A COMMERCIAL LIGHTING EDUCATION AND RESEARCH FACILITY
FOR THE PACIFIC NORTHWEST

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INTRODUCTION

The commercial sector is the fastest growing electricity consumer in the Pacific Northwest, having risen from 18 percent of regional energy use in 1983 to 20.2 percent in 1985. Lighting (directly through luminaires and indirectly through increased air conditioning and ventilation loads) accounts for more than one-half of the total commercial electricity consumption.

The conservation potential from more efficient lighting and better lighting design is equally significant. Lighting codes in the Pacific Northwest allow no more than 1.5 to 2.0 watts per square foot for office space, yet well-lit buildings have been designed at less than 1.0 watt per square foot. It has been estimated that each 0.1 watt per square foot that lighting density is not reduced in the Northwest represents 122 average megawatts of lost opportunity resources by the year 2007. This is only in new building construction. An additional significant resource opportunity is that created by retrofits.

Despite the potential for conservation through energy-efficient lighting design and technologies, the building community has been slow to adopt the full range of applicable strategies. There are several explanations for this, including:

- Energy costs represent only a small fraction of total rental amounts.
- The decision-making structure within the commercial building market is diffuse.
- A high fraction of buildings are built on speculation, where the emphasis is on reducing first costs.
- Credible information on the performance and availability of new technologies for saving energy is scattered.
- Liability creates an incentive for the designer or architect to be conservative when creating a lighting system.
- Lighting is generally the last building system to be installed; lighting design is put off until the last minute with inadequate attention paid to the task.
Most lighting research is directed at technology rather than at the design or "applications" level.

To overcome these market barriers, in 1986 Seattle City Light, the Natural Resources Defense Council, and the Northwest Conservation Act Coalition proposed to the Bonneville Power Administration the construction and operation of a Lighting Lab that will provide lighting design assistance to the Pacific Northwest. After lengthy research, market analysis and planning, the Lighting Lab is moving ahead and is expected to open for business by mid-1989.

The Lighting Lab is based on the hypothesis that the failure to implement state-of-the-art lighting efficiency measures is a market problem rather than a technical problem. The technologies for achieving energy goals are well known as individual components, and no serious question exists as to their feasibility or cost-effectiveness. However, they have rarely, if ever, been demonstrated by combining components into systems to see the overall effect.²

The intent of the Lighting Lab is to promote combinations of efficiency and good design. It is expected that the best lighting design strategies will be adopted by the more progressive designers. Their designs will be publicized, and subsequently emulated by other designers in the region. By this method the Lighting Lab sponsors hope to effect a long-lasting change in the regional marketplace for highly efficient, state-of-the-art commercial lighting systems and design approaches for both new construction and retrofit application.

OVERVIEW: DESIGN ASSISTANCE

The Lighting Lab is part of a larger strategy to provide design assistance to beat the Model Conservation Standards established by the Northwest Power Planning Council. This larger strategy is taking the form of a program offered by the Bonneville Power Administration called Energy Smart Design Assistance. Smart Design is offered to Northwest utilities who in turn will provide simulation modeling to building designers and modelers. For most building energy simulation models, lighting is simply an input or assumption, specified in terms of watts per square foot. The Lighting Lab will help raise designers' confidence in specifying a lighting power density of less than 1.5 watts per square foot.

Designers work from visual memory or from professional guidelines provided by the Illuminating Engineering Society. Changes in design will not be made unless the designer can see the effect of the change, or verify visually that energy is saved without perceptible effect on the building environment. Even lighting experts find it difficult to predict what a particular energy level -- say 0.5 w/ft² -- "looks like." The only way to "see" what a particular lighting design will look like is to simulate it physically.
The Lighting Lab addresses this need in two distinct ways. First, it will provide visual demonstrations of a number of the most generic and attractive lighting strategies, both to designers and to other elements of the building community. This will enable users to see what various levels of efficiency look like, and to see how different efficient components can be used to achieve desired effects.

Second, the Lighting Lab will provide individualized mock-ups of spaces that can be used by individual designers to see how to meet energy goals for their particular space using a selection of equipment.

The Lighting Lab will provide a level of design assistance unprecedented in the region, and we believe on the continent, to overcome the most significant market barriers for energy efficient lighting: the lack of familiarity with the range of options available, and the resulting lack of confidence in achieving simultaneously the goals of efficiency and high quality lighting.

LAB COMPONENTS

The Lighting Lab will have four basic components: education, technical assistance, daylighting, and the mock-up. See Figure 1.

Education

Of all the elements of the Lighting Lab, the education portion of the facility will appeal to the widest variety of users. It will show how energy efficient design can lead to improved lighting systems.

Guided seminars will be conducted by Lighting Lab staff who will present lighting concepts and strategies to the visitor. Visitors will also be told how other portions of the Lab may be used.

The most promising and widely-applicable options of efficient lighting hardware will be demonstrated at the Lab. For example, more efficient lamp and ballast combinations, using the same fixtures, will be employed to confirm the large energy savings that can be achieved "invisibly." Footcandle meters and watt meters will be used to further illustrate the effect.

For lighting strategies and equipment that do affect architectural design considerations, specific exhibits for different kinds of occupancies will show a variety of different effects of lighting distribution and their consequences in terms of energy use.

Showcase modules that house "vignettes" of typical lighting applications will demonstrate products in context with interior design elements. Examples are retail display, corridor lighting, office computer facilities, lobbies, conference rooms, etc. These modules can be changed as equipment
or design strategies advance, or as clients' needs are redirected, perhaps every other month.

Lighting controls whose effects can easily be seen, such as occupancy sensors and dimming controls, will also be included.

Technical Information

An important element of the Lighting Lab is a technical information center. The resource center will house product catalogues and reference manuals and will serve as a product information clearinghouse. Designers can visit or call the resource center to learn about available products to fit a particular need, or to obtain performance specifications and costs for particular products. They may also be referred to local manufacturers' reps or suppliers for products and services. The resource center will also be a source of information on local and regional energy code requirements.

The resource center will have microcomputers available for designers to use, along with a range of software to analyze lighting performance, light distribution, design layout, and cost-effectiveness of contending lighting strategies.

Staff in the resource center will develop case studies of good lighting design that achieve low power density, and technical briefs on new products for distribution to users or potential users. The same staff will organize or coordinate educational seminars for technical and non-technical users.

Daylighting

With funding provided by the Washington State Energy Office, the University of Washington School of Architecture will design and install at the Lighting Lab a daylighting testing area. This area will include a 10' by 10' overcast sky simulator into which physical scale models can be placed and metered to determine the daylighting potential. An artificial direct beam sun will also be installed to simulate sunlight penetration into the models, which can then be photographed. An area for model construction will also be available.

The Mock-Up

The mock-up space is the real strategy testing center for particular groups to use for their proposed projects. Having the ability to test lighting hypotheses visually should greatly increase the number of efficient lighting strategies being implemented by lighting designers. In order to demonstrate and compare efficient lighting strategies effectively a lighting mock-up facility must have built-in flexibility.
The mock-up area will consist of about 1,000 square feet designed to allow rapid installation and removal of different equipment options. A variety of wall panels, partition panels, furniture, and computer screens will be available for comparison of interior design components in different light.

In addition, clients can introduce architectural interior design elements into the Lab to test the effects of various lighting strategies. In many cases, the demonstrations from the educational portion of the facility will indicate a number of possible strategies that may be applicable to a particular space. The only way a designer will trust these new types of equipment will be to experiment with the effects in a laboratory setting before specifying them for an actual project.

When not in use by client-users, the mock-up will be used for research. Equipment and systems provided by manufacturers or suppliers will be tested to collect energy consumption data and evaluate energy efficiency.

LAB OPERATION AND COST

The Lighting Lab will be administered by Seattle City Light. It will be staffed full-time by five people: a project manager, a lighting design specialist, a lighting technician, a technical resource and education coordinator, and a secretary/receptionist. Additional utility staff from Seattle City Light or neighboring utilities may work with their commercial customers at the Lab with the assistance of Lab staff. Many of these users will be part of the BPA-sponsored Energy Smart Design Assistance Program or the Commercial Incentives Pilot Program. Efforts will be made to attract users from around the Pacific Northwest.

A Technical Advisory Committee has been established and will meet every one to two months to provide guidance on technical and operational issues. Meetings of the Advisory Committee will be open to all interested parties.

The agreement with Bonneville is for construction and operation of the Lighting Lab over a three year period. After gaining experience with the Lab, the co-sponsors will seek funding for operation beyond 1991. The three year cost of the Lighting Lab will be $1,714,446. This includes $329,547 for design and construction (build-out of a leased space), $57,000 for acquisition of initial equipment and furnishings, and $300,000 for annual operating costs. Bonneville will pay for about 61 percent of the total, and the co-sponsors and other donors who have been solicited will pay about 39 percent of the total cost.
SUMMARY

A Lighting Lab is being built in Seattle to provide design assistance to lighting designers in the Pacific Northwest. The Lab addresses a lack of familiarity with the integration of lighting equipment, controls, daylighting and interior design, and the resulting lack of confidence in achieving simultaneously the goals of energy efficiency and high quality lighting. The Lighting Lab is intended to increase the regional marketplace for highly efficient, state-of-the-art commercial lighting systems and design approaches for both new construction and retrofit application.

The Lighting Lab will have areas for education, technical information and assistance, daylighting, and mock-up of specific applications. The Lab will be staffed by five full-time employees and will be guided by a Technical Advisory Committee. The Lab will be open for business by mid-1989.
Footnotes


Figure 1. Lighting Lab bubble diagram.