



SUSTAINABILITY AND GREEN INITIATIVES

by Randy Smith

Duke University's Green Lab Program: Creating More Sustainable Research Labs

On a per square foot basis, research labs can require five times more energy to operate than classrooms and office spaces. That's a lot of chilled water, steam and electricity, not to mention dollars. If your local utility company uses fossil fuel as the primary fuel source for electrical generation, the carbon footprint for a typical research laboratory can be quite large.

Average Research Lab Results In Significant Environmental Impact

Laboratories also typically utilize hazardous chemicals and a large volume of consumable supplies and copious amounts of water. All these factors taken together can result in a significant environmental impact for the average research lab.

Creating a Sustainable Lab: New Construction

If you're lucky enough to be planning for a new laboratory building, you begin with the understanding that you will have to pay to operate and maintain the building for maybe upwards of forty years.

Due consideration of "lifetime cost"—the purchase price, plus operation and maintenance costs over the life of an item—here is critical. "Value

engineering” on building systems that lower the purchase price but increase operating and maintenance costs may not look like a good value ten years down the road.

There are many options out there for high efficiency fume hoods, “intelligent” ventilation systems and the like that can be incorporated into either new construction or to a retrofit that can have a significant impact on bottom line operating costs. This would also be a great time to consider space for a “freezer farm” for shared ultralow temperature storage of biological samples, potentially reducing plug load and heat load.

Creating a More Sustainable Lab: Renovating and Remodeling

If you’re like most of us, you’re not currently designing a new lab but trying to reduce the environmental (and cost) impacts of the labs you’re working in now. In order to encourage and guide laboratories in their sustainability efforts, many universities have created a “Green Lab” program.

These programs, customized to each university’s needs, set the bar by defining expectations and sustainable lab criteria, then provide resources to help labs achieve their sustainability goals.



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Additionally, the programs often follow up with some recognition of the achievements made. Although the Green Lab programs will vary among institutions, most address similar issues revolving around energy conservation, water conservation, hazardous chemical usage, green purchasing and recycling. While some of these issues involve changes to equipment

or facilities, most are addressed by behavioral changes of the people in the labs.

Fume Hoods and Energy Usage

Energy usage in a laboratory is driven by ventilation (including heating, cooling and humidity control), lighting and plug load (equipment plugged into electrical receptacles).

The fume hood is the major culprit here. Installation of high efficiency, low flow hoods and intelligent ventilation systems are great additions at the facility level, but proper fume hood sash operation by lab personnel is also key.

Closing the sash of a hood equipped with a variable speed fan can greatly reduce the volume of conditioned air expelled from the lab, potentially saving thousands of dollars each year. Many schools have run “Shut the Sash” awareness campaigns and contests to affect this behavioral change.

Energy use from lighting can be reduced by selective elimination of lighting where appropriate, the substitution of task lighting, or just turning out the lights at the end of the day.

Using More Energy-Efficient Equipment

Selection of energy efficient equipment (Energy Star rated, when available), particularly freezers and refrigerators, is important for energy conservation.

For example, full size refrigerators and freezers are generally more energy efficient, on a cooling volume basis, than undercounter models. Simply turning off unused lab equipment and computers will also contribute to energy use reductions.

For most labs, the second largest energy hog (after the fume hood) is an ultralow temperature freezer. They not only draw a lot of electricity but they also give off significant heat into the room that must be cooled.

Freezer preventive maintenance programs will extend the life and efficiency of the equipment, and freezer inventory programs that encourage the discarding of obsolete samples can help reduce the number of freezers in operation.

Elements of Lab Water Conservation

An important element of water conservation for sustainable labs is the elimination of single pass cooling of equipment or reactions with tap water. Sometimes this need can be eliminated with something as simple as an apparatus made from an ice bath and an aquarium pump.

More sophisticated (and expensive) solutions involve small recirculating water chillers or built-in chilled water loops. Conservation of purified (DI, RO, etc) water is important, too, since it takes 2 to 3 volumes of water to make 1 volume of purified water. Sterilizers can also be modified to utilize less water.



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Funding Sources and Financial Incentives

When considering energy and water conservation measures, it is important to keep in mind where the financial incentives lie. Generally speaking, the faculty are not responsible for paying energy or water costs associated with their research lab and therefore may need encouragement through funding assistance in order to make changes to equipment.

It seems logical that the funding source would be the entity that benefits from reduced energy and water usage. At my institution, this is at the school level. Arts and Sciences has two programs in place to assist faculty with energy efficient equipment upgrades.

One program bridges the cost differential between standard equipment models and more energy efficient models. The second is a purchasing assistance program that focuses on ultralow temperature storage by providing \$3000 toward the purchase price of a specific ultracold freezer model that saves \$500 per year in energy costs vs. other models.

Benefits of Practicing Green Chemistry

Making a lab more sustainable also involves reducing the quantity of hazardous materials that leave the lab. Practicing “green chemistry” can help. MIT and the EPA have resources on the web that can be a guide.

Additionally, taking care to keep the quantities of hazardous material ordered to that actually needed is important; that quantity discount may not really be a great deal from an environmental point of view come disposal time. And, following all federal, state and local regulations goes without saying.

Recycling and Green Purchasing

Green purchasing and recycling go hand in hand. Green purchasing covers everything from choosing supplies with recycled or recyclable content, to buying from suppliers with sustainability certifications, to simply grouping orders to reduce shipping packaging.

Many vendors will take back their shipping containers or things like pipet tip boxes; with a little effort, most things are recyclable.

A Huge Piece of the Campus Environmental Footprint

Research labs can be a huge part of the environmental footprint of a college campus. Many of the steps needed to be taken to make those

labs more environmentally sustainable and less costly to operate are free or low cost, involving only changes in occupant behavior.

Other changes may have significant initial costs but attractive returns on investment. There is no need to reinvent the wheel here. Many of your colleagues have gotten started and are happy to share their experiences.



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