Best Practices Guide: Energy Efficiency Projects and Principal Investigators

I²SL International Institute for Sustainable Laboratories®

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Executive Summary

Laboratory facilities exist to meet the needs of their occupants. Retrofit projects that improve safety, control, and efficiency are beneficial for occupants and for facilities engineers. However, projects that necessitate disruption to research are at risk of being perceived negatively if the scientists' needs, opinions, and priorities are not taken into account. This guide for facilities staff, which draws on the experiences of the I²SL community, contains strategies for ensuring that lab retrofit projects proceed successfully and smoothly to the satisfaction of engineers and scientists alike.

About This Guide

Motivation

Laboratory facilities, like other buildings, exist to meet the functional requirements of their occupants. The requirements placed on labs, however, are more complex, demanding, and variable than for most other buildings.

Lab energy managers, energy consultants, and facilities engineers are tasked with helping buildings meet their functional requirements in a safe and efficient manner. This goal frequently necessitates major retrofits to existing lab buildings.

While some projects (e.g., chiller replacements) can be performed with minimal disruption to occupants, others (e.g., zonal controls retrofits, lighting fixture replacement, fume hood upgrades) are more invasive and may result in disruption to scientists' work during construction, along with permanent, noticeable changes to their working environment. Failure to address occupants' needs and concerns regarding staff relocations, research schedules, construction clean-up, and lab conditions leads to strained relationships and negatively impacts the effectiveness of the facility as a home for high-quality research.

> A safe, efficient, and pleasant work environment helps scientists to produce research that draws in funding for the organization.

Projects that improve safety, efficiency, environmental quality, equipment maintenance, and research workflow are beneficial for occupants and facilities staff alike. Satisfied occupants are more likely to cooperate with future retrofit projects, to follow usage guidelines for new equipment, and to work collaboratively with operations and maintenance staff. For some types of projects, occupant cooperation plays a vital role in achieving persistence of energy savings. A safe, efficient, and pleasant work environment also helps scientists to produce research that draws in funding for the organization.

By incorporating strategies based on lessons learned throughout the community, the majority of lab retrofit projects can be carried out with minimal disruption and to the reasonable satisfaction of all involved.

Using This Guide

This document aims to provide a guide for facilities staff, energy managers, and consultants embarking on energy retrofit projects in lab buildings. The guide focuses on understanding the needs and optimizing the experience of key lab decision makers such as Principal Investigators without compromising energy savings goals. It also demonstrates ways that facilities staff can communicate the intent of the project, identify unforeseen impacts, build trust, and open lines of communication with researchers.

This document is not intended to replace or duplicate good project management strategies; it is instead a supplement focused on the particular needs of scientists in lab facilities. Standard project management protocols such as careful scheduling, assigning clear responsibilities, problem escalation, and proper communication should be followed as for any construction project. Selecting contractors with experience working in laboratory or other complex space types should also help to promote success.

The strategies described in this document do not represent a single prescriptive recipe for success, but are a collection of ideas and lessons learned that can be adapted for use according to the needs and structure of a specific project. While this guide focuses on retrofit projects, many of the ideas are equally applicable to new construction. Additionally, a tailored approach to gathering user input for new construction projects was the topic of an I²SL webinar presented by Tracey Abel in 2015; a link to the webinar recording is provided in the References section at the end of this document.

Creation of This Guide

This guide was built from the shared experiences of the I²SL community, as addressed during a roundtable discussion session at the 2015 I²SL Annual Conference in San Diego. Session attendees later provided valuable reviews and feedback on the draft guide. The authors also included input from a series of stakeholder interviews carried out in 2015. I²SL wishes to thank all contributors to the production and review of this document.

Understanding and Communicating With Decision-Making Scientists

Principal Investigators and Their Priorities

Principal Investigators (PIs), the scientists who lead research groups, are not often seen wearing a lab coat. PIs are responsible for obtaining funding for research, for the direction of their group's work, and for guiding the careers of the group's researchers.

Beyond these key responsibilities, PIs' facility-related priorities may include safety, space temperature and temperature stability, noise levels, space sharing, cleanliness, lighting levels, and research workflow. In the face of many competing priorities, lab energy efficiency often falls below the radar. Additionally, even highly intelligent building occupants are typically unfamiliar with the specifics of commercial building heating, ventilation, and air conditioning (HVAC) and electrical systems and do not often consider their role in the overall performance of the building.

Energy efficiency may not be high on the priority list, but not because scientists don't recognize its importance. A 2014 Pew poll of U.S. adults and of professional scientists found that 87 percent of scientists believe that climate change is mostly due to human activity; only 50 percent of non-scientist adults shared this view. Further, a 2015 study by the Center for Energy Efficient Labs reported that 65 percent of key decision makers in U.S. labs regard energy efficiency as important or very important when making purchasing decisions.

While the title of this guide refers specifically to PIs as the key decision makers among lab scientists, it also deals indirectly with the satisfaction of all lab occupants and those who facilitate their work.

Points of Contact

Facilities staff must choose the best channels of communication with PIs and other scientists in labs. The best point of contact between facilities and scientists is a function of organizational structure and internal politics and should be chosen carefully. A successful project will often identify both leadership and operational points of contact.

On the operational side, **lab managers** (where present) can be an excellent bridge between facilities staff and scientists. With a lab manager in place, the busy PI can be less involved in the details of decisions involving the lab. On a large campus, **building managers** often have existing relationships with PIs and can therefore take on much of the task of gathering data on scientists' needs and concerns.

In some facilities, **Environmental health and safety (EH&S) staff** are natural ambassadors who can help to facilitate projects and overcome conflicts. Ventilation risk studies, if required for a particular project, represent an opportunity for EH&S staff to explain project goals and obtain occupant feedback. In some buildings, however, occupants are fearful of assessment and may not be cooperative with EH&S personnel. Similarly, **facilities operations and maintenance** or **engineering staff** in any given building may have developed collaborative or adversarial relationships with the occupants.

Leadership communication channels can be critical in obtaining the active cooperation of building occupants. The **Dean of Research** at an academic institution, or a company's **Chief Science Officer**, is a powerful ally. A project supported by research leadership is much more likely to be welcomed by scientists.

Choosing Communication Strategies

Starting early: Proper communication is crucial during the execution phase of any project. However, the groundwork for a productive relationship can

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be laid well before the project is planned. Facilities staff interviewed during the preparation of this guide highlighted two successful strategies:

- **Invite scientists to join facilities energy teams.** By asking a researcher from each lab to join regular stakeholder meetings (also attended by facilities staff, EH&S staff, utility representatives, and financial personnel), lab scientists can learn about facility goals and stakeholders' motivations and can provide input, ask questions, and receive early warning of proposed projects. This inclusive approach has been successful in many academic and industrial settings.
- **Develop a network of allies.** A less formal route to a similar end, this method involves identifying and developing an informal working relationship with occupants known to be interested in energy efficiency. As an ambassador for the facilities department, a scientist ally is an "internal barometer" on potential conflicts and barriers relating to proposed projects.

Once the project is identified, a wide range of strategies is in use at different organizations; each strategy comes with associated advantages and drawbacks and must be considered in the context of the project at hand. Successful management of change often involves using a combination of communication strategies. The options described below allow the project team to gather input at the same time as informing occupants about the expected benefits of the upcoming project. Communication methods in common use include:

- **Townhall meetings:** These are large, inclusive meetings for all building occupants and are a clear sign that the project is open for comments. By including the contractor in the meeting, interested occupants can also ask questions about the construction process. However, attendance at townhall meetings is often low and occupants may not feel a sense of urgency to participate. When reviewing input received at townhall meetings, it is worth considering whether the occupants who chose to attend were skewed toward those with the strongest objections.

- **Design charrettes or focus group meetings:** Meetings at which researchers are invited to provide comments and input on the project design. Invitations are typically targeted to specific individuals. For large projects, the use of a professional facilitator or mediator can help to tease out opinions.
- **Individual interviews:** Targeted discussions with individual stakeholders are an excellent way to obtain detailed input and feedback, but may be time-consuming.
- **Online surveys:** These are easy and quick to administer, but obtaining responses may be challenging. Online surveys are more likely to gather responses if they are distributed by someone with a personal connection to the respondents (e.g., a lab manager or an EH&S staff member with whom scientists have a good working relationship).

In all cases, the scope and purpose of group discussions should be made clear to all participants. It is helpful to delineate which aspects of the project are open for discussion and which are fixed. The discussion should establish shared and individual responsibilities and clear deadlines for input. Explaining why and when the requested information is required can help project management to obtain useful responses in a timely manner and to ensure that occupant expectations are managed.

Communication Options

- Invite scientists to join the facilities energy team
- Develop an informal network of allies
- Conduct townhall meetings
- Offer design charrettes or focus group meetings
- Conduct individual interviews
- Collect information with online surveys

Scheduling Projects

Research scientists are largely accustomed to schedule constraints. In a complex facility, service interruptions, safety briefings, lab cleanups, and equipment outages are common. Experimental equipment is finicky, research schedules are reworked based on new results, funding cycles come and go, and project staff changes are frequent. One facility engineer reported that it was more challenging to introduce and coordinate a major retrofit project in a law school library than in a science building! If approached in an organized, collaborative way, laboratory project scheduling can be a straightforward exercise.

Occupant objections can be minimized by scheduling work well in advance. When scheduling projects, it is vital to consult with scientists to ensure that interruptions do not conflict with crucial experimental deadlines. Lab experiments may span months, and grant funding patterns may necessitate that work is completed during a certain period. Major facilities projects have been shelved indefinitely because coordination with experimental schedules was not addressed. It is generally acknowledged that coordinating a construction schedule with the needs of scientists will affect the project budget; scheduling and changeover requirements should therefore be included in the project specifications sent to potential bidders.

Project schedules, once fixed, should be respected as much as possible. Initial schedules should be realistic and should include buffers to accommodate unforeseen changes. Any changes to the plan should be communicated to lab occupants as soon as they are known.

The lead-time required for notifications depends on the scale of the project. For a project involving moderate disruption (e.g., a lab HVAC controls retrofit), an early warning might be delivered 3 to 6 months in advance. One month before the project, meetings with individual labs might be arranged to discuss specific concerns. One week before work commences, another meeting may be required to coordinate details with each lab.

Communication During Construction

Managing communication with PIs and occupants continues to be important once construction has begun. As mentioned above, changes to the construction schedule should be communicated as soon as they arise. Additionally, posting an **official project email address** in building common areas helps to ensure that occupant questions, issues, and complaints are directed to the project manager (and not, for example, to the flooring contractor working in a space).

Project Design

Knowing the functional needs of each space involved in the project is critical to successful project design. Sources of this information include energy auditors, lab managers, and building managers, along with researchers' comments gathered during interviews or design charrettes.

Distinguishing Needs From Desires

Designing a successful project requires balancing the needs of the occupants with the energy (and safety) goals of the retrofit. These goals can occasionally appear to be in direct opposition. Examples include:

Posting an official project email address in building common areas helps to ensure that occupant questions, issues, and complaints are directed to the project manager

- Facilities staff intends to initiate night setback of airflow in labs. PI reports the labs are in continuous use at all hours, therefore airflows cannot be set back.
- Facilities team intends to upgrade HVAC zone controls from pneumatic to direct digital controls (DDC). PI reports that any new controls must produce a constant room temperature of 72°F ±0.2°F to permit tissue samples to be grown on the bench.
- PI requests extra air supply to condition a small room currently containing four ultra-low-temperature freezers. Facilities engineering team anticipates that this lab will move to a different building within the next 3 years.

With a careful approach, each of these issues can be addressed to the reasonable satisfaction of all parties. By breaking down requests to determine real needs, unnecessary work and roadblocks can be avoided. Possible solutions include:

- Poll other labs (or draw on experience) to determine whether the PI's request is typical or reasonable.
- Log current space temperatures to demonstrate the level of variation under which research is proceeding successfully.
- Offer a conditioned enclosure (with tight temperature controls) as an alternative to implementing large-scale changes to air handler operations.

- Offer to implement proposed energy-saving changes on a trial basis (where possible) and to reverse if issues arise.
- If special space conditions are required, ask whether these are required 24/7, or whether conditions might be relaxed at nights or during weekends.
- Provide override buttons or occupancy-based controls to permit night setback operation.
- When interviewing researchers, ask what they *do* in the lab, not what they *need*. Conditions can then be chosen to be typical of that type of research.
- Offer alternatives where special services are requested, e.g., suggest that freezers might be spread out between two equipment rooms, or offer temporary spot cooling equipment (if available). Don't expect even these highly intelligent occupants to be familiar with HVAC design requirements or equipment constraints—help them understand!

Creating an Attractive Package

Energy efficiency projects, while disruptive, often result in an improved working environment for the occupants. By asking researchers to list their concerns about existing space conditions, then adding low-cost items to proposed projects, occupant satisfaction with the overall project can be improved significantly. Facilities management staff may also be appreciative of these improvements. The process of incorporating low-cost, occupant-driven additions to projects should be started early in planning and must be done in coordination with the project manager.

- **Add wish list items to project scope**, e.g., patching and painting or replacing stained ceiling tiles. Improvements to the researchers' working environment are good for productivity and may boost positive impressions of the project. Before asking users to discuss their wish list, a portion of the project's budget must be committed to implementing at least some of the requested items.

Incorporating low-cost, occupant-driven additions to projects should be started early in planning and must be done in coordination with the project manager.

- **Emphasize benefits to research and to occupant comfort**, e.g., by highlighting better temperature control, lighting levels, or space cleanliness expected to be a result of the project. The driving goals of the project (e.g., improved ventilation, reduced CO_2 emissions, reduced maintenance requirements) may also be communicated in order to demonstrate the need for the project and its associated disruption.

Some research grants may provide funding for remodeling projects. Scientists may be able to confirm whether such funding is available for a given project.

Other strategies to encourage adoption of proposed projects:

- **Develop facility design guidelines for lab improvement projects.** With a general policy in place, projects that bring labs into line with the rest of the institution are more readily acceptable.

- **Make participation the default assumption**. In most institutions polled, lab PIs do not have official authority to prevent facilities projects from going forward. Tenant support should be sought wherever possible, however; severe repercussions may be associated with foisting a project on an unwilling lab.
- **Seek prior approval and coordination support from the Dean of Research, Chief Security Officer (CSO), or Chief Executive Officer (CEO).** Leadership buy-in is very persuasive and signals that the project is pre-approved and that support is available for working on tenant issues.
- **Know when to back off.** One special case or holdout need not derail the entire effort.
- **Use focus group or meeting minutes** to provide a record of information distributed, requested, and received. Clear deadlines during information collection periods can also help to avoid issues surfacing during the later stages of the project.
- **Create an Owner's Project Requirements document** for the project, incorporating input from PIs and other stakeholders.

KEYS TO ACHIEVING PROJECT BUY-IN

- Add wishlist items to project scope
- Emphasize benefits to research and to occupant comfort
- Develop an institutional standard policy
- Make participation the default assumption
- Seek prior approval of the Dean of Research, CSO, or CEO
- Know when to back off
- Create an Owner's Project Requirements document

Demonstrating Success

Project follow-up work is important for a number of reasons, including documentation of success and discovery of issues remaining beyond commissioning.

> Success may be demonstrated to the occupants in a number of ways, including research-style posters, follow-up meetings, email updates, and installation of building dashboards showing live information about improved energy consumption.

Projects that are known to be successful are likely to be more easily replicated in other buildings.

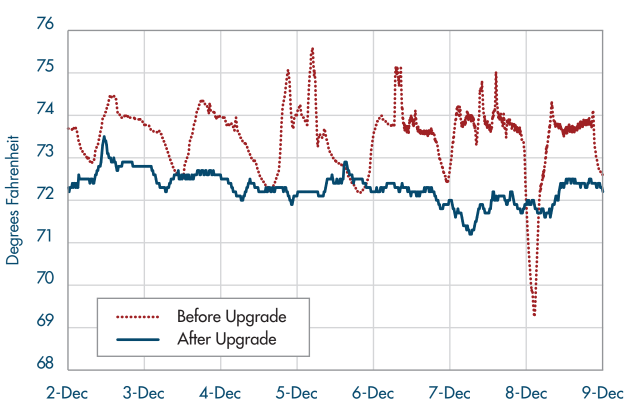
Success may be demonstrated to the occupants in a number of ways, including research-style posters about the project, follow-up meetings, email updates, or installation of building dashboards showing live information about improved energy consumption. Note that dashboards are not always used by researchers, who have many competing requests for their attention on a daily basis. It may be possible to make dashboards or facility reports more engaging for users by including safety, scheduling, or other day-to-day updates along with energy-related data.

If the project team anticipates making lasting changes to the occupant experience, some precautionary measurements may be helpful. Making measurements before implementation and comparing with those taken afterward is an excellent way to demonstrate that conditions have improved (especially if occupant perceptions differ). As with measurement and verification of energy savings, advanced planning is essential. Data logging is inexpensive and simple to perform. Two example cases follow:

- **Noise level measurements** before and after a controls retrofit project that resulted in reduced airflow rates in the labs. Occupant complaints of increased noise after the project could be understood and resolved because sound-level readings were taken before and after implementation. Overall sound levels were indeed lower, but noisy vacuum pumps could now be heard more clearly because of reduced background noise.

- **Space temperature logging** before and after a pneumatic-to-DDC controls retrofit project. New thermostats were equipped with LCD screens showing room temperature, leading to occupant reports of temperature instabilities. Temperature logger data from before the retrofit were used to demonstrate that space temperature variations were actually reduced as a result of the project.

Temperature Logging Before and After Controls Upgrade



Light level readings might also be taken to allay concerns following lighting retrofit projects. Other useful actions might include:

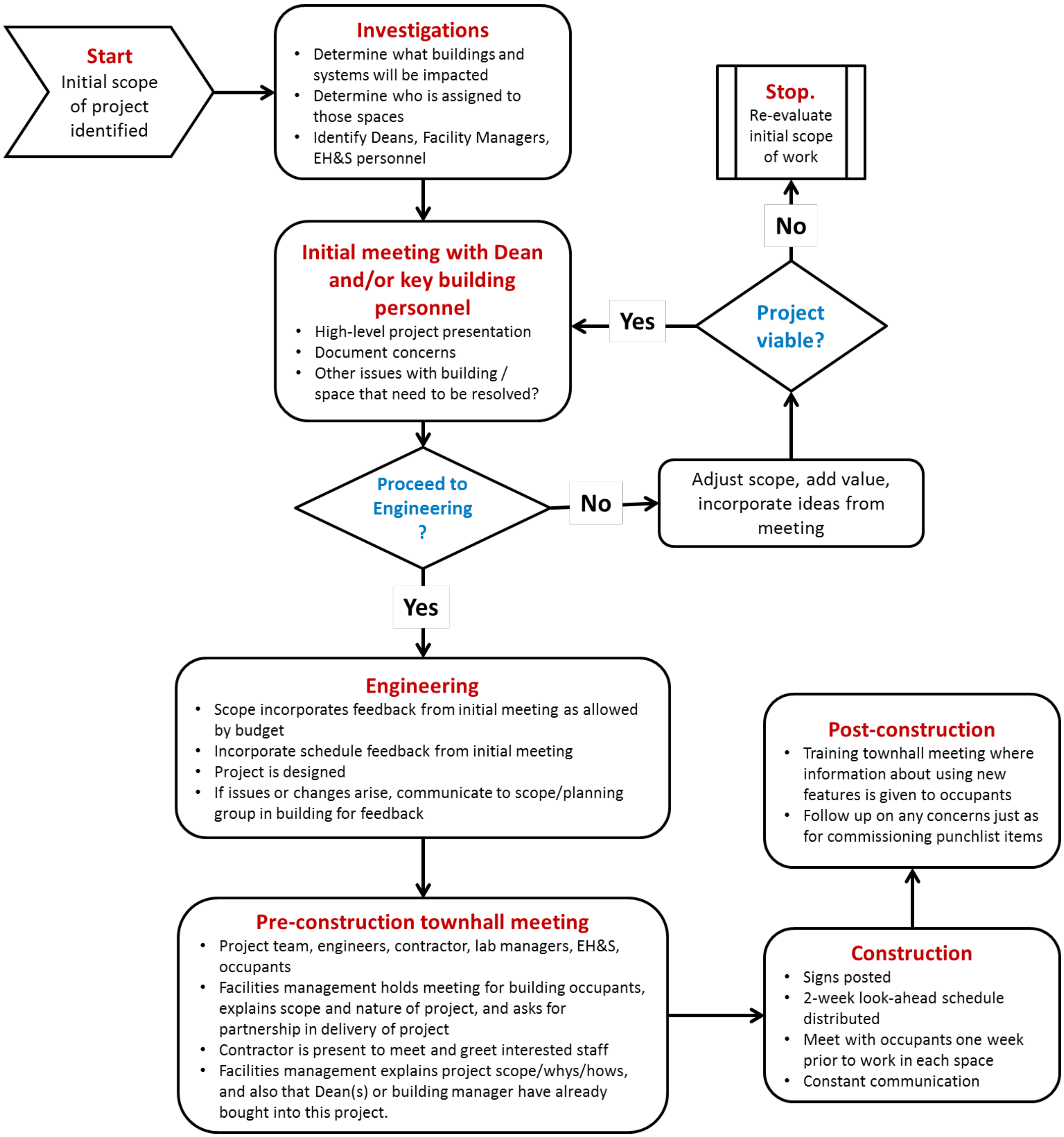
- **Photographing** lab spaces before, during, and after construction to document space conditions. This encourages clean work practices and helps to prevent misunderstandings about damage to equipment.
- **Training occupants** on new building features. This allows concerns to be aired and provides an opportunity to demonstrate success. Where tenant behavior affects energy consumption, this also ensures that tenants are informed of their responsibilities to support the laboratory's performance.

Ideas for Improving Post-Project Satisfaction

- Conduct follow-up meetings
- Provide real-time dashboards showing energy consumption
- Create informative research-style posters on the project
- Measure environmental parameters before and after the project
- Photograph labs before and after the project
- Train occupants on new building features

Case Study: University of California, Irvine

As stated throughout this guide, there is no single correct way to approach occupant interactions during a lab retrofit project. The University of California, Irvine (UC Irvine) developed a successful strategy based on its organizational structure and project needs. A flowchart illustrating this approach is provided below.



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Concept to Completion, I^{2}SL webinar by Tracey Abel (Dec 17, 2015). The presentation describes a process for capturing lab user input for building design and its successful application at Colorado State University: www.i2sl.org/training/2015/webinar_dec17.html