreciate a supervisor with whom they develop some rapport. Some will seek and appreciate this contact more than others, but in general, interns want a job with a human face. It is important to take the time to know and treat interns as persons and to welcome and even initiate personal conversation at an appropriate level.

Program Costs and Benefits

Detailed costs for the Nebraska program are listed on page 11, but some general information is presented below to help begin the process of deciding whether some form of *The Intern Solution* is appropriate for your organization. This discussion is based on Nebraska's experience, providing lighting surveys in a wide variety of school and state-owned buildings. Undergraduate architecture and engineering students were employed, at an average cost of $6.00 per hour (including FICA withholding). Six to eleven interns were employed during each of three summers. The staff architect and engineer managed the program at an average cost of $16.80 per person per hour, including benefits.

The survey program cost for an average summer of six interns working for 13 weeks was $32,925. The various cost categories are shown in the pie chart on page 9.

During a typical summer, six interns should be able to complete survey reports on about 340 buildings covering 9.4 million square feet and identify lighting improvements costing $4.6 million. The simple payback for these may range from two to eight years, depending on local electric and labor rates.

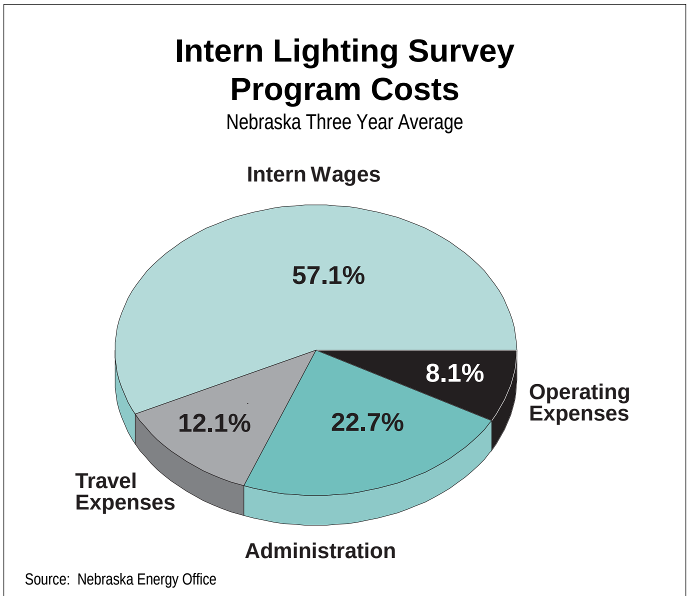
For a specific building example, consider a 50,000 square foot office building of average complexity. A trained intern could walk-through this building in about half a day and

Typical Survey Costs for a 50,000 Square Foot Building

Survey Costs	
Intern wages	$78
Supervisor salary	$31
Travel expenses	$16
Operating expenses	$11
Total survey cost	$136
Typical Analysis	
Cost of improvements recommended	$24,330
Electric cost savings @ 5 1/2¢ per kilowatt-hour	$4,010/year
Maintenance cost savings	$1,287/year
Total cost savings	$5,297/year
Simple payback (electric only)	6.1 years
Simple payback (all savings)	4.6 years
Internal rate of return (IRR)	21.5%
Savings	
Electricity savings	72,900 kilowatt-hours per year
Carbon dioxide pollution prevention*	98,415 pounds per year
Sulfur dioxide pollution prevention*	331,812 grams per year
Nitrogen oxides pollution prevention*	134,456 grams per year

*Based on national averages

Source: Nebraska Energy Office

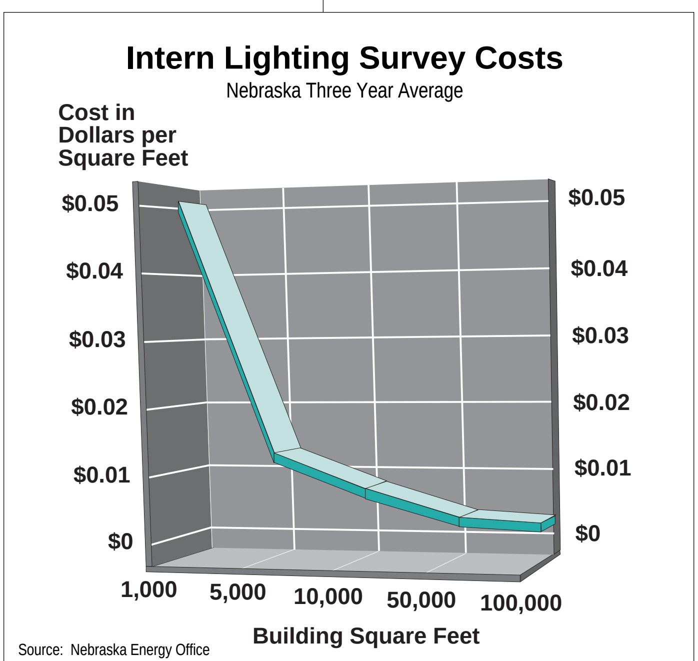


another full day would be required to complete the analysis and write the survey report. Another 1.8 hours of supervisor time should be apportioned to this building for administration and technical review, including a portion of program start-up costs. The expected costs and benefits are shown on page 8.

Staff Costs

Allow at least three months from the time you get approval for the program to the time training begins. Six months is probably more realistic. During this period, you must determine the buildings that will be targeted for surveys and gather data on those buildings, advertise the program and hire interns, collect equipment and prepare administrative procedures, training materials and computer support for the interns. These program start-up considerations will be discussed in greater detail in the next chapter.

Supervisors should allocate 20 to 40 percent of their time for program preparation and operation. The tasks may be shared by several individuals. Technical training will require a full time commitment for at least a week. The first few weeks after training will require between 40-80 percent of the supervisor's time as initial problems, computer glitches and issues that were not properly understood during training are resolved.



Intern Costs

In addition to hourly wages and FICA withholding, you may need to allocate program money to reimburse interns for travel and lodging expenses. Nebraska's program required each intern to have access to a reliable, insured vehicle and interns were reimbursed 27.5 cents per mile. Most interns felt that they made money on the mileage. Actual meal and other expenses were reimbursed based on receipts and lodging was billed directly to the state. These travel costs added about 21 percent to the intern's wage costs and comprised 12.1 percent of the operating budget for the survey program. These figures represent a program in which the surveyed buildings were dispersed throughout the state, so a different target group of buildings might not require as much travel.

Operating Expenses

Operating costs for the program may include computers and printers, lightmeters and other survey equipment, forms and printer paper, copying, filing, mailing and telephone costs. These might also include basic office expenses such as staples and pens and even office space expenses. In Nebraska's case, there were available office spaces with desks and tables, to which interns were assigned. Five interns could share three workstations in a large cubicle (200+ square feet) with little conflict. In the final year of Nebraska's program, when 11 interns were officed, it was decided not only to rent faster (486/33) computers, but to rent a laser printer for sole use by the interns. This reduced conflicts with staff members over shared office printers.

Intern Benefits

The program costs and benefits previously described assume the availability of interns who are excited about the job opportunity and believe they will derive significant benefits from the experience. Nebraska's approach has been to pay an hourly wage and invest as much responsibility in the interns as prudently possible.

Decent Wage

The more you are able to offer, the more qualified applicants your intern program will attract. The salary should be comparable to other part-time, entry-level technical work — a dollar or two higher than minimum wage should be considered.

Course Credit

The availability of scholastic credit indicates that the educational institution finds value in the training and experience that the interns gain through the job. In Nebraska, where the program was operated by a government agency, the course credit from the university was optional. Only a few interns actually availed themselves of the opportunity because, by the time they reached their junior and senior years, most had already planned the courses needed for graduation and didn't need the extra credit. Nevertheless, the fact that credit was available gave the internships greater credibility compared to other summer jobs.

Lighting Survey Costs, 1992-1994

Lighting Survey Costs and Benefits Nebraska Energy Office, 1992-94	1992	1993	1994	3-yr total	3-yr average	% of costs
Costs						
num of interns	6.5	4.5	11	22	7.3	
interns- hours	3474	2755	6314	12,543	4181	
wages	$20,568	$16,307	$38,329	$75,204	$25,068	57%
admin - hours	402	667	709	1778	593	
wages	$6,763	$11,893	$11,254	$29,910	$9,970	23%
total personnel cost	$27,331	$28,200	$49,583	$105,114	$35,038	80%
travel costs	$6,046	$5,472	$4,394	$15,912	$5,304	12%
operating expenses	$2,015	$1,469	$7,192	$10,676	$3,559	8%
total survey costs	$35,392	$35,141	$61,169	$131,702	$43,901	100%
surveys completed						
number of bldgs	270	240	854	1364	455	
square feet	14,205,373	7,686,563	15,717,295	37,609,231	12,536,410	
cost of recommends	$2,085,046	$6,190,875	$10,024,906	$18,300,827	$6,100,276	
est kWh$ savings	$412,764	$681,623	$850,059	$1,944,446	$648,149	
est maint$ savings	n/a	$209,313	$436,171	$645,484	$322,742	
est total$ savings	$412,764	$890,936	$1,286,230	$2,589,930	$970,891	
est kWh savings	7,636,478	20,008,273	27,189,998	54,834,749	18,278,250	
avg bldg size	52,612	32,027	18,404		27,553	
SP: elec only	5.1	9.1	11.8		9.4	
SP:elec+maint	n/a	6.9	7.8		6.3	
elec price: $/kWh	$0.054	$0.034	$0.031		$0.035	
calculated output						
days per intern	67	77	72		71.3	
weeks per intern	13.4	15.4	14.4		14.3	
intern days	434.3	344.4	789.3	1567.9	522.6	
intern weeks	86.9	68.9	157.9	313.6	104.5	
bldgs/intern per day	0.6	0.7	1.1		0.9	
bldgs/intern per week	3.1	3.5	5.4		4.3	
sq.ft./intern per day	32,709	22,319	19,913		23,987	
sq.ft./intern per week	163,468	111,561	99,540		119,927	
calculated survey costs						
cost per building	$131	$146	$72		$97	
cost per sq.ft.	$0.0025	$0.0046	$0.0039		$0.0035	
cost per $ recommend	$0.0170	$0.0057	$0.0061	$0.0072	$0.0072	
cost per $ saved	$0.0857	$0.0394	$0.0476	$0.0509	$0.0452	
total program cost						
survey+installation	$2,120,438	$6,226,016	$10,086,075	$18,432,529	$6,144,177	
survey cost, % of Tot	1.7%	0.6%	0.6%	0.7%	0.7%	

Source; Nebraska Energy Office

Responsibility

At the beginning of the summer, interns received a data sheet for each building they were to survey. It was the interns' job to organize their assigned buildings into cohesive groups, contact the building managers, schedule trips, conduct the on-site building walk-throughs, recommend appropriate lighting improvements, analyze and verify the results and prepare reports. Supervision was minimal except to correct technical, procedural or personnel problems. The purpose of this approach was to minimize the supervision responsibilities of the program managers and encourage interns to rise to a higher level of responsibility.

Flexibility

Interns had significant flexibility in scheduling their tasks. This is consistent with the approach of treating the interns and their work professionally. Although limited to 40-hour work weeks by state rules, interns had the opportunity to schedule both day and overnight trips to best fit with their other activities. Interns also determined the pace at which they surveyed buildings and planned adequate time in the office for analysis and report writing. Since interns received no paid vacation or sick leave, they were allowed to work additional hours to make up for sick days or holidays when the office was closed.

An Intern's 1994 Experience

One of the 1994 interns wrote a 20 page paper as part of the requirements for additional architecture course credit offered through the University of Nebraska. It included a discussion of the GreenLights program in general and the results achieved by the 1994 intern team. Here are several excerpts from that report which deal more with the intern experience.

"The training period was somewhat overwhelming because we were given a lot of information very quickly and then basically sent off to work. We did a complete survey of a building with our supervisors from start to finish and it quickly became apparent that on-the-job training and experience was going to be more beneficial than anything we would learn in a training session.

"This work experience also gave me several 'revelations.' First of all, it became horribly apparent that lighting has been one of the most commonly overlooked design elements. This can be seen from several different perspectives. From the perspective of aesthetics, the University of Nebraska at Omaha Fine Arts Building is a good example. This building, constructed quite recently, has been featured in *Architecture* and is generally considered to be an effective building. While the lighting used in this building makes an obvious attempt at being energy efficient, it appears as though aesthetics have been sacrificed for efficiency when this does not need to be the case. Industrial fixtures designed for warehouses are used in classrooms and compact fluorescent fixtures that are extremely energy efficient stick out of the walls as though they were an afterthought. Aesthetics do not have to be sacrificed for energy efficiency as they were in this case. The two should be combined to create an overall lighting scheme that works effectively and efficiently.

"A final perspective on lighting design is the ergonomic factor. Employees in offices that were poorly or inefficiently lit were more likely to complain to me about the lighting and ask how I could improve it.

"Another 'revelation' from this summer is the financial impact that lighting design has. It seems that when students consider the life cycle cost of a building they are only concerned with the heating and cooling of the building. While this is also extremely significant, lighting design can play a major role. Natural light becomes just as important in design as natural ventilation and shading because poor use of natural lighting and reliance upon artificial means of illumination can add a tremendous burden to the life cycle cost of a building.

"The GreenLights Program has a lot to offer. The hardest part of the program was convincing people that I could cut the amount of wattage and maintain their current lighting level or even improve it. For the average Joe Q. Public, the ideas presented by GreenLights don't always make sense until he sees concrete evidence.

"After such a short training period we didn't feel comfortable with what we were doing, but by the end of the summer we were talking as though we were experts. I enjoyed talking with people about changes that could be made in their buildings.

"My experience from this summer has already begun to affect my work in the studio.

"I'm sure that this experience will continue to influence my designs through the rest of my education and I would strongly recommend this program to other students."

Travel

Interns seemed to enjoy the travel opportunities afforded by the program, even though it was all in-state and business related. During interviews, applicants were asked how much and in what parts of the state they wanted to travel. Building assignments were based in part on these preferences. Some interns scheduled travel to coincide with a weekend visit to friends or family, in which case the program reimbursed mileage to and from the furthest building survey location.

Realistic Experience

One of the primary goals of Nebraska's program was to give the interns a true taste of the job of a consulting engineer or architect. This was possible because the problem was small and easily defined: "recommend energy-saving improvements for the lighting system." Thus, interns could learn the task quickly and do their field and computer work with minimal supervision. Liability issues were covered by the Energy Office's technical review and the fact that the interns were not expected to produce complete, perfect lighting designs, but only to explore the realm of potential energy-efficiency improvements and recommend

Intern Comments

This is a compilation of some of the more insightful comments from the 1994 interns' exit interviews:

1. Was the job what you expected?
- Thought it would be a lot harder
- A lot more fun (and interesting) than it sounded
- A little more technical than I expected
- Learned more than I planned on

2. What was the best part of the job for you?
- The people - it was a really fun group
- Having the responsibility of completing the projects from start to finish
- How well we worked as a group
- The practical experience
- All I learned

3. What was the worst part of the job for you?
- Initial difficulty in recognizing fixtures
- Determining correct hours of operation
- Reviewing reports
- Monotony of surveys
- Computer program was very dry
- Repetitiveness of data entry

4. How will this experience be helpful in the remainder of your schooling?
- Combine aesthetics with energy efficiency
- Design studio: lighting and how it affects people using the space
- Part of my future designs. I will never overlook lighting again
- A better idea of appropriate lighting and its costs
- More comfortable with lighting issues
- Lots of new design ideas from buildings I've seen - good and bad

5. How will this experience be helpful in your professional practice?
- More aware of issues they don't teach you in school - new job opportunities
- Utilizing most advanced, energy-efficient lighting systems
- Made me aware of the importance of details
- Opened my eyes to a whole new area of expertise
- Everyone in the architecture profession should take a more in-depth look at lighting and energy efficiency
- Aesthetics and energy efficiency - good combination for a future with diminishing resources

6. How have your attitudes and awareness of energy in building design changed?
- Awareness of what is and isn't energy efficient
- Have put efficient bulbs in my room and my fraternity
- Really surprised that lighting design has been so neglected and the fact that so much energy can be saved by upgrading lights
- More energy-conscious - we have not turned on our air conditioner all summer and we don't leave unnecessary lights on

7. Did you receive an adequate level of supervision?
- Very appropriate - let us solve most of our own problems and work according to our individual methods, but offered assistance and advice whenever needed
- Yes - door was always open
- Could use more complete references and cost lists
- We had enough freedom to work independently, but they were involved enough to know what was going on with each individual
- Sometimes conflicting information between supervisors

8. Was it helpful to have more experienced interns providing leadership?
- Yes - they understood the problems we faced
- Only in the first couple of weeks
- Yes, but would have been better if everybody gave the same answers to questions
- Especially at the beginning
- Good for advice on upgrades to try so we didn't have to bother supervisors
- No
- Practical experience for things that "popped up" in the field
- Should have one in the office all the time, not doing any surveys

9. Was your initial training adequate?
- Can only learn so much in theory - best to get out and DO IT
- Very overwhelming - so much happened that I don't remember
- No - I had a lot of questions when we were on our own
- Felt confident when going out separately
- Some of the technical knowledge didn't seem to apply
- A little overwhelming
- Didn't seem adequate at the time, but it was

those that were most promising. Responsibility for the suitability of recommendations fell on the building owner or a designer or contractor retained to implement the recommendations. This gave interns the opportunity to make significant recommendations in a safe environment.

Significant Task

Interns are typically very idealistic. This job gives them an opportunity to get out and "make a difference in society" by recommending improvements which are cost effective, environmentally sound and energy efficient. Since recommendations are based on sound technology and are generally noncontroversial, it is easy to feel good about the work.

Useful Training

Initial training topics are chosen for maximum utility. The purpose of the initial training is to give interns the knowledge and skills needed to do the job well. This involves some conceptual information, but primarily consists of demonstrating practical information that interns must apply. This quickly differentiates the internship from normal classroom lectures and provides a sense of applicability and progress. After interns become comfortable with the mechanics of their job, additional topics should be introduced depending on the interns' interests. Small, practical design problems, videos and field-trips can provide short "vacations" from the normal survey task and reinforce the understanding that, even as interns are doing the job, they are also learning information which will be valuable throughout their professional careers. Some of the additional training was voluntary, but interns were paid for time spent in continuing education.

References

Since interns were in their final year or two of school, one of the benefits of the internship was the opportunity to get some practical experience which would look good on a resume. Additionally, supervisors offered to provide references for graduate school or a full-time job.

Program Start-Up

This section describes the administrative and personnel decisions, agreements, policy directions, data collection and organization needed before beginning an intern program. Readers should gain an understanding of all the necessary steps and be able to organize a coordinated approach to accomplish these preliminary tasks.

The success of an intern program depends on many factors. The scope of the project, the dedication of the people involved and the thoroughness of those efforts will all have a dramatic effect on the outcome. The program can be made more successful by anticipating questions and making as many decisions as possible before interns arrive for training.

By their nature, internships are short-term learning experiences, usually lasting less than a year and often, only a few months. To maximize the effectiveness of the internship, a great deal of planning is required before the program begins. Once surveys are underway, implementing changes other than small adjustments, will distract from the survey process. Procedures must be established, equipment available and buildings ready to be surveyed when the interns finish training. This internship is an action-oriented program and interns expect to get to work. Delays and uncertainty will hurt morale and hinder your program.

The program start-up phase consists of bringing together a number of diverse elements at the proper time. These include:

- Goals. Know what the program is supposed to accomplish
- Funding. Resources are in-place, available and any restrictions resolved
- Buildings. Target groups are selected, prioritized, data collected and assigned
- Interns. Internships are advertised and interns are hired
- Training. (To be discussed in the next chapter)
- Tools. Equipment, supplies, computers and space are acquired
- Procedures. Administrative, personnel and program policies are finalized

This chapter will discuss each of these elements and the issues which should be decided ahead of time. Examples will be given from the Nebraska program, which may be similar to the decisions needed in your program. It will also discuss the impacts that certain decisions may have on your programs.

Goals of the Survey Program

Define your program thoroughly in terms of the goals and objectives you plan to accomplish. Also decide what your program will not accomplish. Is your goal to survey a certain number of buildings, to implement a utility's integrated resource plan, to market energy efficiency or pollution prevention or to provide employment and educational opportunities? Often, at least some of your goals will be dictated by the availability of funding. In any case, you must decide at the outset exactly what the program parameters are and make sure those parameters are respected. Having parameters clearly defined allows you to address other program decisions.

Funding

Funding for your survey program often depends on the goals or may even dictate those goals. Typically, you will have most funding committed early in the program's development so that any financial restrictions can guide later development decisions. This manual describes how using interns can reduce survey costs, but surveys will never be free. Even if interns are volunteers or are required to participate for class credit, there will be costs for equipment, supplies, travel and supervision.

Funding sources may include grants from parties not directly involved in the surveys, partnerships with entities who are involved in the planning and operation of the program and service fees or reimbursements from building managers who benefit from the surveys.

Each of these entities may have different reporting requirements which may include financial, status and program reporting for the entire survey program as well as copies of survey reports and recommendations for all or a portion of the buildings surveyed. These requirements should be clearly identified during initial planning so that you can design the appropriate reporting procedures in your program. Any required forms or reproducible originals should be obtained ahead of time and in sufficient quantity.

If you will be reimbursed for survey costs by the owners of buildings, you may need to develop a simple, standard contract or letter of agreement specifying the work to be done, reports to be delivered, basis for charges and other information specific to your situation.

Since funding details will vary greatly from program to program, the issue will not be addressed further in this manual.

Building Selection and Prioritization

If your program goals do not limit surveys to a particular group of buildings, what type of buildings will be surveyed must be decided. Some questions to consider in making this decision:

- Do surveys need to be apportioned equitably among several sponsors or among political subdivisions? If so, is it more important to proceed uniformly among the groups at the start or should one group be finished before another is started?
- Are certain buildings likely to benefit more from a survey? These might include buildings with high lighting loads, many inefficient lamps, poor controls and long hours of use or expensive utility rates. Other considerations might also include buildings in disadvantaged neighborhoods or those with owners in financial distress.

- Will results in a single building or group of buildings generate additional program opportunities? These may be buildings which are more visible because they are used by many people or supported by taxes, contributions or user fees or are likely to attract media attention.
- Have the managers of certain buildings made a prior commitment to make the recommended changes or do they have a history of implementing projects when shown the advantages? The likelihood of implementation is a great motivator for interns and helps the overall success of the survey program.
- Do certain building managers have funds or financing opportunities available to implement recommended improvements? Implementation, followed by tracking of utility bills to verify savings, may provide support to continue or expand the survey program.
- Is there a need to limit which buildings are eligible for surveys or can other building types be added later?

Consideration of factors such as these will help define your program's target buildings. After this has been decided, advertising the availability of surveys may determine which building owners are most receptive to the program. This may not be needed if a commitment has been made. In this case, the collection of pre-survey data to prioritize the buildings could begin.

Pre-Survey Data Collection

Time at a building site can be reduced and made more effective by careful planning and collection of as much information as possible before the walk-through survey. While information about a building can be collected at any time prior to a site visit, if the information is available during the start-up phase, it can be used to prioritize buildings so that those which are most likely to benefit from lighting improvements can be surveyed first. Detailed building information prior to start-up may also affect your selection of interns, if that selection is based on geographic considerations. Finally, building information will permit more strategic trip planning which can reduce your program costs.

Unless you have a very small number of target buildings and can interview each owner or manager personally, you will probably need to send out a questionnaire to building managers to request the necessary information. This questionnaire can be easily combined with an announcement of program availability, so that by responding to the questionnaire, the building manager is also requesting a survey from your program.

Your pre-survey questionnaire should request all the information listed as "Building Identification" and "Building Information and Energy Use" for the

Example of Database Contents

Building Identification

Building name, mailing address and physical location
Building contact name, title and phone number
Owner or responsible agency, contact name and phone number
Complex or facility name, (if applicable

Building Information and Energy Use

Building type and primary building use (maybe a checklist)
Year of construction and additions
Floor area
Annual hours of use (full- and part-time)
Electric utility name and phone number
Twelve months of electric bill data (kilowatt-hours, kilowatts, cost)
Base electric load estimate

Survey Information

Assigned to intern
Priority number, if applicable
Status (keyword, checklist or date completed)

Survey Results

Estimated current lighting cost and kilowatt-hours
Upgrade cost(s)
Savings (kilowatt-hours, kilowatts, dollars, maintenance)
Payback, internal rate of return or other benefit-cost criterion
Implementation status
Location of paper file

Flat File Versus Relational Databases

If you have a lot of information which is being repeated from one record to the next, you may want to investigate a relational rather than flat-file database for information storage. In a relational database, repetitive information is entered only once and is matched with all the records to which that information applies by a "key" field. In this case, if you have a number of buildings which are owned by the same agencies, you can enter the contact information once for each agency and then mark which buildings belong to each agency. Similarly, if there are many buildings on central electric meters such as a college campus, the meter data should be entered only once and the record for each building drawing from that meter should point to the single meter record. This is a more efficient and accurate way to store data, but it requires a more sophisticated database program and usually some programming time.

database shown on this page. You may want to request information on the lighting equipment currently used in the building as well. This should be general enough that you are not asking the building manager to complete the survey for you, but concentrations of inefficient lamps may indicate a building which could achieve significant benefits from the survey program.

You should also request a building plan of some type. This is a valuable and often-overlooked tool. The most desirable — and rare — is an actual electrical lighting plan. A good alternative is a reflected ceiling plan. A simple floor plan with dimensions, or at least drawn to scale, is next in order of desirability. If none of these is available, there is usually an evacuation plan which can be copied. Even a rough sketch of the building outline and major rooms is better than nothing — the intern can always redraw this more accurately during the walk-through survey, if necessary.

Finally, if your program targets buildings owned or operated by disadvantaged individuals or if the buildings are located in low-income or blighted areas, you may also need to request information about these factors. This information may be used to determine eligibility, priority or both.

Two examples of pre-survey questionnaires are shown at the end of this chapter on pages 35-37.

Estimating Your Program's Capabilities

Usually, the number of available interns is limited by program funding, availability of space and other tools or even administrative overhead.

Building Inventory Computer Screen
(Page 1)

Records Organize Go To Exit

Building ID# 0001-0

GREEN LIGHTS BUILDING INVENTORY

Building Identification:
STATE CAPITOL
1445 K ST
LINCOLN , NE 68509
County: Lancaster
Legislative District: 28

Building Owner/Operator:
Agency# 065-04
Agency: Administrative Serv.
Division: STATE BLDG.

Contact: DANNY SCHLICHENMAIER
Phone:

Contact: BOB RIPLEY
Phone:

Complex: CAPITOL COMPLEX

Primary Use: office building
Secondary: museum

Full Time: 2600 hr/yr
Part Time: 1040 hr/yr

Constructed: 1932 Construction Type: load bearing masonry wall & steel
Remaining: 75yrs Size: 289,400(net) 401,760(gross) floors:18

Primary Heating System: central Primary Cooling System: central

Edit ||F:\interns\inventor\SB2 ||Rec 1/2761 ||File ||ExclLock|| Num

You can use this section to estimate how many buildings interns can survey.

In general, Nebraska's interns found they could walk-through about 100,000 square feet (in one or several buildings) in an eight-hour day. Another two to three days would then be required for travel, data entry, analysis and report preparation. These estimates and the averages in the table on page 20 may need to be modified according to specific features such as:

- Small buildings require more time per square foot than larger buildings. There is a minimum amount of overhead time required for each building for travel, information collection, analysis, report writing and administrative time, regardless of the size of the building.
- A building's location may require extra travel time and even overnight stays. Remote locations may also limit the number of interns available to perform some surveys, particularly if interns are working part-time and have other job or educational commitments.
- Complex buildings, with many different types of rooms, schedules and luminaire types, require much more survey time than similar-sized buildings which have a single schedule, only a few luminaire types and many

Building Inventory Computer Screen
(page 2)

Records Organize Go To Exit

Electric Utility: LES
City: LINCOLN Phone:

electric metering: indiv sq.ft. on central meter: 0

Demand Metered? N

	Electric Consumption kWh	cost	Demand kW	cost
Jan	430,536	$10,333	0	$0
Feb	216,280	$5,191	0	$0
Mar	590,488	$14,172	0	$0
Apr	176,216	$4,229	0	$0
May	455,888	$10,941	0	$0
Jun	443,568	$10,645	0	$0
Jul	283,664	$6,808	0	$0
Aug	368,264	$8,838	0	$0
Sep	355,320	$8,528	0	$0
Oct	377,048	$9,049	0	$0
Nov	238,568	$5,726	0	$0
Dec	521,360	$12,513	0	$0

Edit ||F:\interns\inventor\SB2 ||Rec 1/2761 ||File ||ExclLock|| Num

Estimating Intern Survey Output
(Including travel, walk-through, calculations and reporting)

	Per day	Per week
Buildings surveyed per intern	0.9	4.3
Square feet surveyed per intern	23,987	119,927

Source: Nebraska Energy Office

similar rooms. Some buildings such as dormitories are extremely simple because of repetitive features. Occasionally, you will also encounter identical buildings, where several reports can reference the same analysis and recommendations.

• Comprehensive inventories of a building's lighting equipment and comprehensive lists of recommendations add to the time required for the walk-through survey, analysis and report writing, compared to simpler surveys. More surveys can be completed if interns only inventory and analyze lighting equipment that they know can be economically replaced or only recommend particular technologies. However, this will reduce the overall savings and may result in missed savings opportunities, both at the time of the survey and in the future.

Priority List

If you lack the time, interns or money to provide surveys for all your target buildings, then you will need some criterion for deciding which buildings are surveyed and in what order.

This criterion may be dictated by your goal or funding source such as financial need or location within various utilities' service territories or political subdivisions. If these situations do not apply, then you will probably want to prioritize surveys based on maximizing your impact and minimizing your costs. Possible priorities for building surveys include:

- High energy use or cost (kilowatt-hours or dollars)
- Intensity of energy use (watts per square foot or dollars per square foot)
- High connected lighting load (kilowatts)
- Large numbers of inefficient lamps
- Higher-cost utility billing schedules
- Building use or location
- Long hours of use or large size

There is even a rationale for giving priority to the first building managers to respond to the announcement of program availability: these individuals may be more likely to implement the recommendations, which is the ultimate goal of a survey program.

Whatever your basis for selecting and prioritizing buildings, it should be decided before the building questionnaires are distributed. However, it is also wise to allow for some flexibility so that you can survey an extra, lower priority building at a remote location, rather than leaving it for a second trip later in the program. One way to build this cost-saving approach into the priority calculation is to select and prioritize groups of buildings at the same location, rather than individual buildings. That way, any particular site is only visited once.

Building Assignment

The purposes for assigning buildings to particular interns are to hold down program costs by minimizing travel, to provide overall guidance to each intern and to give each intern a sense of responsibility for a specific group of buildings. In the interest of minimizing travel costs, it is best to group buildings geographically and then assign a particular intern or team of interns to each region. Interns may also be assigned buildings in several regions to maximize their exposure to different designs and environments.

During employment interviews, interns should be asked how much they would like to travel and if there are particular regions where they would or would not prefer to travel. Those desires should be a strong guide to regional assignments, tempered by the supervisor's evaluation of the intern's maturity and ability.

In some survey programs, minimal travel may be required. In those cases, criteria for building assignment may be based more on the type of building and the supervisor's evaluation of each intern's ability. It is usually still best to have only one or two interns assigned to a particular location or political subdivision, so that building managers don't have too many different interns working in their buildings.

Supervisors need to be aware of each intern's progress and be ready to make reassignments, if necessary, for the good of both the intern and the program. A balance needs to achieved between individual responsibility and a team mentality in which interns believe that their work contributes to the success of the overall program.

Intern Selection

The success of the intern survey program will depend greatly on the talents, capabilities, dependability and dedication of the interns. Since internships are generally of short duration, there is not much opportunity to make major personnel changes once the program is underway. Correction and even disciplinary procedures may be needed occasionally, but losing or replacing an intern will handicap your efforts because of the retraining requirements or reduced program output. The best defense is careful selection in the first place. You can increase your program's chances for success by selecting interns who already have an interest in your program's basic objectives, have demonstrated technical competence and come with good personal references. Some items to consider when recruiting interns:

- Place employment announcements and job descriptions at universities, colleges, trade schools and high school classes that offer courses relevant to your program objectives. You may want to restrict advertisement to students in specific fields such as building sciences and other technical disciplines or you may want to require completion of certain classes or a particular number of credits. The purpose of the targeted advertisement is to allow the educational institution to act as a screening mechanism for potential interns as well as to locate students who will be most likely to profit educationally from the internship.
- If the target buildings are geographically dispersed, consider recruiting interns from different regions and having them work out of remote offices in the areas where their buildings are located. This allows interns to work in areas with which they are familiar and can reduce program travel expenses.
- Successful interns must be highly self-motivated. They will need to take initiative to make contacts, plan inspection trips, perform analyses and complete reports with little administrative coaching. Selecting self-motivated interns allows the supervisor to focus on administrative activities.
- Interns' dependability and honesty is vital to your program. Interns must be at their planned workplace, doing their job and keeping accurate records of their time and expenses, because a supervisor won't have time to oversee everybody's work habits. Treat the information from references very seriously.
- A valid driver's license will be required if your program requires significant travel. A dependable, insured private vehicle may also be a requirement unless your program can provide vehicles for interns.

These objectives should be restated and emphasized when students are interviewed for the internships. Develop standard questions to be asked in all interviews. Standardized questions should also be used when requesting references on applicants. Even though the internship is a temporary position, you should be thoroughly professional in your hiring practices.

A sample job description, pre-interview information sheet, interview questions and reference request are included at the end of this chapter starting on page 30.

Program Tools

This section will discuss decisions regarding survey types, analysis hardware and software, equipment and supplies and office space. These are all tools that interns will need to produce lighting surveys effectively.

Survey Types

The program goals, funding sources and report requirements will usually dictate the sort of survey to be performed. The main question is whether the survey will be a comprehensive inventory of lighting equipment with recommendations of all energy-saving upgrades. This is the approach required under the EPA's GreenLights Memorandum of Understanding. If a comprehensive survey is not required, then program goals must be carefully considered. Will entire buildings be surveyed or just areas with certain uses? Are only particular technologies to be considered or will interns have considerable freedom in designing lighting system improvements? Will the report present various options for certain spaces or just the one considered optimal by the intern? Will upgrades be presented individually or will a package of upgrades be recommended, with savings estimates to include interaction between control and luminaire recommendations?

Analysis Software

The selection of analysis procedures depends on the survey type selected. If a comprehensive survey is to be employed, particularly for buildings owned by GreenLights partners, then the EPA's Decision Support Software is the most likely choice. It does not operate perfectly in every situation, but it does provide a systematic format for analysis of almost all lighting equipment in a building.

If a comprehensive survey is not required, then there are several analysis methods available. These essentially automate simple hand calculations in which the current lighting cost, based on watts and hours of use, is compared to the estimated cost of the recommended upgrade. The calculated savings are then compared to the cost of the upgrade. If your program only provides surveys for small, simple buildings, actual hand calculations may be sufficient for your analysis needs. These require only a four-function calculator and possibly a standard calculation form. There are several drawbacks to using hand calculations: they are more prone to math errors than computer calculations (requiring extra technical review), handwriting is more difficult to read than printed output and calculations quickly become tedious for the interns. This makes it less likely that the necessary "what-if" calculations will be done to optimize recommendations.

If justified by the number of separate calculations, there are several ways to automate lighting calculations. Any spreadsheet can be used to prepare a simple template for lighting calculations. This will provide consistent, readable output and as long as the cells with formulas are protected, math errors will be prevented. This reduces the reviewer's job to verifying that entry data is correct. Addition of spreadsheet macros can provide utilities such as simple error checking, product and price catalogs and automatic printing. If you add too many features though, you might as well purchase single-project calculation software. These may be based on spreadsheet or database programs, but usually include the error checking and product and price catalogs. Some may even recommend upgrades or provide databases of common substitutions. These features greatly speed up comparison of several alternate recommendations. As software gets more sophisticated, however, some flexibility will be lost and occasionally you may still find that the desired recommendation requires calculation by hand or a simple spreadsheet.

Hardware Requirements

The analysis methods selected will determine hardware requirements. If you are using hand calculations exclusively, all you really need is a simple calculator or adding machine. User-written spreadsheets vary in their hardware requirements, depending on the base spreadsheet selected. Lighting project calculation software for PC-compatible computers typically requires lots of conventional memory, so it's a good idea to get a computer with additional memory above one megabyte and configure the computer to load as much into upper memory as possible. Speed is not a great consideration for this software because the calculations are usually fairly limited.

Whole-building analysis software, on the other hand, can require tremendous computer resources. For a program such as Decision Support System you should probably have at least a 386 computer operating at 25 MHz and a 486/33 is desirable. The software will run reliably on lesser computers, but most analyses take too long. The problem is not so much in the computer, which can be left to run overnight, if necessary, as in the interns' interaction with the computer. Typically, there will be system crashes while interns are getting used to the survey and software and it is very frustrating to have the crash occur after the computer has been tied up all day running an analysis. Faster computers mean that any problems are identified and can be fixed more quickly.

Most lighting software can be run over a local area network, but lacks support for simultaneous access to network data. This is not a major problem if you have sufficient hard disk space to store multiple copies of programs and data. Even if a network is available, it may be better to store stand-alone programs on individual computers, as long as each intern works at only one computer. The network can then be used to route output to a common printer.

Printing requirements for spreadsheet and single-project analyses are not a problem. The printed output for each project is only a single page or several pages. These can be printed locally with either a dot-matrix or laser printer or routed over a network. But, whole-building analysis software can severely tax your printer's capabilities — a complete report for a moderate-sized building can exceed 100 pages. You should have a printer capable of printing at least four pages per minute to avoid long delays. You should also train interns to review output on the computer screen before printing, to make sure that only the correct output is printed. Finally, remember to budget for printer paper and replacement toner cartridges or ribbons.

Consider renting computers and printers for the intern program, unless the necessary equipment fits within a larger computer acquisition and upgrade plan. Renting provides the quality of equipment you need for the time you need it, and the costs are easy to track.

Equipment and Supplies

In addition to a calculator or computer and printer, interns will need measurement equipment and some basic office equipment and supplies. Depending on your interns' schedules and locations, some or all of these items may be shared.

The most basic lighting survey equipment consists of a clipboard and pencil, a lightmeter and a tape measure. There are small, analog lightmeters costing only about $60, which work quite well for a while. After repeated trips to the floor, they tend to lose calibration and recalibrating them is difficult. Digital lightmeters maintain calibration fairly well, even with the abuse that accompanies regular use. The single-unit model seems to be a little easier to use than one with the display separate from the sensor, because it only takes one hand to operate. Special features such as peak-hold and averaging capabilities may be used occasionally, but are generally wasted in these surveys. A ten- or 12-foot tape measure is useful for measuring ceiling height, room dimensions and plenum depths. An electronic distance meter is a nice time-saving addition if you have the budget for it.

Another very useful tool is a small flashlight, preferably one with a halogen lamp which can be focused. This is useful for reading information printed on lamps when the lamp is turned off. It is also useful for locating switches in dark rooms and inspecting plenums.

Architects' and engineers' scales should be provided for reading room dimensions from plans accurately. This will reduce on-site time for the survey.

Interns should be provided with reference material on lamps, luminaires, ballasts and prices for all of these. Manufacturers' catalogs are usually provided free of charge. Catalogs that list mean or average lamp lumens are more useful than those listing only initial lumens. Other sources of reference materials are listed on pages 58-63. You should also provide instructions for any software and example calculations for typical lighting upgrades.

Finally, typical office equipment such as staples, tape, correction fluid, paper, pens and pencils should be provided for the interns. If you are using hand calculations or adding notes to software output, you may want to provide a typewriter — it makes reports easier to review. If fixtures in several rooms are being analyzed as a single project, a ten-key adding machine simplifies the fixture counting.

Office Requirements

Interns need some sort of established office space. Working out of homes is one option. This reduces program costs for office space, but may be too unstructured and require more self-direction than most interns are ready to handle. It may also require extra equipment which could be shared if interns were housed in one or more offices.

You will probably choose to arrange office space in a more traditional setting. The office should include desks or tables and chairs and space for files and small item storage. A copy machine should be available — one with reduction capabilities is very useful for making field copies of floor plans. Telephone service must be available if interns are to make their own arrangements for walk-through surveys. A fax is also a benefit, although it would have been considered a luxury a couple of years ago. Finally, there should be access to a receptionist or an answering system, so that messages can be recorded while interns are out of the office.

Close proximity to the program administrator and technical adviser are desirable to facilitate answers to questions and rapid feedback on technical reviews. Nevertheless, it is possible to house some or all of the interns at locations different from the program administrator. It is more desirable to have adequate facilities for interns than to have them housed nearby. Remote office space will also reduce travel costs for most surveys, but may increase travel costs to centralized meetings. Finally, having several interns assigned to different offices will reduce the impact on individual office environments. Usually, program partners, utilities or local governments will donate space and services for a time, so there should not be any office rental costs.

Two or three interns can share an office space with a desk and table fairly effectively. Usually, not all interns will be in the office at the same time, so this will provide room for one to work at a computer and another to use the table for plan review or trip planning. A 100- to 150-square foot space is adequate for two or three interns, providing other support services are available elsewhere in the office. Five interns can also share three workspaces in a 200-square foot office area.

Procedures

This section discusses those administrative, financial, program status and technical review issues which must be decided prior to intern training.

Administrative Procedures

By the time interns actually begin work, you should have in place procedures for all common administrative, financial and personnel situations. Timesheets, scheduling and trip planning forms, reimbursement requests, telephone logs, mileage logs and any other paperwork should be available and their proper use clearly and simply communicated so that interns can concentrate on learning to survey rather than digging through a paper chase.

There should also be a well-defined process for handling survey reports. This process should start with completion of the draft report and include each step through which the report passes until it is delivered to the building manager and copies are placed in the appropriate program files. In between, there may be several reviews, some recalculation and rewriting, copying and mailing. There should be a report tracking system in place to show that each report has gone through all the proper steps before it is delivered. Ideally, this system would also be able to track the location of the working file for each building and its current status in the survey process.

Survey Reports

No matter which modeling or lighting calculation software is selected, the reports are generated for lighting surveyors and generally unfit for normal human consumption and comprehension. You should carefully consider the audience for your program's lighting survey and design the report's content and style around their needs. It may be advantageous to design several reports, customized for various entities connected with the survey such as the building manager, the building owner, the survey program sponsor, the local utility and the state energy office. Here are some items which should normally be included:

- Cover letter which includes who to contact, other available information and a disclaimer
- Room-by-room or project-by-project listing of recommended upgrades
- Summary sheet of costs and savings (table or graph)

- Building plan identifying locations of recommended upgrades
- Building-specific notes or comments by the intern
- Standard pages describing the typical technologies recommended

"Other information" might include raw data, review data, notes on technologies or specific upgrades not recommended, fixture and equipment counts and various summary reports. These types of information are easily produced from the modeling software, but will probably not be desired by the initial recipient of the report. Readers can request this information later, when they are ready to implement recommendations or need to schedule further study or design work.

Technical Review

To protect the credibility of your office and the survey program, all surveys should be reviewed for technical accuracy and appropriate recommendations. The more complete the review process, the less likely a survey will be released that contains inaccurate or inappropriate information. Determining the type of reviews to be completed and the process to be followed for reviews will prevent confusion when completed surveys are ready for review. Some issues you may want to consider during the development of your technical review procedures:

- Who will be providing the technical review? What is their technical experience? Where are they located?
- Will interns be reviewing each others' reports? If so, you may need to locate intern offices to accommodate these reviews. Extra training will also be necessary.
- What time constraints do the technical reviewers have? A thorough review of a large report may require more than an hour. Are reviewers being paid or reimbursed for their time?
- How and where will the approved surveys be assembled for printing? Will your program need to cover the postage costs required to send them to or from this location?

Given the right supervisors and partners, technical review does not appear to create a large problem. However, this does not reduce the importance of a thorough technical review process. A successful review process can teach your interns what types of recommendations are appropriate and successful, provide consistency among reports and ensure the credibility of your program.

Recordkeeping Procedures

Unless your target group of buildings is so small that accurate records can be kept by hand, you will want some sort of computerized database to organize building contacts and pre-survey data, prioritize surveys, mark assignment of buildings to interns, record progress during the survey process and record survey results for later compilation. A flat-file database will work fine, but if your target buildings are generally grouped in complexes and you have a database programmer available, a relational database structure is more appropriate. Examples of typical database fields are shown on page 18.

You should also plan for long-term archiving of raw survey data, calculations, recommendations and reports. How much of this will be maintained electronically, how much in paper files and what should be discarded after certain dates are typical issues to be considered.

Pages 30-37 illustrate examples of documents and forms developed by the Nebraska Energy Office to recruit interns and request pre-survey building data.

Job Description for Summer Lighting Interns
Nebraska Energy Office, 12-17-91

The Nebraska Energy Office is seeking six Architecture or Engineering students for full-time internships during the summer of 1992. These interns will survey the lighting systems in school buildings throughout the state and prepare reports recommending lighting improvements. Interns will gain experience in practical energy conservation and technical consulting methods.

Educational qualifications are admission to the College of Architecture or completion of two years of a curriculum in the College of Engineering and Technology.

Candidates must be highly motivated and able to work with minimal supervision. They will be located throughout Nebraska, so intended summer residence will be a factor in selection. Each intern must have a valid driver's license and access to a private vehicle, as the job will involve considerable travel and occasional overnight stays. Physical agility is required for tasks such as climbing ladders.

Employment will begin with two days of training in Lincoln following Spring semester final exams, and will end with an evaluation meeting in Lincoln the second week of August. Wages will be $5.50 per hour with expenses reimbursed. Architecture students may also receive independent study credit.

In addition, the Energy Office is seeking one student for a half-time internship beginning in late March and continuing through the Summer of 1992. This intern will be located in Lincoln and will perform data entry and analysis, review survey reports and provide administrative support to the interns described above. Educational qualifications and wages are the same. Some field survey and report writing work will be available if credit for independent study is desired.

The application closing date for these positions is February 7, 1992.

For further information, or to make application, contact:

Prof. William Borner
246 Architecture Hall

Constance (Connie) Husa
W181 Nebraska Hall

Application for Internship

Nebraska Energy Office
Lighting Efficiency Survey Program

last name	first name	initial	social security #	home phone #
mailing address	city	state	zip	daytime phone #

intended summer address	city	phone #	beginning date

Do you intend to take summer courses? ☐ yes ☐ no If "yes", what course and what time does it meet?	current GPA	number of credit hours completed

Architecture students	-OR-	Engineering students
Have you completed or are you currently enrolled in Arch 459? ☐ yes ☐ no		major ________________ class ☐ sophomore ☐ junior ☐ senior
Verification of application or admission to the College of Architecture signature of dean or academic adviser / date typed name and title / phone #		Verification of completion of 4 semesters (including current semester) signature of dean, department chair or academic adviser / date typed name and title / phone #

most recent employer			supervisor	phone #
employer's address	city	state	period of employment from	to
description of duties				

second most recent employer			supervisor	phone #
employer's address	city	state	period of employment from	to
description of duties				

additional reference (not a relative) name	phone #	relationship to you	
mailing address	city	state	zip

I authorize the Nebraska Energy Office to contact the individuals named above for the purpose of obtaining and/or verifying information related to this job application.

signed ______________________________ date ________________

Return completed application to Prof. William Borner (Arch 246) or the Nebraska Energy Office by 4:00 pm, Friday, February 18, 1994.
questions: contact Lynn Chamberlin, Nebraska Energy Office, PO Box 95085 (1200 N Street, Suite 110) Lincoln NE 68509, 471-2867

Pre-Interview Information for Lighting Internships - Summer 1994

Job Description

The Nebraska Energy Office is seeking six Architecture or Engineering students for full-time internships during the summer of 1994. These interns will survey the lighting systems in state-owned buildings throughout Nebraska and prepare reports recommending energy efficiency improvements. Interns will gain experience in practical energy conservation and technical consulting methods.

Interns must be highly motivated and able to work with minimal supervision. Each intern will be given background information on 40-45 buildings for which he/she will perform lighting surveys. The intern will be responsible to schedule an appointment, survey the lighting system and prepare a complete report on each assigned building.

Energy Office personnel will supervise the interns and provide training and individual help as needed, and will review reports to make sure they are complete and correct.

Wages. The pay rate is $5.50 per hour, from which taxes and social security will be deducted.

Other Benefits. Interns do not receive insurance benefits, paid holidays or vacation or sick leave. They are considered temporary full-time employees.

Reimbursable Expenses. Meal expenses are reimbursable up to $20/day, as long as they are taken as part of overnight travel. There is no reimbursement for meals on 1-day travel. Mileage is reimbursed at 27½¢/mile. You must present receipts and keep detailed records of actual expenses and miles driven.

Lodging Expenses. Overnight lodging will be reserved and paid directly from the Energy Office. You must plan your travel in advance so that appropriate arrangements can be made.

Personal Vehicle. This job will require extensive travel for which you must provide your own vehicle. You are responsible to maintain insurance on this vehicle. You must have a valid drivers license.

Physical Ability. Some physical agility is required for tasks such as climbing a ladder.

Office Hours. Normal office work hours are 8am to 5pm with a 1-hour lunch break. When you are not traveling, you should be in the Energy Office during these hours. The work week is limited to 40 hours with no overtime. If you are traveling outstate, you may need to arrange your schedule to quit earlier in the day on Friday to avoid exceeding 40 hours. This should be authorized in advance.

Schedule. Employment will begin May 11 with three days of training, and will end on August 12.

Holidays. State offices will be closed on May 30 and July 4, but interns are not paid for the holidays. You may arrange your travel schedule to work 40 hours during the balance of these weeks, or you may work short weeks. A limited number of personal holidays (without pay) may be authorized.

Independent Study Credit. Architecture students may receive independent study credit related to the summer work. You must arrange this with a faculty member prior to the summer.

Student Intern Interview Questions/Format

Name:______________________ Interviewed By:__________________

The interviews will be started with a review of the program, its purpose and the responsibilities associated with the internship positions.

1. You've had a chance to look at the job description, would you give us a brief description of your past employment and the type of responsibilities that are most relevant to this position.

2. In your previous work experience what type of direct contact did you have with clients? Were you comfortable with that contact? (We should clarify at this point that the interns selected will have direct contact with a large number of individuals and they will need to feel comfortable with this type of direct contact.)

3. Are you planning on receiving class credit through the College of Architecture for the internship program?

4. Are you planning on taking any classes during the summer sessions?

5. Are you physically able to make inspections that may include climbing?

6. Do you have any questions about the internships under the state level?

7. This position will require self-motivated people who need minimal supervision. You will need to schedule your travel and office time (within constraints) and be responsible for making timely progress on your assigned building surveys. Will you be able to work in this type of environment?

8. Are you confident with your math skills through the physics level?

9. Do you have any other questions?

10. How did you hear about the position?

11. Do you have anything that you would like to add that would explain your qualifications on why we should hire you for the position?

Example Reference Check Sheet
At least one reference was contacted for each applicant who scored well in the interview. Past employers were contacted first, followed by personal references if necessary.

Applicant Name: ______________________________

contacted: ______________________________
____
____

checked by: ____________________ date/time: ____________________

1. Verify dates of employment and job description:

2. What was your overall impression of this employee?

3. Was employee dependable and punctual?

4. Did employee show initiative in completing tasks?

5. Was employee able to work without supervision?

6. Did you have any reason to doubt the employee's integrity?

7. Did the employee have a good work attitude and respond well to supervision?

8. How did the employee interact with co-workers and clients/customers?

9. Would you hire this employee again?

10. Any other information which would help us make this employment decision?

Nebraska School Lighting Efficiency Program

Lighting Questionnaire And Survey Application

☐ I request a free lighting survey and report from the Nebraska Energy Office.

SCHOOL DISTRICT AND BUILDING IDENTIFICATION

School District or Organizational Unit Name	☐ Public ☐ Private	School Building Name
Street or P.O. Box		Building Address or Location

City	County	Zip Code	Name of Contact Person	Phone No. ( )

If you are applying for Lighting Surveys on more than one building, please complete one of these questionnaires for each building.

BUILDING USE INFORMATION

Total Square Feet Heated or Air Conditioned	Average Annual Operating Hours	Year of Original Construction: Year(s) of Addition(s):

Functional Use (check all that apply)
☐ Administrative ☐ Classrooms ☐ Maintenance ☐ Transportation ☐ Cafeteria ☐ Gymnasium /Athletic Complex ☐ Shop ☐ Other (specify) ________________

ENERGY SOURCE AND HISTORY INFORMATION

Primary Fuel Supplier Name	Alternate Fuel Supplier Name	Electricity Supplier Name

Complete the Energy Consumption History below using the most recent 12 month period

Primary Fuel Type:				Alternate Fuel Type:				Electricity			
Mo.	Year	Units	Dollars	Mo.	Year	Units	Dollars	Mo.	Year	Units	Dollars
			$				$				$
TOTALS				TOTALS				TOTALS			

UTILITY WAIVER

________________________________ authorizes the Nebraska Energy Office to obtain past, present
(District or Organizational Unit)
and/or future energy consumption information from the energy supplier(s) named above.

sign here ◆ ________________________________ Signature and Title of Certified School Representative ________________ Date

Be sure to complete the reverse side of the form.

Lighting Information:
For each area of your building please check the box which indicates the type of lighting in use. If you don't know, put a question mark in the box. If you have different types of lighting in the area, please check all appropriate boxes. If this type of area is not present in this building, indicate "not applicable". If your building has a number of additions and it is too difficult to summarize the different types of lighting in the additions, you may use more than one questionnaire.

Hallways: ☐ Incandescent ☐ Fluorescent ☐ Not Applicable ☐ Other: ____________ (Specify)

Stairwells: ☐ Incandescent ☐ Fluorescent ☐ Not Applicable ☐ Other: ____________ (Specify)

Classrooms: ☐ Incandescent ☐ Fluorescent ☐ Not Applicable ☐ Other: ____________ (Specify)

Exit Signs: ☐ Incandescent ☐ Fluorescent ☐ Not Applicable ☐ Other: ____________ (Specify)

Locker Rooms: ☐ Incandescent ☐ Fluorescent ☐ Not Applicable ☐ Other: ____________ (Specify)

Gymnasium: ☐ Incandescent ☐ Fluorescent ☐ Mercury Vapor ☐ Metal Halide ☐ Not Applicable ☐ Other: ____________ (Specify)

Cafeteria: ☐ Incandescent ☐ Fluorescent ☐ Not Applicable ☐ Other: ____________ (Specify)

Entrance/Lobby: ☐ Incandescent ☐ Fluorescent ☐ Not Applicable ☐ Other: ____________ (Specify)

Parking Lot & Outside Lighting: ☐ Incandescent ☐ High Pressure Sodium ☐ Mercury Vapor ☐ Metal Halide ☐ Not Applicable ☐ Other: ____________ (Specify)

Outside Lighting Control: ☐ Switch or Breaker ☐ Timer ☐ Photocell

Comments: ____

____

____

Nebraska Energy Office
State Capitol
Ninth Floor
P.O. Box 95085
Lincoln, NE 68509-5085
(402) 471-2867

State of Nebraska - Green Lights Program Building Data 04/22/93

Building Identification:

Building Identification:

____

____

____________, NE ____

County: __________

Legislative District: __

Contact: ____________________

Phone: (   ) ___ - _____

Building Owned or Operated by:

Agency Number: ____

Agency: ________________

Division: ________________

Contact: ________________

Phone: (   ) ___ - _____

Complex Name: ________________________

Building Use - Primary: ________________________

Secondary: ________________________

Operating Hours - Full Use: ______ hr/yr ("open for business")

Part Use: ______ hr/yr (additional for cleaning, etc)

Constructed In: ____ Construction Type: ____________________________

Remaining Life: ___ yrs Square Footage: _______ (net) # Floors: __

_______ (gross)

Primary Heating System: _______

Primary Cooling System: _______

Electric Utility: ____

city: ____________________ phone: (   ) ___ - _____

Is electricity metered ☐ at the individual building (meter# ____________)

or ☐ through a central meter? (if "central", what is the total area of the buildings metered through this central meter: ______________ sq.ft.)

Please complete this table using actual billings for this meter:

month	electricity		demand, if metered		total cost
	kWh	cost	kW	cost	
Jan					
Feb					
Mar					
Apr					
May					
Jun					
Jul					
Aug					
Sep					
Oct					
Nov					
Dec					
TOTAL					

Form Completed by: ____________________________ Phone: ____________

(please print)

Intern Training

While not providing actual training material for interns, this section should provide the supervisor and/or trainer with a clear understanding of the topics which should be covered and a training format which the Nebraska Energy Office has found effective.

Technical training for lighting surveys involves teaching interns that an ordinary phenomenon, artificial lighting which they have instinctively and unthinkingly used every day of their lives, does not just happen. There is a science, as well as an art, to providing an attractive and effective visual environment and there are good and bad designs for accomplishing this goal. The surveyor's job is to evaluate the current lighting system and visual environment and offer suggestions to improve the lighting while reducing electricity use and cost and resulting air pollution.

An effective training agenda for interns will combine a variety of learning experiences in different settings. Even though interns are used to taking notes in classroom lectures, that is not the most effective way to communicate either the concepts or skills necessary to become a proficient lighting surveyor. This training is the new interns' first exposure to the heart of the job. If selection has been done with care, interns will be capable of understanding the concepts in the technical training, but it is important to present the information in the proper sequence and paced so that interns with less technical backgrounds do not become discouraged.

A sample agenda for technical training is shown on page 39. Other topics such as personnel policies, administrative procedures and other non-technical items should be included at strategic points throughout the agenda. Five consecutive days of training can be fairly grueling, so the first day is typically on a Wednesday, providing three days of training, a weekend and then two final days of training the following week. The sample agenda emphasizes field experience in addition to classroom training. In the classroom, it is easy to lecture without providing clear motivation or a basis for evaluating information. Interns are used to receiving theoretical information in the classroom and then discovering that most of it is not really very useful in the field. The approach described here attempts to demonstrate in the field the sort of information which is vital to the interns' success. Once interns recognize the information they lack and why it is important, classroom training will be enhanced. Frequent changes of location and activity serve to keep everyone refreshed and alert as well as providing opportunities to consolidate what has been discussed so far and ask questions in smaller groups.

Electricity Fundamentals

Some basic electricity terminology is necessary in order to understand the electricity and lighting concepts involved in the rest of training, but there is no need for the student to become proficient in circuit analysis or other electric power

Sample Lighting Intern Training Agenda

Day One

- Program overview, goals and what to expect from the job
- Electricity and lighting fundamentals
- Walking tour of lighting equipment
- Lighting examples and calculations
- Lighting equipment overview and demonstration
- More lighting examples and calculations
- Introduction to economic analysis
- Demonstrate single-project calculation software

Day Two

- Introduction to whole-building analysis software
- Divide into trainer-led teams to survey sample rooms
- Enter survey data, run analyses, review results and compare
- Modify data and analysis parameters and rerun
- Use single-project analysis software to refine analyses

Day Three

- Divide into trainer-led teams (three-five persons) to survey small buildings
- Enter data, run analyses, review results and refine as necessary

Day Four

- Divide into trainer-led teams to survey medium-sized buildings
- Enter data, run analyses, review results and refine as necessary

Day Five

- Divide into teams of two or three without trainers to survey small buildings
- Enter data with trainers on hand to help with computer problems and questions

NOTE: Presentations on administrative and personnel policies, financial procedures and other non-technical items — maybe even some fun, team-building activities — should be interspersed throughout this agenda to break up the sessions.

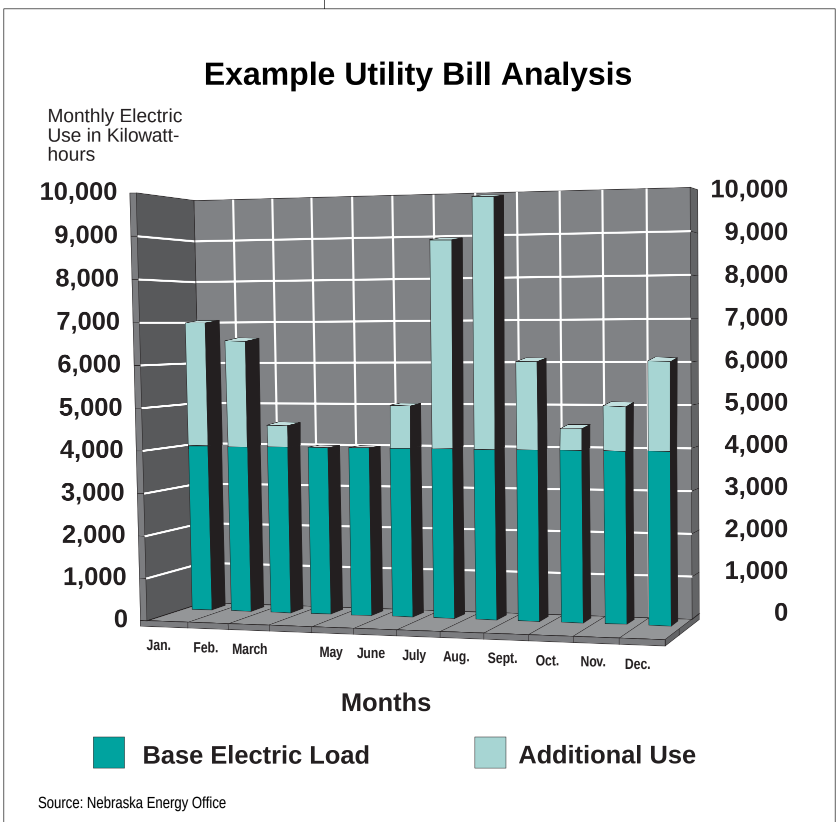
calculations. One of the most important concepts is a clear distinction between electric energy, measured in "kilowatt-hours," and electric power, measured in "kilowatts" or "watts." This is not an easy distinction — many professionals consistently confuse the terms.

Interns also need to become comfortable with the "kilo-" prefix so that they can instinctively convert between watts and kilowatts by moving the decimal point three places left or right, effectively multiplying or dividing by 1000.

"Volts" and "amps" do not need to be discussed at this time, but interns should be introduced to the idea of alternating current and the concepts of power factor and harmonics. Interns will encounter these terms when they read that a ballast features a "high power factor" or they are asked about "reduced harmonic" lamps, but there's little need for them to be able to discuss the subjects in detail. It's enough for them to recognize the terms, identify them as power quality issues and know to refer such questions to an authority.

Energy Versus Power

It is important to differentiate between kilowatt-hours, which measure the amount of energy delivered or used and kilowatts or watts which measure the rate at which the energy is supplied or used. These concepts can be communicated fairly clearly in the context of an electric bill. From the utility's perspective, power (or demand) represents the cost of providing electric service through equipment such as generators, distribution wires and transformers. The utility charges for demand to recover its fixed costs of owning and keeping this equipment available, no matter how much electric energy is actually used. Demand is measured by a meter which records only the maximum kilowatts — the highest rate of electricity use — each month. On the other hand, energy fees relate to the utility's variable cost of generating electricity, which is usually the cost of coal or other fuel. The more electricity is used, the more fuel has to go into the boiler. The energy charge is measured by a meter which adds up all the energy which flows through it during a month. Of course, there's a lot more to utility bills than these generalities, but it illustrates the point. This distinction should be discussed to the point that interns are able to understand which lighting efficiency strategies are likely to affect energy use only, and which also impact demand.



Reading Utility Bills

This largely-underrated skill helps keep the lighting surveyor in contact with the real world by focusing on the bottom line of actual energy use, demand and cost in the building to be surveyed. It is recommended to get copies of actual electric bills for twelve months for each building to be surveyed. When these are not available, most utilities can provide a 12-month transcript of charges. As a last resort, the building manager or bookkeeper can usually pick out the monthly electric cost from ledgers and you can work backward from the applicable electric rate schedule to calculate approximate electric bills.

A simple spreadsheet analysis of the billing data provides valuable clues about how much electricity is actually used for lighting. If the billed kilowatt-hours are displayed on a bar or line graph by months, the minimum month (or average of minimum months) usually marks the "base load" which is electricity used for lighting, fans and appliances. Variations in electric use above the base load are often caused by weather and may be unrelated to lighting as illustrated in the chart on this page. Multiplying the monthly base load by 12 months provides a convenient cap for energy savings. In a building with minimal fan and appliance use, where almost all base load electricity is used for lighting, it is unlikely that the most ambitious lighting efficiency program will save more than about 50 percent of this base load on an annual basis. As fan energy and appliance electricity requirements increase in relation to lighting electric use, the fraction of the base load which can reasonably be saved by lighting efficiency improvements decreases.[2]

[2]This is a rule of thumb only. In cooling-dominated buildings with large internal electrical loads and minimal heat loss through the skin, savings from lighting efficiency improvements may be higher than suggested by this method because the improvements also reduce the building's cooling load. This provides additional savings because less electricity is used by the lighting system and then less electricity is used by the air conditioner to remove the heat generated by the lights.

Energy costs can also be quickly calculated from this data. If demand is not metered separately and there is not a great difference between seasonal rates, simply dividing the annual electric cost by the annual kilowatt-hours use will give an acceptable price for most calculations. If you use modeling software which can handle more complex seasonal rates and demand charges, these can be calculated from the same data. The most conservative calculations will arise from reviewing the applicable utility rate schedule and using the energy cost from the highest block rate which applies for each month.

Finally, reviewing billing information prior to the survey can give clues about building use that might otherwise be missed. The intern may need to ask the building manager about the cause of peak usage in certain months. If a load factor is calculated from the demand bills, it may indicate periods of unusually heavy building use. The intern should verify this with the building manager and consider it in calculating the annual hours of lighting use.

Hand Calculations

Even if modeling software will be used for actual energy and cost savings estimates, interns should work out several energy-saving problems on paper with a calculator. This will solidify the numeric relationships in their minds and develop a habit of thinking critically about the relative magnitude of entry data and the savings that result. This thinking skill is vital in reviewing computer output and noticing results that “just don’t seem right” for a particular lighting upgrade. Example problems should involve changes in both power and hours of use. Several examples are shown at the end of this chapter starting on page 54. After working through these problems, interns will realize that the computer software is not doing anything they can’t understand or duplicate and that the value of the software is that it does repetitious calculations quickly and accurately. This will give interns confidence to spot check results and seek an explanation if answers don’t look right.

Pollution Prevention

While discussing electric energy, it’s a good time to talk about the environmental benefits of energy efficiency. If fewer kilowatt-hours are used by the lighting system, then fewer need to be generated by the utility. Since most electric generation involves the release of undesirable gases — nitrogen oxides, sulfur oxides and carbon dioxide — to the atmosphere, any decrease in the electricity used by the customer will cause a proportional decrease in these atmospheric emissions. The exact proportion of emissions reduced will vary by location and season, depending on the mix of generation equipment and fuel used by each utility. Although the main focus of the calculations is reducing wasted electricity and saving dollars, interns should learn that the lighting improvements they recommend will have a direct impact on preventing air pollution as well.

Lighting Fundamentals

The chapters on lighting fundamentals and upgrade technologies from the GreenLights *Lighting Upgrade Manual* have been used successfully in intern training and are recommended as both a trainer resource and a handout. These and other training materials are available from sources listed starting on page 58. Rather than repeating the information in these sources, this chapter will focus on training techniques needed to use these materials effectively.

Walking Tour of Lighting Equipment

Trainers should resist the temptation to plunge directly into a daylong classroom session on lighting equipment. Initially, it is best to provide some very basic lighting concepts, introduce the various lighting sources and then take interns out to explore the streets, observing lamps in their natural habitat. In most settings, it is not difficult to find examples of 20 or 30 different lamps and luminaires within a few blocks of the training facility. Trainers should scout out the most interesting luminaires ahead of time and then lead a 30- to 45-minute tour of the lighting devices. This is an excellent time to introduce characteristics of various sources, such as experiencing the color of rooms with cool white fluorescent lamps compared to those using warmer color lamps or noting that recessed downlights may have incandescent, compact fluorescent or high intensity discharge lamps. If a switch is accessible and the building manager doesn't mind, flicking a high intensity discharge lamp off and then on will provide a graphic example of warm-up/restrike time requirements, to be discussed later in the classroom. Other interesting features might include a noisy ballast, an incandescent lamp placed back into a compact fluorescent retrofit by an unthinking custodian and an occupancy sensor — the one controlling the automatic door is no different from those that control lights. Finally, this is an opportunity to comment on the rampant lighting waste that will undoubtedly be noticed.

Vocabulary

The science of illumination has a large vocabulary all its own which can be overwhelming at first. While there is value in using the correct terminology, the intern forms a unique bridge between the professional illuminating engineer and the non-technical building manager and it is not desirable to encourage the intern to talk like the professional designer. A few, well-defined terms will suffice for most survey work. For example, it is acceptable for the intern to speak of a "fixture" rather than a "luminaire," as long as it is understood that the term includes all the parts necessary to convert electricity to light and direct that light to the task for which it is intended.

"Watts" do not measure light output. Most interns, along with the rest of the general population, think of light levels in terms of the wattage of an incandescent lamp it takes to provide the desired illumination. "Watts" measure the electric power supplied to the lighting equipment or luminaire. Light output from a lamp is measured in "lumens" and the illumination falling on a surface is measured in "footcandles." Except when looking directly at a light-producing object, what our eyes actually see is the light energy reflected by a surface.

A particular lamp's effectiveness at converting electric energy to light is measured in "lumens per watt." Technically, this value is called "efficacy" rather than "efficiency" because it is not expressed in consistent units. Conceptually, it *is* the efficiency of conversion and there is little reason to make a hard distinction between the terms. All the electric energy that goes into the lamp is converted to heat or light and the most efficient lamp is the one which provides the most visible light for a given input.

Absorption, Reflection and Transmission

Interns should understand that light obeys the "law of conservation of energy." When light energy strikes a surface, three things can happen to it. It may be reflected back or transmitted through the material as light or it may be absorbed and change to heat energy. This has implications for luminaire design. The most efficient luminaire is the one in which the minimum amount of light energy is absorbed by the luminaire itself, leaving most of the light to exit the luminaire via reflection and/or transmission and perform a useful lighting function. Ultimately, all the electricity consumed by the lamp and ballast becomes heat energy, which helps heat the building during the winter,[3] but requires extra cooling during the summer.

Colors of Light

Light is a form of energy called electromagnetic radiation, which also includes radio/television signals and microwaves. The portion of the spectrum called "visible light" is special because human eyes can detect it. Without these light waves entering the eye and stimulating the retina, there is no seeing. Sunlight and all "white" light sources, are a mixture of all the colors in the spectrum or rainbow and the color we use to describe any particular object is actually the color of light that it

[3] Additional heat may be required in the winter to replace reduced lighting energy after a lighting upgrade. If the building is heated by electric resistance, savings may be reduced or eliminated during the coldest months. Other forms of space heat are generally cheaper than electricity, so savings reduction will not be as great. In most temperate climates, it is safe to ignore heating and cooling interactions by assuming that normal summer savings will offset any winter penalty.

reflects to our eyes. For example, a "red" object reflects red light and absorbs all other colors of light shining on it.

Since human eyes expect to see objects under white light, our brains try to interpret a scene in a way that balances it to white. We feel that we can see objects with their "proper" colors under a residential-type incandescent light and also in full sunlight, but if these two light sources are placed side-by-side, the objects under the incandescent light look yellow-orange compared to those in the sunlight. And objects illuminated by sunlight look blue compared to objects under the incandescent light. Interns should understand that there are objective measurements of color, the correlated color temperature and color rendering index, but there are also subjective effects which may affect the importance of those measurements.

Electric Light Sources

It is not necessary for interns to understand everything about producing light from electricity, but the concepts are not difficult and most interns will be curious and easy to teach on these points. A working knowledge of how lamps convert electricity to light will enable the intern to understand why some designs are inherently better than others for certain applications.

Lighting Showrooms

Lighting showrooms or training centers have been established in many larger cities. They may be operated by a utility, lighting vendor, university or professional organization. It is well worth the effort to locate one of these showrooms and plan at least a half day of training there. A showroom provides an excellent opportunity to give interns a close look at many lighting products. The opportunity to consider a particular feature while actually holding the lamp makes the learning experience much more effective. Teaching lamp identification in the showroom where the model number and wattage are clearly printed on each lamp is a bit artificial, but it provides an opportunity to discuss the internal structural and mechanical features which will permit identification of unmarked or poorly marked lamps in the field. The showroom also provides an opportunity to compare different light sources in terms of color temperature, color rendering ability, warm-up/restrike time, noise and flicker, reinforcing many of the concepts taught in the classroom.

Lighting System Identification

Lamp Identification

Initially, this is the part of the lighting survey which is most difficult. Most interns have never thought of light as coming from anything other than a "light bulb" and are overwhelmed by the variety of lamps they encounter in the field. The best approach is to point out the most common lamps first and then discuss unusual lamps in comparison to those usually found. This is much more effective than merely presenting a list of lamp options with no guidance as to which are most important for the intern to know. Once interns learn to recognize the typical lamps found in buildings, an unusual lamp can usually be identified by reference to a lighting catalog. It is a good use of some informal time to simply have interns page through several manufacturers' catalogs and note the many different products available.

If lamps are clearly marked and easily viewed, identification is usually not difficult. Here are some tricks for making that identification:

- The general lamp type — incandescent, quartz-halogen, fluorescent and various types of high intensity discharge — is usually obvious by observing the color and shape of the operating lamp.
- Full-sized fluorescents in louvered fixtures often have at least one tube where the identifying information can be read from the floor. Lensed fixtures must be opened to read the manufacturer's markings. Many tubes that are marked "F40," actually draw 34 watts, so you must read all the text printed on the lamp. After a little experience, interns will learn to differentiate a T-8 from a T-12 lamp at a distance.
- Interns will need to become adept at climbing. A ladder is the preferred means to get close to a luminaire, but a solid desk or table will often work.
- A fluorescent luminaire must be opened and usually a pair of tubes removed to access the channel where the ballast is located. If the ballast is too dirty to read, it is probably a standard electromagnetic ballast. Efficient electromagnetic ballasts have a circled "E" on their label. Some electronic ballasts are obvious because of their squared corners and cooling fins, but others are the same shape as electromagnetic units and must be identified by reading the label. If a ballast is leaking, you should notify the building manager.
- When opening a fluorescent fixture, there are usually clips at two or all four corners. Normally, the lens or louver is hinged on one side, but sometimes it pivots on free pins, providing an excellent opportunity to drop the whole unit.
- Many incandescents and some high intensity discharge lamps have the manufacturer's markings printed on the end. In downlights, this information is often visible from the floor. If the lamp can be switched off momentarily, the information can be read, sometimes with the aid of a small flashlight. If the lights can't be switched off, the data can often be read from an operating lamp with the aid of a "pinhole camera." This is a tiny hole poked through a paper or card. A

small aperture can be formed between the tips of three fingers for another viewing method. When the operating lamp is viewed through this aperture, it is much less bright and any printing appears in sharp focus.

- Reflector lamps may have markings on the back of the reflector. This may require removing a hot lamp from its luminaire, so it's a good idea to carry a handkerchief to protect your fingers.
- With a little practice, the wattage of compact fluorescent lamps can usually be determined by the shape and length of the tubes.
- Almost all exit signs can be opened by removing one or two small screws on one of the faces or the bottom. Sometimes the face is snap- or friction-fit and can be gently pried loose.
- Unmarked lamps can be sketched and any characteristic noted for later identification from a lamp catalog.
- If access to a lamp is not possible, look for a similar lamp in a supply closet or ask the custodian.

Occasionally, a lamp cannot be identified. But over time, experience will prevent this from occurring often.

Luminaire Identification

The importance of identifying luminaires depends on the type of analysis being used for the survey. Some calculation software requires detailed luminaire information and some does not. In any case, the luminaire should be described accurately enough that readers of the report can locate the luminaire to which a particular recommendation applies. Identification is largely a matter of learning the vocabulary; this takes time in the field. Review of manufacturers' catalogs will also help acquaint interns with common terminology. In most cases, interns should be taught to identify luminaires in terms of the light source, dimensions and any shielding material such as a globe, lens or louver.

Control Identification

Normally, training for identifying controls consists of simply showing examples of the various control types available and describing their operation and appropriate applications. During a building walk-through, interns will learn to look around or ask building occupants if switches or other controls cannot be found. The building operator can usually provide a quick summary of installed controls and their operation, either during the walk-through or in a pre- or post-survey interview.

Energy Efficiency Concepts and Practice

Interns should learn a systematic approach to understanding and controlling lighting energy use. Initially, everyone just learns standard substitutions. That is acceptable at the beginning, but eventually interns need to think of lighting energy in terms of power and time, rather than in terms of "incandescent lamps are bad" — a trivial statement which is not always true. Normally, the progression to consider in saving lighting energy is matching the illumination to the task, producing and delivering light efficiently and controlling lamp operation.

Match the Illumination to the Task

Interns must consider the tasks normally performed in each space and the amount of illumination necessary for people in that space to perform their jobs effectively and comfortably. The natural assumption that "more light is better" is not necessarily true. It is also not always true that the best light level for a task is the level currently provided. Interns should measure the illumination in various areas, but it is just as important to talk to the people working in those areas. Do they feel like they have enough light to do their job effectively? Are there glare problems from too much light, inappropriate luminaires or work surfaces poorly located in relation to the luminaires? Sometimes a simple suggestion to relocate a floor lamp will increase visual comfort dramatically. Other problems such as a buzzing ballast or flickering tube should be brought to the attention of the maintenance people or noted in the survey report. Wherever the intern recommends that light levels be changed significantly, it is wise to record workplace footcandles formally. Then the proposed changes can be justified, if necessary.

Produce and Deliver Light Efficiently

At first, delivering light efficiently seems like the main goal of lighting surveys because interns typically just suggest a list of common substitutions. Often that's the right approach, but it can lead to missed opportunities or wasted money. The real question is, "how can the illumination required for the task be provided using the least electricity." A systems approach suggests working backward from the task to the electric wiring. Should walls be repainted a lighter color? Should luminaires be repositioned or task lights introduced? Can the luminaire be made more efficient or replaced with a more efficient design? Should the lamp and/or ballast be improved to provide more light output for less electricity?

Control Lamp Operation

It is important that the controls be appropriate to the space, the tasks and the luminaires being controlled. Occupancy sensors are state-of-the-art technology and will undoubtedly continue to be very important in reducing energy waste, but they are not the only control available. In a small room such as a supply closet or private bath, it may save more energy to leave a 100-watt incandescent in place and control it with a door switch or twist-timer. Automatic timers can be used to customize occupancy sensors, so that less light is provided during off hours, even when the space is occupied. Occupancy sensor controlled lights can also be considered a security device, so that hall lights don't need to always be on to discourage vandalism. Dimmers and bi-level controls for fluorescent and high intensity discharge lamps should also be suggested when appropriate.

Training for Lighting Surveys

Training interns to do lighting surveys is best done in small steps. Start by surveying the classroom and a few rooms nearby. Walk through these with small groups of interns, demonstrating how to open luminaires to identify the lamps and ballasts and how to measure dimensions, estimate reflectances, measure the illumination and evaluate the overall visual environment. Through all of this, explain not only what is being done, but why. At first, the trainer will be doing all the work and interns will be taking notes and standing in awe. But once a task has been demonstrated, interns should be selected to repeat the tasks at the next opportunity. Get interns involved as quickly and as much as they are able. Watch for those who hold back — they may need some extra coaching or an invitation to get their hands dirty.

Interns should take the data collected in this demonstration survey and make energy-saving recommendations based on hand calculations or enter the data in a modeling program and draw conclusions. This is also best done in small groups. Results should be compared between the various groups and discussed by the trainer. There is a natural tendency at this point to compete for the fastest payback or highest rate of return. This provides a convenient opportunity to remind interns that these are not the survey goals. If savings opportunities exist in a building, they should be discovered; if not, there's nothing the surveyor can do but report that fact. The quality of the survey and subsequent report is not measured by its benefit-to-cost ratio, but by its completeness, accuracy and usefulness.

After the initial demonstration survey, several more training surveys of increasing complexity should be performed. A small building, with 8-15 rooms is about right for the second survey, while the third should be a building of 20-30 rooms or a portion of a larger building. The trainer should lead these surveys, but do less and less survey work as training progresses, eventually becoming an adviser in the background and offering comment only about features that may have been overlooked by the interns. After each survey, calculations should be completed, recommendations made and results discussed.

Finally, interns should be divided into groups of two or three and sent out to survey a small or medium-sized building without the trainer. However, the trainer should be available for questions when interns return to perform the analyses. The whole point of this progression has been to get the interns to work independently, yet know when to ask questions of the trainer or supervisor.

Building Survey Techniques

Interns should be trained to collect as much data prior to the on-site survey as possible. Basic information about each building, including electric bills and floor plans, should already be on file. This should be reviewed and an estimate made of the time required for the walk-through. Electric base load and prices should be calculated from the bills and room lists prepared from the plans. If plans contain sufficient detail, room dimensions and sometimes fixture counts can also be noted. If these have not been provided, the intern should request them when making an appointment for the walk-though survey. On-site time can be reduced and made much more effective with this type of preparation.

When the intern arrives at the building site, it is a good idea to drive or walk around the perimeter or at least inspect what is visible from the parking area. Plans should be oriented to the building. This will indicate any special areas that the building manager should be asked about. It may also highlight exterior lights, which the building manager might have overlooked.

Inside the building, the intern should meet with the building manager to review the purpose and procedures to be used in the survey and verify the information which has been provided previously. If no one from the building staff will be accompanying the intern, verify that building occupants have been notified of the survey and ask the proper procedure for surveying locked areas. Finally, take this opportunity to ask the manager or maintenance person about current maintenance practices, normal lighting replacements and any recent lighting improvements. These items should be verified by actual inspection, but asking this information will give the intern an idea of what to look for and what management considers “good” lighting practice.

Finally, it is time to begin the room-by-room survey. Depending on program parameters, the intern may be inventorying all lights in the building or just those which are attached to the building (unlike desk and other task lights) and are likely to be upgraded. In each space, the intern should record the data necessary for the intended analysis. This may be just the electrical characteristics of certain luminaires — lamp type, wattage and number — or it may include room dimensions, reflectances, current illumination levels, tasks performed in the space, any special use schedules and comments or complaints by occupants of the spaces being surveyed. Data collection forms should be provided during training — these serve as a guide and checklist to make sure that no information is missed. The items marked on the data forms may differ depending on the goals of the survey program, the analysis methods being used and the completeness of the inventory expected. After training and some experience, interns may find that they can customize their data entry forms or even keep notes on a clean copy of the building plans.

Interns should inspect lamps and ballasts in several luminaires of each type. These may be selected randomly in the first few rooms. If everything is as expected, the remainder of the luminaires of that type may be assumed to be similar. In a large building, however, it is wise to continue occasional spot checks on luminaires.

Controls for each group of luminaires should be identified, although not all analysis software will require this level of detail. Where electronic or mechanical timer controls are in use, the intern should verify that controls are correctly set.

In addition to measuring illumination with the lightmeter, the intern should get in the habit of discussing the lighting with a few occupants in each space. Normally, individuals who ask the intern about the purpose of the survey will volunteer opinions about the lights. Rather than general comments such as, "these lights are terrible," it is much more valuable to ascertain what features of the lights are "terrible." Is the problem the amount of light or does it result from shadows, glare, reflections, flickering tubes, buzzing ballasts or dirty luminaires? Sometimes a simple suggestion on task arrangement or maintenance procedure will be a welcome solution. The intern must balance the information gained by unobtrusive interviews with both the need to complete the survey and the need to not interfere with employees' work.

There are many lights which aren't anyone's "responsibility." These are the exit sign lights, vending machine lights and exterior lights that few of the building occupants or users even notice. Often, these are in use constantly or for many hours each day and upgrades can provide significant savings even if the wattages of individual lamps are not large. Interns will need to be reminded several times to notice these luminaires which are easily ignored.

Lighting Project Analysis

Time requirements and methods to train interns to estimate energy savings from recommended lighting upgrades will depend on the analysis method selected for the program. If hand calculations or a single-project computer program such as a spreadsheet are being used, training will consist of a number of example problems with discussion of both the appropriate upgrade recommendations and calculation methods for each situation. Comprehensive lighting modeling software will make recommendations and handle the calculations, but requires training on proper data entry techniques, review of the results and error recovery. Even with modeling software, some time must be spent on discussing appropriate upgrades and calculations so that interns are able to handle special situations where the model does not give an appropriate solution.

Project Costs

Interns must be provided with reliable cost estimates for typical lighting equipment and upgrades. It is not possible for the supervisor to foresee every possible upgrade and estimate a cost, but the more information that can be placed in the intern's hands, the more confident the intern will feel in recommending creative solutions. Generally, both equipment and installation costs for replacement or retrofitting of all common luminaires and installation of controls should be provided.

With open purchasing contracts, equipment costs are relatively easy to obtain. In other cases, several lighting suppliers may need to be consulted to determine typical costs. Installation costs may be developed from contractor's guides such as *Means Electrical Cost Data* or provided by local contractors.

One of the great benefits of some modeling programs, such as the Decision Support Software and ProjectKalc distributed through the GreenLights program, is that they have internal databases of project costs. ProjectKalc also contains provisions to modify equipment costs based on local purchase and installation experience.

Benefit-Cost Analysis

The simplest sort of financial analysis is the "simple payback." It is easily explained, but intuitive enough that it usually needs no explanation. If you include annualized maintenance cost changes along with the electricity savings, simple payback usually gives the same answer as more sophisticated methods. It is a good teaching tool to give interns a feel for the purpose of benefit-cost analyses. Then more sophisticated methods can be explained by comparison.

Within federal and state governments, attention has been shifting toward life-cycle cost as a means of comparing the benefits and costs of decisions. Simple payback is a step toward replacing lowest first cost as the purchase criterion, but life-cycle costing techniques usually refer to financial analyses which include the time-value of money and the effects of inflation, maintenance and taxes. There are a number of these measures, all closely related, such as internal rate of return and annual, present or future equivalent values.

It is not necessary for the intern to become proficient in these analyses or to understand their derivation. However, interns should learn what a particular analysis means to your program's target buildings. This will serve as a guide as to which lighting improvements to recommend. For example, if it has been determined that building managers favor projects with an average simple payback of three years and will not consider any project with simple payback exceeding seven years, the intern has a lot of guidance in how to proceed with the analysis and what to include in the report. EPA's GreenLights program requires installation of all upgrades which meet a minimum internal rate of return threshold. In this case, interns should have a general understanding that internal rate of return may be compared to the rates of return generated by other investment opportunities.

Continuing Education

There is no way that interns can be expected to retain everything that has been discussed as part of this technical training curriculum. It is wise to plan several additional training meetings over the first few weeks to deal with questions which come up in the field. Some questions can be handled best in discussion with the individual intern. Others have wider applicability and should be reviewed by the group for everyone's benefit. Interns should be encouraged to keep a journal of problems and questions that they encounter. These journals provide a convenient starting point for planning additional training to meet the interns' needs.

Additional training meetings also provide an opportunity for quality-control checks and fine-tuning of survey and analysis methods. After interns have had a few weeks of experience, it may be helpful to have the trainer or supervisor walk through the same building after an intern has finished, to see what might have been missed. This sort of performance review can be threatening if not understood as a normal and necessary part of the training process — it is not a final exam, but an evaluation of how successful the training was and what still needs to be learned. The same sort of performance review can be applied to analysis techniques and upgrade recommendations. Deficiencies in technique, performance or understanding must be dealt with individually or in the group to assure an overall high-quality survey program.

In addition to reinforcing the concepts and skills in the original training, continuing education can provide enrichment in topics such as lighting design methods and code requirements. There is so much for interns to learn about identifying lamps, surveying buildings and making appropriate upgrade recommendations, that it is inappropriate to discuss lighting design in the initial training. Later on though, you may find that interns have developed a "one-for-one" replacement mentality and need to think in larger terms, asking questions such as, “what would an ideal lighting system for this space look like?” Training interns to design lighting systems from scratch will increase their overall understanding of lighting efficiency. Interaction with lighting codes and power budgets, such as that found in *ASHRAE/IES Standard 90.1-1989*, is another good way to expand the interns’ frames of reference. The point of these activities is not for interns to design lighting systems, but to encourage them to think in larger terms than merely replacing lamps or even fixtures. True, most of their survey work will involve simple replacements, but expanding their perspectives a little will give interns a more knowledgeable perspective on the upgrades they recommend.

Finally, continuing education will add to the interns’ general understanding about energy efficiency and the need to consider energy costs in design and operating decisions. For many, this internship is the first of many exposures to energy issues during a professional career. If you are able to instill an energy-efficiency ethic and teach the interns to think critically about energy issues and pollution prevention, you will indirectly affect many decisions which will be made in future years. Therefore, it is appropriate to provide introductory-level information on subjects other than lighting. These might include other building topics such as envelopes, mechanical systems and landscaping and also societal energy, environmental, economic and national security issues. The interests and career directions of the interns should figure strongly in the choice of topics presented. Don’t be confined to lectures — consider guest speakers, field trips and videos or assign short reports on areas of special interest. These activities demonstrate a concern for interns’ professional development and will make the internship experience more valuable for them.

Pages 54-57 are examples of lighting and power problems and training materials developed by the Nebraska Energy Office.

Example AC power and lighting problems used for training student interns.

1. How much electricity will a 60W incandescent lamp use over its 1000-hour rated life?

60 W × 1000 hr/lamp = 60,000 Wh/lamp = 60 kWh/lamp

2. A 60W lamp is left "on" constantly. What is the yearly cost for electricity for this lamp at 5¢/kWh?

60 W × 8760 hr/yr = 525.6 ≈ 526 kWh/yr, @ 5¢/kWh = $26.30/yr

3. Each 60W lamp costs 50¢ and the staff time to change this bulb is estimated at $1 per change. The lamp has a rated life of 1000 hours. What is the labor and material cost to operate this lamp for a year?

8760 hr/yr ÷ 1000 hr/lamp = 8.76 lamp/yr
(you can't buy 0.76 lamps, but you can use that amount of a lamp's life)
8.76 lamp/yr × ($0.50 + $1.00)/lamp = $13.14/yr

4. What is the total annual cost to own and operate this lamp?

$26.30 (electricity) + $13.14 (material & maintenance) = $39.44/yr
(note that ⅔ of the owning cost is for electricity)

5. Could the building manager save money by substituting a long-life (2500 hour) lamp, costing $1.00, for this application?

8760 hr/yr ÷ 2500 hr/lamp = 3.50 lamp/yr
3.50 lamp/yr × ($1.00 + $1.00)/lamp = $7.00/year
(same electricity costs as for standard lamp, see problem 2)

total owning cost = $26.30/yr + $7.00/yr = $33.30/yr, yes, a 16% savings

6. Long-life incandescents provide less light for the same amount of electricity. Would this substitution be a good idea if a 75W long-life bulb (same cost) became necessary?

75 W × 8760 hr/yr = 657 kWh/yr, @ 5¢/kWh = $32.85/yr
(same material and maintenance costs as problem 5)

total owning cost = $32.85/yr + $7.00/yr = $39.85/yr, no, a 1% cost increase

This example illustrates the difference between electric energy and demand. It works fairly well when the table is displayed on an overhead while a story is told about a couple of college sophomores who come down to their rented apartment for a 10-hour party one summer day, compared to a grad student who spends most of his time at school and just comes home to sleep. The power requirements are just made up to illustrate the differences if these apartments were billed for demand compared to energy-only.

Also, note that the apartment with the level load factor (grad student) pays about the same, no matter which billing schedule is used. This illustrates why residential accounts are usually billed for energy only, with the demand assumed to average out over a month

Average Electric Load (W)	Sophomores	Grad Student
air conditioner	2500	200
lighting	1000	150
hot tub heater	3000	-
refrigerator	1500	150
stereo (1000W amp)	1000	-
miscellaneous	1000	40
Total Demand (kW)	10,000W = 10 kW	540W = 0.54 kW
× hours/month	× 10 hours	× 6 hr/day × 31 days
Energy Used (kWh)	100 kWh	100 kWh
Non-Demand Billing Example		
Energy Charge Total Bill	100 kWh @ 5½¢ $5.50/month	100 kWh @ 5½¢ $5.50/month
Demand Billing Example		
Energy Charge	100 kWh @ 3¢ $3.00	100 kWh @ 3¢ $3.00
Demand Charge	10 kW @ $5 $50.00	0.54 kW @ $5 $2.70
Total Bill	$53.00/month	$5.70/month

EXAMPLE

This problem addresses the recurring question, "is it cheaper to leave fluorescent lamps on if you'll only be gone a short time?" The rated life of fluorescent lamps is based on a 3-hour per start cycle. According to the IES Handbook, expected life should increase by 7% and 36% if the lamps operate 4 hours and 9 hours per cycle, respectively.

Problem: An office is lighted by 40W fluorescent lamps and is used nine hours a day, 200 days per year. Is it cheaper to leave the lights on all day, or to turn them off for an hour at noon while the occupant is at lunch? Use the following data:

rated lamp life (3-hour cycle) = 20,000 hours
lamp costs = $1.00 (purchase) + $2.00 (labor) = $3.00/lamp
electricity cost = $0.05/kWh

Solution: Since we don't know the number of lamps, we will solve for a single lamp.

Solution	Leave "ON"	Turn "OFF"
annual hours of use	200 days/yr × 9 hr/day = 1800 hr/yr	200days/yr × (4+4)hr/day = 1600 hr/yr
expected life (graph)	20,000 hr × 1.36 = 27,200 hr/lamp	20,000 hr × 1.07 = 21,400 hr/lamp
lamps per year	1800 hr/yr ÷ 27,200 hr/lamp = 0.0662 lamp/yr	1600 hr/yr ÷ 21,400 hr/lamp = 0.0748 lamp/yr
lamp cost	0.0662 lamp/yr × $3.00/lamp = $0.20/yr	0.0748 lamp/yr × $3.00/lamp = $0.22/yr
electricity cost (40W rated lamp)	40W × 1800 hr/yr = 72 kWh/yr 72 kWh/yr × $0.05/kWh = $3.60/yr	40W × 1600 hr/yr = 64 kWh/yr 64 kWh/yr × $0.05/kWh = $3.20/yr
total owning cost	$0.20 + $3.60 = $3.80/yr	$0.22 + $3.20 = $3.42/yr

This example shows that cycling fluorescent lights affects the number of hours that the lamp can be expected to operate. However, it also reduces the annual operating hours, so that the actual effect on years of service is not significant. In either case the electricity cost far exceeds the purchase and installation cost of the lamp. There will be some break-even point where the extra cost of lamp replacement becomes more expensive than the electricity saved, but that point is difficult to calculate and the effect is small in any case. We recommend turning off fluorescents unless you know that you will be back within a minute or two.

This problem, with floor plans and a lighting plan, was given about halfway through the program to encourage interns to think more creatively about lighting upgrades, rather than just recommending one-for-one replacements.

Lighting Design Problem

Problem: Redesign the lighting for the first and second floor lobbies and stairs in the Nebraska Center for Continuing Education to produce the most efficient lighting system appropriate to these spaces. Estimate the annual electric cost for your design.

Parameters

- freehand sketches with short explanations are fine — please, no boards or other fancy renderings.
- You may assume these spaces are in line for major cosmetic changes or you may assume lighting upgrades for energy efficiency only — state your assumptions and then design accordingly.
- Designs will be presented (2-3 minutes each) at the meeting on Friday, July 29.

Information

- All lights are used 24 hours a day.
- Electricity costs $0.02/kWh with no demand charge.
- The first floor lobby is the check-in area for the hotel as well as providing circulation and assembly space, display areas and a casual sitting/meeting space.
- The second floor lobby is primarily used for circulation, conference registration and refreshment breaks.
- The stairs are, well ... stairs I guess — things you walk up and down.
- Current electric cost: 16.025kW × 8760hr/yr = 140,379 kWh/yr @ 2¢ = $2808/yr.

Selected References[4]

Individual Listings

***Advanced Lighting Guidelines: 1993*, Electric Power Research Institute (EPRI)/California Energy Commission (CEC)/United States Department of Energy (DOE), May 1993.**

EPRI, the CEC and the DOE have collaborated to produce the 1993 update of the *Advanced Lighting Guidelines* (originally published in 1990 by the CEC). The *Guidelines* include four new chapters that address lighting controls. This series of *Guidelines* provides comprehensive and objective information about current lighting equipment and controls.

The *Guidelines* address the following areas:

- Lighting design practice
- Computer-aided lighting design
- Luminaires and lighting systems
- Energy-efficient fluorescent ballasts
- Full-size fluorescent lamps
- Compact fluorescent lamps
- Tungsten-halogen lamps
- Metal halide and high pressure sodium lamps
- Daylighting and lumen maintenance
- Occupant sensors time-scheduling systems
- Retrofit control technologies

Besides providing technology overviews and applications, each chapter concludes with guideline specifications to use in accurately designating lighting upgrade components. The *Guidelines* also tabulate representative performance data, which can be very difficult to locate in product literature.

To obtain a copy of the *Advanced Lighting Guidelines: 1993*, contact your local utility if your utility is a member of EPRI. Otherwise, call the CEC at 916-654-5200.

***Applied Illumination Engineering*, Jack L. Lindsey, 1991.**

The Association of Energy Engineers uses this text to prepare applicants to take the Certified Lighting Efficiency Professional examination. This 480-page book is particularly useful for learning about illuminance calculations, basic design considerations and the operating characteristics of each light source family.

It also provides application guidelines for industrial, office, retail and outdoor lighting.

You can order this textbook from the Association of Energy Engineers by calling 404-925-9558.

***ASHRAE/IES Standard 90.1-1989*, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and Illuminating Engineering Society (IES), 1989.**

Commonly known as *"Standard 90.1," ASHRAE/IES 90.1-1989* is the efficiency standard that GreenLights participants agree to follow when designing new lighting systems. *Standard 90.1* is currently a national, voluntary consensus standard. However, this standard is becoming law in many states. The *Energy Policy Act* of 1992 requires that all states certify by October 1994 that their commercial energy code provisions meet or exceed requirements of *Standard 90.1*.

GreenLights participants only need to meet the lighting system portion of the standard wattage per square foot. *Standard 90.1* sets maximum wattage densities or wattage per square foot for lighting systems based on the type of building or expected uses within each space. The lighting portion of *Standard 90.1* does not apply to the following: outdoor manufacturing or processing facilities, theatrical lighting, specialty lighting, emergency lighting, signage, retail display windows and dwelling unit lighting. Daylighting and lighting controls receive consideration and credits and minimum efficiency standards are specified for fluorescent lamp ballasts based on the Federal Ballast Standards.

You can purchase *Standard 90.1* by contacting ASHRAE at 404-636-8400 or IES at 212-248-5000.

***Illuminations: A Training Textbook for Senior Lighting Technicians*, InterNational Association of Lighting Management Companies (NALMCO), First Edition, 1993.**

Illuminations is a 74-page course workbook for use by Apprentice Lighting Technicians (NALMCO designation) for upgrading their status to Senior Lighting Technician. The workbook, with answers

[4] Excerpted from *Lighting Upgrade Manual,* GreenLights Program, U.S. Environmental Protection Agency

provided in the back, consists of seven chapters, each with a quiz for self-testing:

- Service basics including electricity, instrumentation and disposal and similar issues
- Lamp operation including lamp construction and operation — all types and color effects
- Ballast operation including fluorescent and high intensity discharge ballast components, types, wattage, ballast factor, harmonics, starting temperature, efficacy and replacement
- Troubleshooting including visual symptoms, possible causes, explanations and/or remedies
- Controls including photocells, time clocks, occupancy sensors, dimmers and energy management systems
- Lighting upgrade devices and technologies including reflectors, compact fluorescents, ballast upgrades, correcting overlit situations, lenses and louvers, high intensity discharge conversions and measuring energy effectiveness
- Emergency lighting including exit signs, fixture types, applications, batteries and maintenance

Illuminations is clear and understandable. The publication's greatest strength is its extensive illustrations and photos, which help to clarify the ideas discussed. The textbook for Apprentice Lighting Technicians is also available — entitled *Lighten Up* — and is recommended for newcomers to the lighting field.

To order, call the NALMCO at 609-799-5501.

***Lighting Management Handbook*, Craig DiLouie, 1993.**

This 300-page non-technical reference provides a clear overview of lighting management principles. It places special emphasis on the importance of effective maintenance and the benefits of a well planned and executed lighting management program. The contents are organized as follows:

- Fundamentals and technology
- The building survey
- Effective illumination for people
- Retrofitting economics
- Maintenance
- Retrofitting financing
- Green engineering or environmental impacts
- Getting help
- Success stories

In addition, the book's appendices include general technical information, worksheets and product guides. To purchase this reference, call the Association of Energy Engineers at 404-925-9558.

Electric Power Research Institute (EPRI)

***Commercial Lighting Efficiency Resource Book*, EPRI, CU-7427, September 1991.**

The *Commercial Lighting Efficiency Resource Book* provides an overview of efficient commercial lighting technologies and programs available to the end-user. Besides providing an overview of lighting conservation opportunities, this 144-page document provides valuable information about lighting education and information in the following areas:

- Extensive annotated lighting reference bibliographies
- Directory of lighting demonstration centers
- Summaries of regulations and codes related to lighting
- Directory of lighting education institutions, courses and seminars
- Listings of lighting magazines and journals
- Directory and descriptions of lighting research organizations
- Directory of lighting professional groups and trade associations
- Directory of energy and environmental groups

The following lighting publications contain a thorough description of the technologies, their advantages, their applications and case studies and are available from EPRI:

- *High Intensity Discharge Lighting* (10 pages), BR-101739
- *Electronic Ballasts* (6 pages), BR-101886
- *Occupancy Sensors* (6 pages), BR-100323
- *Compact Fluorescent Lamps* (6 pages), CU.2042R.4.93
- *Specular Retrofit Reflectors* (6 pages), CU.2046R.6.92
- *Retrofit Lighting Technologies* (10 pages), CU.3040R.7.91

In addition, EPRI offers a series of two-page informational bulletins that cover such topics as lighting maintenance, lighting quality, video display terminal lighting and lamp life.

***Lighting Fundamentals Handbook*, Electric Power Research Institute, TR-101710, March 1993.**

This handbook provides basic information on lighting principles, lighting equipment and other considerations related to lighting design. It is not intended to be an up-to-date reference on current lighting products and equipment. The *Handbook* has three major sections:

- Physics of light including light, vision, optics and photometry
- Lighting equipment and technology including lamps, luminaires and lighting controls
- Lighting design decisions including illuminance targets, quality, economics, codes, power quality, photobiology and waste disposal

To obtain a copy of EPRI Lighting Publications, contact your local utility, if your utility is a member of EPRI, or contact the EPRI Publications Distribution Center at 510-934-4212.

Illuminating Engineering Society (IES)

ED-100 Introductory Lighting

Consisting of approximately 300 pages in a binder, this education program is an updated version of the 1985 fundamentals training materials. This set of ten lessons is intended for those who want a thorough overview of the lighting field:

- Light and color
- Light, vision and perception
- Light sources
- Luminaires and their photometric data
- Illuminance calculations
- Lighting applications for visual performance
- Lighting for visual impact
- Exterior lighting
- Energy management/lighting
- Economics
- Daylighting

ED-150 Intermediate Lighting

This course is the “next step” for those who have already completed the ED-100 fundamentals program or who wish to increase their knowledge gained through practical experience. The IES Technical Knowledge Examination is based on the ED-150 level of knowledge. A 2 1/2-inch binder contains thirteen lessons:

- Vision
- Color
- Light sources and ballasts
- Optical control
- Illuminance calculations
- Psychological aspects of lighting
- Design concepts
- Computers in lighting design and analysis
- Lighting economics
- Daylighting calculations
- Electrical quantities/distribution
- Electrical controls
- Lighting mathematics

***IES Lighting Handbook*, 8th Edition, IES of North America, 1993.**

This 1,000-page technical reference is a combination of two earlier volumes that separately addressed reference information and applications. Considered the “bible” of illumination engineering, the *Handbook* provides broad coverage of all phases of lighting disciplines. The 34 chapters are organized into five general areas:

- Science of lighting including optics, measurement, vision, color and photobiology
- Lighting engineering including sources, luminaires, daylighting and calculations
- Elements of design including process, illuminance selection, economics, codes and standards
- Lighting applications which discusses 15 unique case studies
- Special topics including energy management, controls, maintenance and environmental issues

In addition, the *Handbook* contains an extensive glossary and index as well as many illustrations, graphs, charts, equations, photographs and references.

The *Handbook* is an essential reference for the practicing lighting engineer. You can purchase the manual from the publications office of IES at 212-248-5000. IES members receive a price discount on the *Handbook*.

***IES Lighting Ready Reference*, IES, 1989.**

This book is a compendium of lighting information, including the following: terminology, conversion factors, light source tables, illuminance recommendations, calculation data, energy management considerations, cost analysis methods and lighting survey procedures. The *Ready Reference* includes the most often used material from the *IES Lighting Handbook*. You can purchase the 168-page reference from the publications office of IES at 212-248-5000. IES members receive the *Ready Reference* upon joining the society.

***VDT Lighting: IES Recommended Practice for Lighting Offices Containing Computer Visual Display Terminals.* IES of North America, 1990. IES RP-24-1989.**

This lighting practice handbook provides recommendations for lighting offices where computer visual display terminals are used. It also offers guidelines regarding light requirements for visual comfort and good visibility, with an analysis of the impact of general lighting on visual display terminal tasks.

To purchase a copy of this handbook, contact the IES at 212-248-5000.

National Lighting Bureau (NLB)

The NLB is an information service established by the National Electrical Manufacturers Association (NEMA). Its purpose is to create more awareness and appreciation of the benefits of good lighting. NLB promotes all aspects of lighting energy management, ranging from productivity to lumen output. Each year the NLB publishes articles in various periodicals and guidebooks written for the lay person. These articles discuss specific lighting systems design, operation, maintenance techniques and system components.

The following publications are basic references that provide an overview of the subject and include lighting applications:

- *Office Lighting and Productivity*
- *Profiting from Lighting Modernization*
- *Getting the Most from Your Lighting Dollar*
- *Solving the Puzzle of Visual Display Terminal Viewing Problems*
- *NLB Guide to Industrial Lighting*
- *NLB Guide to Retail Lighting Management*
- *NLB Guide to Energy Efficient Lighting Systems*
- *Lighting for Safety and Security*
- *Performing a Lighting System Audit*
- *Lighting and Human Performance*

To request a catalog or to order publications, call NLB at 202-457-8437.

***NEMA Guide to Lighting Controls*, National Electrical Manufacturers Association, 1992.**

This *Guide* provides an overview of the following lighting control strategies: on/off, occupancy recognition, scheduling, tuning, daylight harvesting, lumen depreciation compensation and demand control. In addition, it discusses hardware options and applications for each control strategy.

To order, call NLB at 202-457-8437.

National Lighting Product Information Program (NLPIP)

This program publishes objective information about lighting upgrade products and is co-sponsored by four organizations: EPA's GreenLights, the Lighting Research Center, the New York State Energy Research and Development Authority and Northern States Power Company. Two types of publications are available: *Specifier Reports* and *Lighting Answers.*

To purchase these publications, fax your request to the Lighting Research Center, Rensselaer Polytechnic Institute at 518-276-2999.

Specifier Reports

Each *Specifier Report* examines a particular lighting upgrade technology. *Specifier Reports* provide background information about the technology and independent performance test results of name-brand lighting upgrade products. Nine *Specifier Reports* have been published:

- Electronic Ballasts, December 1991
- Power Reducers, March 1992
- Specular Reflectors, July 1992
- Occupancy Sensors, October 1992
- Parking Lot Luminaires, January 1993
- Screwbase Compact Fluorescent Lamp Products, April 1993
- Cathode-Disconnect Ballasts, June 1993
- Exit Sign Technologies, January 1994
- Electronic Ballasts, May 1994

Other *Specifier Reports* to be published in 1994 will address five topics: exit signs, electronic ballasts, daylighting controls, compact fluorescent lamp luminaires and replacements for incandescent reflector lamps. High intensity discharge systems for retail display lighting will also be researched in 1994.

Lighting Answers

Lighting Answers provide informative text about the performance characteristics of specific lighting technologies, but do not include comparative performance test results. *Lighting Answers* published in 1993 addressed T8 fluorescent systems and polarizing panels for fluorescent luminaires. Additional *Lighting Answers* planned for publication in 1994 will cover task lighting and high intensity discharge dimming. Other topics under consideration are electronic ballast electromagnetic interference (EMI) and 2'x4' lighting systems.

Periodicals

Energy User News, Chilton Publications, Published Monthly.

This monthly publication addresses many aspects of the energy industry. Each edition contains a section devoted to lighting, usually featuring a case study and at least one article discussing a lighting product or issue. Some *Energy User News* issues feature product guides, which are technology-specific tables that list the participating manufacturers (with phone numbers) and the attributes of their products. The September 1993 edition featured lighting as the centerpiece and contained the following information:

- Several lighting articles and product announcements
- Special report about lighting, retrofit planning and power quality
- Technology report on tungsten-halogen lamps
- Commentary on successful occupancy sensor retrofits
- Product guides for compact fluorescents, halogens, high intensity discharges, reflectors and electronic ballasts

To order back issues, call 215-964-4028.

Lighting Management and Maintenance, NALMCO, Published Monthly.

This monthly publication addresses issues and technologies directly related to upgrading and maintaining commercial and industrial lighting systems. The following are some topics addressed in *Lighting Management and Maintenance*: the lighting industry, legislation, new products and applications, waste disposal, surveying and the lighting management business.

To order a subscription, call NALMCO at 609-799-5501.

Other EPA GreenLights Publications

EPA GreenLights Program Lighting Upgrade Manual

This document is a practical reference for every phase of the lighting upgrade process: organizing staff, setting goals, surveying facilities, evaluating lighting systems, financing upgrades, planning projects, requesting bids, disposing lamps and ballasts, maintaining lighting systems and reporting project results. It provides comprehensive technical information about lighting technologies and controls and is organized as follows:

- GreenLights program
- Implementation planning guidebook
- Financial considerations
- Lighting waste disposal
- Progress reporting
- Public recognition lighting fundamentals

- Lighting upgrade technologies
- Lighting maintenance
- Lighting evaluations
- The lighting survey

GreenLights Brochure

EPA has produced a four-color brochure for marketing the GreenLights program. It outlines the program's goals and commitments, while describing what some of the participants are doing. This document is an essential tool for any GreenLights marketing presentation.

To order copies of any of these publications, please contact GreenLights Customer Service at 202-775-6650 or Fax 202-775-6680.

GreenLights Update

This free monthly newsletter is the primary vehicle for informing GreenLights participants and other interested parties about the latest program enhancements. Each month's newsletter addresses lighting technologies, applications, case studies and special events. Every issue contains the latest schedule for Lighting Upgrade Workshops and a copy of the reporting form used by participants to report completed projects to EPA.

Light Briefs

EPA publishes two-page *Light Briefs* on various implementation issues. These publications are intended to provide an introduction to technical and financial issues affecting upgrade decisions. Four *Light Briefs* focus on technologies: occupancy sensors, electronic ballasts, specular reflectors and efficient fluorescent lamps. Other releases cover rolling financing strategies, financing options, measuring lighting upgrade profitability and waste disposal. Current copies have been mailed to all GreenLights participants.

Power Pages

Power Pages are short publications that address lighting technologies, applications and specific questions or issues about the GreenLights program. Look for announcements of *Power Pages* in the *Update* newsletter.

These documents are available through the GreenLights faxline. To request fax delivery, call 202-233-9659. Periodically contact the faxline to retrieve the latest information from GreenLights. If you do not have a fax machine, contact GreenLights Customer Service.

Program Operation

This section describes intern responsibilities and administrative and technical aspects of operating the survey program. Readers will learn the administrative requirements of a program and be able to identify, train and coordinate the individuals responsible for various aspects of the program.

Intern Responsibilities

Interns should be encouraged to take total responsibility for their assigned buildings. Each intern will receive the pre-survey data on those buildings and is expected to produce a complete survey report for each building. This will involve contacting building managers to schedule appointments, walking through each building, collecting and analyzing data, making recommendations, preparing reports and maintaining files.

Initial Contact

The intern contacts the building manager to schedule a walk-through survey for each building. This gives the building manager one name and one face to associate with your program, avoiding confusion regarding who to contact with questions or comments about the survey on their building. Contact information, including the building manager's name and telephone number, should be available from the pre-survey information for the building. Any pre-survey information missing from the file should be requested during this initial contact.

Ideally, appointments should be scheduled several weeks in advance, although this takes some practice. Appointments beyond the coming week may be somewhat tentative depending on travel schedules discussed below and on the next page.

Trip Planning

Careful trip planning can result in significant savings to your program travel budget. Train interns to follow this systematic process in scheduling survey trips:

- Select buildings to be surveyed. After a few weeks of experience, interns should be encouraged to schedule visits first to the most remote of their assigned buildings. By starting at remote locations and working back toward the home city, the remaining buildings will always be easier and cheaper to visit.
- Review the file information on all assigned buildings at the location. Each building's square footage, floor plan and utility bills should be analyzed. Careful plan review may suggest potential surprises such as building additions that were not included on the original building plan. High utility bills or unusual billing patterns may indicate additional buildings on the site. Anything unusual should be verified with a phone call to the building manager. At this point, the intern and supervisor should decide whether and how to survey any additional buildings at the site.
- Once the intern has determined what buildings to expect at the site and reviewed information for those buildings, the total time for walk-through surveys should be estimated. Square footage per intern per day is a reasonably accurate method for

trip planning, providing the intern is working from accurate information and does not encounter any major surprises during the walk-through. An experienced intern can walk-through nearly 100,000 square feet in an eight-hour day. Less experienced interns should consider what they have comfortably completed prior to the trip and plan accordingly.

- If there is additional time available on the trip, the intern should review other assigned buildings near the original location. It is less expensive to pay an intern for an extra day or two at a remote location than to pay travel costs twice. Some double-trip situations will still occur if the intern runs out of time before completing all the scheduled buildings at a location or if late building assignments are made. However, careful review by a supervisor can avoid many situations caused simply by inexperience and poor planning.
- If there are no additional buildings at nearby locations, the intern should consider buildings located along the route. Again, the more remote buildings should be given priority.
- When all the buildings to be surveyed on the trip have been determined, driving times can be calculated. These times are then added to the estimates of building walk-through time to determine the time of arrival at each building.
- Appointments should be scheduled with the building managers. They should be informed if the intern is traveling a long distance and asked to allow for unforeseen delays that may be encountered.
- Overnight lodging reservations can be made based on the appointment schedule and the driving and survey times that have been determined.
- The intern should carry names and telephone numbers of building managers for each building scheduled on a trip. This will simplify contact if the intern experiences delay in travel. Polite consideration of the building manager's time will help to reinforce the credibility of your program.

Building Walk-Through

No matter how experienced an intern, the building walk-through portion of the lighting survey requires planning. Before leaving the office, the intern should have taken as much information as possible from whatever plans were provided. This might include room numbers and dimensions, tasks and even luminaire types and numbers from detailed plans.

At the building, the intern should start by interviewing the manager to verify information such as use schedules, maintenance procedures and recent changes in the lighting system.

During the building walk-through, the intern will collect information on the lighting system existing in the building. This information is normally recorded on a room by room basis and may include:

• Luminaire information
  Type and number of each luminaire
  Type and number of lamps and ballasts
  Condition of each component
• Control information
  Types of controls
  Schedule of lighting use
• Room information
  Tasks performed in the space
  Current illumination and evaluation
  Room dimensions
  Ceiling height and plenum depth
  Reflectances of ceiling, walls and floor
  Window and daylighting data

This information should be recorded on a prepared data collection form. The exact information and arrangement of the form will depend on the analysis method chosen for your particular program.

Interns should also carry clean copies of the building floor plan. One copy may be used for notes such as lighting levels or special tasks in rooms or areas of the building. Another copy may be used to track room numbers, dimensions and any revisions such as remodeling or additions.

When a building does not have assigned room numbers, it is imperative that the intern mark on the plan the room numbers or other identification that are used for the survey. The numbers should then be transferred to a clean copy of the plans for inclusion in the completed survey report. This is the only way that the building manager may know where in the building a particular upgrade recommendation is located.

Computer Data Entry and Analysis

The time required for data entry and analysis varies greatly depending on building size, complexity, use and the number of similar room or areas. To begin, interns can expect to spend at least two hours in the office for each hour in the field. With experience, interns will be able to better estimate the time required for office work based on the complexity of the building.

Interns should be trained to use a consistent system for data collection, so that one intern can read another's field notes and complete the data entry, if necessary.

Initial Survey Reviews

The intern should prepare a draft report containing the items discussed in the Start-Up chapter. He or she should then review all calculations and recommendations and verify that the calculated costs and savings are reasonable and that upgrades are appropriate for the spaces in which they are recommended. Clarifying notes should be added to explain any apparent discrepancies, reasons why certain technologies were or were not recommended and any significant changes in illumination for the spaces.

When the report is acceptable to the surveying intern, it should be reviewed by a second intern. The second intern reviews the report from the perspective of someone who has no preconceived ideas of what should be recommended. In addition to checking accuracy and appropriateness of recommendations, this review should consider the overall clarity of the report. This process encourages interaction of ideas and lighting concepts between interns.

Survey Data Files

Keep accurate files on the buildings to be surveyed under the program. Set up a simple orderly system before any surveys are completed and make sure that interns understand and maintain the system throughout the life of the program. This will exemplify an orderly, businesslike attitude toward the survey process and encourage interns to keep working files in order while files are in their possession. It may also save program money by preventing lost files and the need to resurvey buildings.

There are many steps required to complete a building survey from initial data collection to delivery of the final report. These steps can generate large amounts of paper and require lots of filing space.

Specific files should be made at various stages of the building survey process. Some of the stages that should be considered for preparing files:

- When initial building data is received, a *Working File* should be started for the building. This file should include the pre-survey data and any plan received. The *Working File* is then given to the intern assigned to survey the building. The intern adds raw data, survey notes, calculations and any additional information received during the building walk-through and subsequent conversations with the building manager.
- When all the data has been analyzed on the building and the survey is completed and initially reviewed, a *Record File* should be completed. This file includes

information from the *Working File* as well as analysis results, recommendations and materials for the final report. The *Record File* is then passed to the supervisor for technical review.
• Following final technical review and approval, a *Report File* is prepared. This is a copy of information contained in the *Record File* that will be provided to the building manager. To avoid confusion, this file should only contain the final survey report that is required or requested. Including the initial building data and the intern's data will only confuse the readers.

Computer Screen of Lighting Survey Status

```
Records    Organize    Go To    Exit

                                     LIGHTING SURVEY STATUS REPORT
  Building ID# 0001-0

  assigned to: _Group                Building: STATE CAPITOL
                                               1445 K ST
  contact: BOB RIPLEY                          LINCOLN            , NE
   agency: Administrative Serv.
 division: STATE BLDG.                Complex: CAPITOL COMPLEX

     SCHEDULE  Y  building operator contacted, site visit scheduled
      ON-SITE  Y  site visit conducted, survey data collected
     DATA ENT  Y  lighting survey data entered in computer
     ANALYSIS  Y  GL DSS and/or QuickCalc run, results entered
     REVIEWED  Y  results reviewed/accepted by Kelly or Anita
     FIN REPT  Y  final report accepteded by Lynn or Kirk
     COMPETED  Y  report copied, filed and delivered         PRINT? N

                    (Press [PgDn] to report analysis results)
Edit      ||F:\interns\inventor\SB2 ||Rec 1/2761      ||File ||ExclLock||    Num
```

Recordkeeping

Interns should provide some sort of progress report at least weekly indicating the survey status of each of their assigned buildings. This will help the supervisor determine whether each intern is making satisfactory progress on the assigned surveys or if some sort of problem has developed which must be corrected. This recordkeeping can be as simple as checking boxes on a wall chart or it may involve updating the status of each survey on the computerized building database. Additional information on developing a computerized building database can be found on page 18.

Computer Screen of Lighting Analysis Results

```
Records    Organize    Go To    Exit

                                   LIGHTING SURVEY ANALYSIS RESULTS
  Building ID# 0001-0

  assigned to: _Group                  Building: STATE CAPITOL

                               Old Costs               New Costs
        Project Cost       Energy      Maint       Energy      Maint

          $223,956         $34,378    $32,605      $16,091    $25,695

                     electric savings          composite
                        kWh      %kWh         IRR        NPV

                      751,579    53.0        12.20     $134,124

Edit      ||F:\interns\inventor\SB2 ||Rec 1/2761      ||File ||ExclLock||    Num
```

Administrative Supervisor Responsibilities

Trip Planning Review

Careful review by a supervisor of survey trip plans can result in substantial cost savings. Well-planned trips not only reduce travel reimbursement costs, but reduce road time and give interns more productive time in the field. Skillful assignment of buildings discussed in the Start Up chapter, is the first step this process.

The supervisor should be involved with interns in planning longer trips as described earlier in this chapter. In some cases, the supervisor may need to reassign buildings from one intern to another. Additional savings may be achieved by organizing trips with two or more interns. A team approach can save substantially on mileage reimbursements when long distances are involved and interns may enjoy the company on longer trips.

Consider having one person make all lodging reservations rather than allowing individual interns to secure their own reservations. The person assigned to this task can investigate hotel costs in heavily-used areas to ensure that your program is receiving the best costs available.

Finally, you may choose to allow interns to survey buildings in areas where they have friends or relatives who can provide lodging. This offers advantages to the interns and to your program budget. Interns may also be allowed to schedule a survey trip in conjunction with a holiday or weekend away. This way, the program can reimburse for mileage costs to and from the furthest survey location while the intern is responsible for lodging costs and any meals not associated with the survey trip.

Recordkeeping

Requirements for recordkeeping may vary depending on your program's funding source, supervision requirements and whether the studies are being completed as a free service or under contract. Accurate documents are useful for analyzing your program costs as well as supporting any billings or audit requests. Examples of some recordkeeping forms which you may need:

- Time Sheet. This should be detailed enough to permit accurate billing of hours to particular projects or contracts, if needed.
- Expense Reimbursement Request. Provide sufficient space to allow for daily costs on separate buildings or contracts.
- Vehicle Travel Log. Recording odometer readings at the beginning and end of survey trips facilitates mileage reimbursement. This form should be kept in the intern's vehicle.

- Overnight Travel Request. A consistent format simplifies the supervisor's review and verification of proper trip planning and coordination with other trips.
- Telephone/Fax and Copier Logs. If interns are housed in office space owned by another organization, it may be necessary to track long distance telephone calls, fax charges and copier use for accurate reimbursement to the host organization.
- Loaned Equipment Agreement. If you provide survey equipment to each intern, you may need a loan agreement for inventory purposes and to make sure that all equipment is returned. If equipment is shared among several interns in an office, a checkout board may be more appropriate so that other interns know who has what equipment and when it will be returned.

If your program provides surveys for buildings under contract, the documents discussed above should help you to keep accurate records for billing. Billing may also include indirect costs for items that are not easily tracked or apportioned such as computer rental, printer and copy paper, toner for printers, file costs and administrative and technical supervision. Carefully review program contracts to ensure that such "hidden" costs are reimbursable.

Copying, Filing and Report Presentation

Contents of the final survey reports should have been decided before any surveys are started. This was discussed in the Start-Up chapter. After interns have reviewed their reports and the technical reviewer has approved the survey, the supervisor should verify that all required documents are included in the final report. The appropriate sections should then be copied and the required documentation filed. Finally, the report should be presented to the building manager. This may be done by the supervisor or the intern.

Provide building managers with information regarding implementation costs, energy and maintenance cost savings and pollution prevention in your initial presentation. Additional information can be provided from your record file when implementation is being planned or at the request of the building manager.

Program Follow-Up Activities

Follow-up is a critical part of any successful program and should be scheduled along with the other aspects of your program. After building managers have had an opportunity to review the report, a sampling of managers should be asked to evaluate the survey program. Questions for evaluation might address:

- Readability of the reports
- Impressions of the intern's approach and effectiveness
- Recommended measures which have been or will be implemented
- Reasons other measures are not being implemented

A Building Manager's 1992 Reaction...

An evaluation of the 1992 Survey Program received this assessment from a public school official, when asked, "What was the most beneficial result of the on-site visit and report?" The school contact responded with three points:

1. An unbiased, outside technician's evaluation
2. A solid energy analysis report that can be used
3. No time frame to work under

The contact then added, "This is a good program for interns and the building owner. Win-win situation."

If there are problems in understanding the reports, this may indicate a need for special communication with other building managers who may be equally confused. Evaluations may also indicate a need for information regarding financing options and other incentives available to encourage implementation of lighting upgrades.

Finally, it may be very advantageous to your program to track one or several years of electric bills in buildings where your recommendations have been implemented. This data can provide you with information to:

- Verify the costs and savings projected by your surveys
- Investigate actual savings achieved by particular types of upgrades
- Justify modifications in future survey recommendations
- Market additional surveys more effectively

Survey Tracking and Program Status Reports

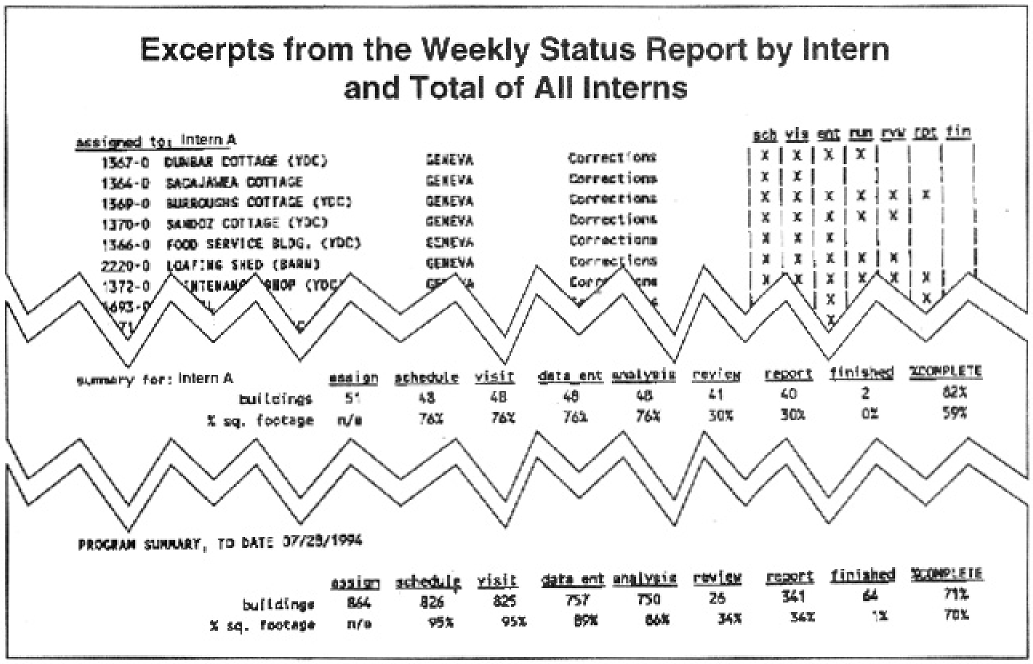
Status and progress reports allow you to review the progress of your program at a glance. These reports can be arranged to provide you with information such as status on each of the assigned buildings, percentage completed on all buildings, per intern or for each contract. In order to prepare this report, the stages indicated in the table at left are each assigned a percent of the survey task. This allows each building a "completion score" which is weighted by the building's floor area to calculate a score for each intern. This allows an estimate of how much of that intern's assigned work has been completed.

This scoring mechanism worked fairly successfully in the Nebraska program. In addition to indicating those interns who were ahead of or behind the pace, a composite score

Lighting Survey Tasks

Stages of Progress	Percent Complete
Scheduled Walk-Through	10%
Building Visited	20%
Building Data Entered	40%
Analysis Run	70%
Initial Review	80%
Final Review	90%
Finished File and Copy	100%

Source: Nebraska Energy Office



Excerpts from the Weekly Status Report by Intern and Total of All Interns

assigned to: Intern A

				sch	vis	ent	run	rvw	rpt	fin
1367-0	DUNBAR COTTAGE (YDC)	GENEVA	Corrections	X	X	X	X			
1364-0	SACAJAWEA COTTAGE	GENEVA	Corrections	X	X					
1369-0	BURROUGHS COTTAGE (YDC)	GENEVA	Corrections	X	X	X	X	X	X	
1370-0	SANDOZ COTTAGE (YDC)	GENEVA	Corrections	X	X	X	X	X		
1366-0	FOOD SERVICE BLDG. (YDC)	GENEVA	Corrections	X	X	X				
2220-0	LOAFING SHED (BARN)	GENEVA	Corrections	X	X	X	X	X		
1372-0	…NTENAN… SHOP (YDC…	GE…A	Corr…ons	X	X	X	X	X	X	

summary for: Intern A

	assign	schedule	visit	data ent	analysis	review	report	finished	%COMPLETE
buildings	51	48	48	48	48	41	40	2	82%
% sq. footage	n/a	76%	76%	76%	76%	30%	30%	0%	59%

PROGRAM SUMMARY, TO DATE 07/28/1994

	assign	schedule	visit	data ent	analysis	review	report	finished	%COMPLETE
buildings	864	826	825	757	750	26	341	64	71%
% sq. footage	n/a	95%	95%	89%	86%	34%	34%	1%	70%

for all surveys gave an indication of how much of the overall program goal had been accomplished.

Reviewing the status reports on a regular basis will highlight problems which interns may be experiencing. Timely review also allows problems to be solved before the program is damaged. During the first few weeks of the program, review of a status report can also help indicate which interns may need additional attention or training.

Making weekly status reports available to the interns can create healthy competition for the highest percentages completed. This is acceptable as long as it is understood that the most important numbers on the report are those showing progress of the overall program.

Technical Supervisor Responsibilities

In addition to administrative supervision, there is an ongoing need for technical support for the interns. This falls in two main areas: advising interns during data analysis and report preparation and reviewing their reports for technical accuracy. The technical supervisor may be the same person who provides administrative supervision or it may be a different person or even a group of support people.

Technical Advising

Often, the technical adviser will be the same person who provided the technical training. This is desirable, because it will eliminate any discrepancies between the initial training and day-to-day advice. Even if the technical adviser did not provide the initial training, he or she must have a thorough understanding of lighting efficiency, energy-saving technologies, calculation methods and sufficient computer knowledge to support whatever analysis method is being used. The adviser must also be generally available, especially during the early weeks of the survey program and able to communicate clearly with the interns.

Lighting Survey Analysis Review Sheet

State of Nebraska - GREEN LIGHTS PROGRAM — Results / Review Sheet 03/31/95

Building ID# 0001-0 (high priority) — Assigned to: _GROUP

Building Identification
STATE CAPITOL
1445 K ST
LINCOLN, NE 68509
(Lancaster County)
Contact: BOB RIPLEY

Building Owned/Operated By
Agency #065-04
Agency: Administrative Serv.
Division: STATE BLDG.
Contact: DANNY SCHLICHENMAIER

Complex: CAPITOL COMPLEX

primary use: office building — full use: 2600 hr/yr
secondary use: museum — part use: 1040 hr/yr
gross building area: 401,760 sq.ft. (289,400 sq.ft. net)

Electric Consumption History
metering: indiv (not pro-rated) **(demand estimated)**

	kWh	energy $	kW	demand $	total $	lf
JAN	430,536	$10,333	1,966	$0	$10,333	0.300
FEB	216,280	$5,191	988	$0	$5,191	0.300
MAR	590,488	$14,172	2,696	$0	$14,172	0.300
APR	176,216	$4,229	805	$0	$4,229	0.300
MAY	455,888	$10,941	2,082	$0	$10,941	0.300
JUN	443,568	$10,645	2,025	$0	$10,645	0.300
JUL	283,664	$6,808	1,295	$0	$6,808	0.300
AUG	368,264	$8,838	1,682	$0	$8,838	0.300
SEP	355,320	$8,528	1,622	$0	$8,528	0.300
OCT	377,048	$9,049	1,722	$0	$9,049	0.300
NOV	238,568	$5,726	1,089	$0	$5,726	0.300
DEC	521,360	$12,513	2,381	$0	$12,513	0.300
TOTAL	4,457,200	$106,973	MAX> 2,696	$0	$106,973	0.189
			min> 805			0.632

avg price: $0.0240/kWh — $0.00/kW — $0.0240/kWh

base: 4,036,608 $96,876 ($0.0240/kWh)
HVAC: 420,592 $10,097

Current Energy Use Indices: 37,864 Btu(elec)/sq.ft. and $0.27/sq.ft

Green Lights Recommendations
calculated IRR: 12.20%
simple payback: 8.9 years

Cost/Value of Improvements
upgrade cost: $223,956
calculated NPV: $134,124

	actual base	model	(mod/act)	saved	(%act)	(%mod)
energy -	4,036,608 kWh	1,418,074	35%	751,579	19%	53%
demand* -	805 kW	540	67%	257	32%	48%
cost -	$96,876	$66,983	69%	$25,197	26%	38%

* based on assumed load factor of 0.30 and 90% diversity in savings

Interns occasionally need someone to suggest initial or alternate upgrade recommendations or verify that they are on the right track. They also need someone to verify calculation methods for more unusual upgrades and solve computer problems as they arise. Offsite support is acceptable as long as the response time is fairly fast. Long delays, particularly regarding computer questions, can hurt morale because interns are focused on completing the report.

Report Review

All surveys produced by your intern program should be reviewed technically for both overall accuracy and appropriateness of the recommended upgrades.

The overall accuracy and reasonableness of savings may be determined by comparing the estimated electricity savings to the current electric bill and electrical base load. You may also need to compare the lighting load estimate from a modeling program with the base load. The program's credibility will be damaged if a report indicates that more energy can be saved than the building uses. This seems obvious, but it happens more than you would imagine.

If your survey fails this test, the problem is either in the electric bill data or the luminaire wattages and hours used to calculate the current lighting load. Both of these should be checked to reconcile the survey with actual usage.

The electric bill information provided to your program may not have been accurate or there may have been data entry errors. Consider the hours of use reported, billed kilowatt-hours and size of the building. Is the intensity of electricity use consistent with other buildings of similar type and use? Often the billing information was completed by someone at a central office rather than at the surveyed building. There is also a possibility that the building was used differently during the period for which bills were reported. Verify suspected discrepancies with the person who supplied the information or with the building manager.

Unless these checks correct the problem, the intern should verify all data entry, including luminaire numbers, lamp wattages and hours of use. As a last resort, start reducing hours of use below what the building occupants claim, at least for some luminaires. Never release a report in which the estimated savings are unreasonably large compared to actual electric use.

You must also verify that upgrades are appropriate for the spaces in which they are recommended. Even if savings are reasonable in relation to actual electric bills, you want to avoid recommendations which are clearly inappropriate for spaces in the building. These decisions may require difficult judgement calls. The purpose of the survey is to explore potential savings opportunities, not redesign the lighting system, so it is expected that building managers and professional designers may modify recommendations for the building. On the other hand, you lose credibility if you make too many unsuitable recommendations.

Poor recommendations may arise from misconceptions by the interns or from modeling programs which lack the sophistication to deal with specialized spaces and lighting needs.

At first, errors may occur in lamp, ballast and control selection because interns do not consider all the properties of particular luminaires. These mistakes can be corrected with experience and oversight by the reviewer. Another problem may be insufficient light levels in the recommended upgrades because interns try to maximize savings. In some spaces, light levels really should be reduced, so interns should note that fact and the reasons for the reduction in their report.

Inappropriate upgrade recommendations from lighting software may result from differences in lighting philosophy between your program and the software writer or they may be caused by pushing the software beyond its limits. In either case, the problem must be resolved. Software can not be blamed for faulty recommendations in your reports.

Modeling software rarely recommends inappropriate light levels if it is given appropriate parameters. If interns entered “wrong” parameters to trick the software into an unusual solution, then all sorts of strange and wonderful side effects may be encountered.

Since the computer program never visited the building, it has to rely on the intern’s data to determine what sort of lighting is appropriate and will save energy in each situation. In some cases, to simplify data, the software makes assumptions that are not valid for the particular building or room. It is the job of the reviewer — who has never visited the building either — to determine whether the recommendation is acceptable or not. The reviewer must look for controls and luminaires which are not appropriate for each particular space and mismatches between controls and luminaires. The review may cause some reduction in calculated savings, but in some cases, it may increase the potential savings from lighting upgrades.

Once inappropriate recommendations have been identified, they must be corrected before the survey report is released. This correction may range from simply having the intern change the recommendation to changing parameters for the software. In some cases, certain luminaires must be excluded from the software model and upgrade savings calculated by hand.

Quality Control Checks

Occasional quality checks during the survey program are important to verify that interns are completing both the walk-through survey and analysis and report writing properly. These checks may indicate areas where correction or improvement is needed. This is discussed in detail in the chapter, “Intern Training.”

OtherIntern-Based Approaches

The Nebraska Energy Office program is only one way to use interns for a lighting survey or other energy or environmental program. This section describes other approaches to The Intern Solution. *Contacts are provided for readers who want to learn more about specific programs.*

This manual has explained Nebraska's approach to reducing the cost of lighting surveys without sacrificing quality. The information presented has explained many of the situations faced by the Nebraska program and how those issues were resolved. This chapter describes how other organizations have developed intern survey programs to achieve their particular objectives and challenges.

Georgia Institute of Technology's Industrial Engineering Senior Design Project

Program Objectives

Since the GreenLights Program began in 1991, management of the implementation phase of the program has been the biggest challenge. Each corporation or institution has unique structures and financial barriers to overcome in the development of an energy efficiency policy.

The Industrial and Systems Engineering senior design project exists as part of the curriculum during the final two quarters at the Institute. The class is designed to have students work with local corporations to optimize a real-life process using the information learned in classes taken at Georgia Tech. Although typical projects usually address manufacturing processes and optimization, some tackle feasibility problems and use the curriculum to analyze the related issues.

Program Description

Six senior industrial engineering students from Georgia Tech will conduct a feasibility study of the EPA GreenLights Partnership with the Georgia Institute of Technology over a period of two quarters. The students will complete a lighting analysis of three Georgia Tech facilities to include: 1) the Van Leer Electrical Engineering Building, 2) the College of Architecture Building and 3) the Gilbert Memorial Library. The results from these analyses may then be extrapolated to other similar structures on the campus. The analysis will include:

• Survey the lighting in each building
• Determine present and required light levels
• Analyze the present lighting system and develop upgrade options
• Evaluate the power rate structure for the institution
• Forecast future energy demands and costs based on projected peak reductions
• Evaluate and describe the purchasing and funding constraints for Georgia Tech
• Develop an implementation plan

The results of these analyses can be used by EPA and Georgia Tech to determine the best approach for Georgia Tech to take in implementing their GreenLights commitment.

Program Responsibilities

Georgia Tech is allowing students to access the facilities and personnel necessary to complete the class requirements. The students are not reimbursed for their time because the work is part of the senior design class. Technical support and report review is being offered by the regional EPA in Atlanta.

Program Results

As of March 1995, the senior design class was half completed and an interim report had been prepared. More complete results will be available in June 1995.

Program Contact

Danny Orlando
U.S. E.P.A. Region Four
AP&T Management Division
Air Programs Branch
345 Courtland Street, NE
Atlanta, GA 30365
Phone: 404-347-2864
Fax: 404-347-2130

Green Spaces/Healthy Places

Program Objectives

Green Spaces/Healthy Places is a service initiative currently underway in Roxbury, Massachusetts, to help improve the environmental conditions and quality of life in the city. The project also creates a partnership between the Environmental Protection Agency, City Year (a youth service organization in the city), the Dudley Street Neighborhood Initiative, Tufts and Brown Universities and businesses in the area. The program is a model for urban environmental action with the following goals:

- Creating "Lead-Safe Zones" around local schools
- Helping people use less water and energy
- Reducing environmental risks like lead and radon
- Turning vacant lots into parks and community gardens

The program will educate neighborhood residents and business owners about these and other environmental, conservation and protection issues, support ongoing community environmental initiatives and help to build additional partnerships among the community, the government and the private sector.

Program Description

This program was designed to educate and inform members and neighborhood residents about environmental concerns in their community. Program objectives include training on these issues and implementation of programs to help to correct existing problems in the area:

- City lots will be revitalized into community gardens
- Environmental indicators that currently exist in the 31- block "pilot area" will be mapped. The mapping will include targeting areas for revitalization and restoration projects
- Teams of young people will complete audits on homes or schools for lead, radon or other sources of air pollution
- The team members will work in conjunction with EPA members and Boston Edison to introduce energy efficient approaches in the neighborhood. Residents and businesses will be informed about lighting sources that will help reduce electrical consumption while saving money and natural resources
- Team members will help establish a model home or business to display energy saving techniques
- Boston City Hospital, the City Office of Environmental Health and team members will work together to provide training and assistance to members and area residents on integrated pest management. Integrated pest management is a technique designed to reduce pest problems without relying heavily on spraying potentially harmful chemicals
- Twice a week, team members will conduct an afternoon environmental club in conjunction with the local YMCA

Program Responsibilities

The program is being financially and technically supported by the partnership between the Americorps Program, the EPA-New England region, Dudley Street, Brown and Tufts Universities and private sponsors.

Additional technical, administrative and organizational support is being provided by:

- City Year is providing energetic young people as team members as well as managing the team on a day to day basis
- Dudley Street Neighborhood Initiative is helping to identify the needs of the community
- Environmental Protection Agency is helping to identify the needs of the community, provide member guidance, training of the involved parties and follow-up audits on completed projects
- Tufts and Brown Universities are providing academic talent to help organize and advise on the projects
- Environmental businesses and industry are providing volunteer time, expertise and financial resources

Program Results

Although started in late 1994, the partnership has begun many of the planned objectives and completed some projects in the community.

During the fall, team members focused on cleaning several targeted areas. Cleaning was completed near a local elementary school as well as on several vacant lots. An abandoned community garden was also cleaned and prepared for planting in the spring.

Green Spaces has started the mapping process which will serve as a planning tool for future projects.

Although the program has just started on some of its objectives, it has been recognized for the positive effects of its current and future projects. A similar program is being planned for Providence, Rhode Island, starting in Spring 1995.

Program Contacts

Lois Adams
U.S. E.P.A. Region One
JFK Federal Building
Boston, MA 02203
Phone: 617-565-3265

Sarah Hammond Creighton
Tufts University
Civil and Environmental Engineering Department
Anderson Hall
Medford, MA 02155
Phone: 617-627-3211

Idaho's GreenLights Program

Program Objectives

The Idaho Department of Water Resources set out to accomplish Idaho's GreenLights commitment through a lighting survey program using electrical engineering student interns. A year-round program was envisioned, with several students working part-time on nearby buildings during the school years and additional students working full-time to survey more remote buildings during the summers. The interns who had worked on the program during the year would provide training and leadership to the summer interns. The hope was to start small and grow into the program, working with just a few agencies at a time until all the state's buildings were surveyed.

Program Description

Funding of $90,000 for one year's operation was provided by the Department of Public Works. Additional funds were planned for subsequent years, but not allocated. Initial survey work was targeted for Ada County, particularly Boise State University. There were several reasons for this choice: the University is near the state agency, it was the source of interns and the University facilities manager was very supportive of the lighting survey work.

The Electrical Engineering Department at the University helped recruit several students to survey part-time during the school year. These students were actually contractors to the state agency and were paid $8.75 per hour. Training was entirely on-the-job and consisted of interns doing surveys with the program manager until the interns were comfortable surveying without supervision. A reference manual with training materials was provided for self-study, but there was not classroom training.

Program Results

Funding for this program was rescinded, for budget-cutting reasons, after three months of operation. During the few months of operation, 27 buildings covering nearly one million square feet were surveyed. Twenty of the buildings were at the University and seven were operated by the Department of Administration. These seven buildings represented the first attempt to expand the program beyond Ada County. Preliminary discussions with the state Department of Transportation would have placed its buildings next in line for surveys.

When it became apparent that funding was to be rescinded, the scope of the program was reduced to provide simple survey reports with estimates of energy savings from typical lighting upgrades, but no economic analysis. Energy savings from the recommended upgrades averaged 31-35 percent. During its operation, an estimated $20,000 was spent for intern wages, operating expenses and administration. Thus, these surveys averaged two cents for each square foot of building surveyed.

The program manager believes that this program was well underway and would have achieved its goals if sufficient funds had been provided. In retrospect, he suggested that in most buildings, surveyors would not have concentrated on room-by-room analyses except where excessive light levels were found. In other buildings, recommendations would be made on a building-wide basis.

Program Contact

Mark Johnson, Energy Specialist
Energy Conservation Bureau
Idaho Department of Water Resources
1301 N. Orchard Street
Boise, ID 83706
Phone: 208-327-5451
Fax: 208-327-7866

Oregon and Washington's Americorps GreenLights Project

Program Objectives

In the states of Oregon and Washington, an intern lighting survey program is currently operating that will help public school districts and other public buildings reduce their annual energy costs, as well as reduce adverse environmental impacts caused by electrical production. This program has been able to build a partnership between the governments of both states, the Bonneville Power Administration, the U.S. Environmental Protection Agency and public and private utilities.

Program Description

To select sites, Bonneville Power Administration announced the availability of the surveys to public schools in both states. Participants were asked to provide information about buildings including age, size, use and electricity consumption in the previous year.

Sixteen building surveyors and two supervisors/team leaders have been hired. Applicants for the positions were drawn from colleges and universities in both Oregon and Washington. The positions were publicized through school career placement offices, campus newspapers and newsletters. The applicants must have had one year of course experience.

Successful surveyor applicants received more than 40 hours of training conducted by EPA staff, state energy offices and the electric utilities. The training included energy efficiency measurement analysis, field trips and lighting survey software use. Upon completion of the building walk-through, the surveyors prepare reports on each facility, summarize their findings, analyze potential savings and provide participants with information regarding the various loan and grant programs available in the state to finance the recommended energy efficiency improvements. The completed reports are sent to the power administration and other project partners for final technical review.

Technical review of the reports will be completed prior to their distribution by the state energy offices and public and private utilities in cooperation with the EPA's regional GreenLights technical support staff.

Program Responsibilities

Funding and management of the program is being provided by the program's partners. Responsibilities vary greatly among the partners. Those responsibilities include:

- All the surveyors are provided with a living allowance and an education award for each year of service through the Americorps program and the federal government. The education award can be used for up to seven years after the end of service. Americorps' members are also eligible to have payments on certain loans deferred while serving, with the interest capitalized during the period of service and paid by the National Service Trust. Health insurance is also available to full-time members under this program.
- Day-to-day management of the program is provided by the power administration and a management team, including members from each of the partner organizations.
- Surveyor training is conducted by staff from the EPA, the state energy offices and the utilities.
- Office space is provided by the power administration and Washington State Energy Office.

Program Results

This is a new program and results are unavailable at this time. However, evaluation and monitoring responsibilities have been developed and will be implemented. The two surveyor supervisors will be responsible for the preparation of annual reports for all the program partners. These reports will summarize the schools and public buildings surveyed, the recommendations made and the responses from the facility managers. The annual reports will also indicate milestones reached, present a year-end financial accounting of the program and any other required documentation.

Program Contact

Marc Ross
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208-3621
Phone: 503-230-5438

The information in this chapter has been provided by organizations who have operated and continue to operate successful intern programs. While not all intern programs are successful, it is our hope that the information provided in *The Intern Solution* will help those and other program operators develop an effective and successful intern-based program.

This project has been funded in part by the U.S. Environmental Protection Agency under Grant # X823843-01-0.
Any findings, conclusions, or opinions are those of the author and do not necessarily reflect the views of the U.S. EPA.

Printed on Recycled Paper

E•N•E•R•G•Y

STATE OF NEBRASKA

Published by the
Nebraska Energy Office
Box 95085
Lincoln, NE 68509-5085
Phone 402-471-2867
Fax 402-471-3064