LEED for Labs – Review and Outlook

By Paul Mathew, Ph.D. and Kath Williams, Ed.D.

Laboratory facilities present a unique challenge for energy efficient and sustainable design, with their inherent complexity of systems, health and safety requirements, long-term flexibility and adaptability needs, energy use intensity, and environmental impacts. The typical laboratory is anywhere from 3-8 times as energy intensive as a typical office building and costs about three times as much per unit area.

LEED, EPC, and LEED-AGL

The Laboratories for the 21st Century (Labs21) Program developed the Environmental Performance Criteria (EPC) in response to a desire by laboratory designers to have a rating system similar to LEED, but more tailored to the unique characteristics of laboratory facilities. It was developed with the expertise of over 40 volunteers, including laboratory architects, engineers, facilities, and health and safety personnel. The EPC modifies some of the LEED credit requirements, and adds several new credits and prerequisites in areas not addressed by LEED. The EPC has been used on many projects by over a dozen organizations, including pharmaceutical companies, federal agencies, colleges and universities. The EPC was also incorporated into the University of California Regents' policy on sustainable design.

While the EPC was well received by the laboratory design community, it was never the intention of Labs21 to provide third-party certification similar to LEED. USGBC was encouraged to develop a LEED Application Guide for Laboratories (LEED-AGL), building on the EPC, and in 2003 USGBC formally sanctioned a committee to begin work on the LEED-AGL. However, since then, progress has been slow because the USGBC has been revising its policy on application guides. The current draft is pending review and further action by the LEED steering committee.

The LEED-AGL uses the EPC as a starting point, and the current draft incorporates most of the EPC requirements. To summarize the distinction between the three products:

- LEED for New Construction (LEED-NC) was developed by USGBC. Laboratories may be currently certified under this rating system, but it is not especially well-suited for this purpose.
- EPC was developed by the Labs21 program. It builds off LEED-NC and is well-suited to laboratories, but Labs21 does not provide certification.
- LEED-AGL is currently under development by USGBC and builds on EPC. When it eventually is launched, laboratories will be able to get a LEED-AGL certification.

In the remainder of this article, we describe key features of the new and modified credits and prerequisites and how to apply these credits in your projects now.

Sustainable sites: Reducing hazards from laboratory effluents

All the LEED-NC credits for sustainable sites are valid for laboratory facilities. However, unlike other commercial buildings, laboratories typically have hazardous effluents that could present risks to people and the environment. Accordingly, the AGL adds a credit for design efforts to manage these risks:

- Use physical or computational modeling to assess and reduce impact of air effluents (see figure 1). Although such modeling adds to design costs, it provides increased assurance of safe effluent dispersion[1].

Water efficiency: Addressing process water use

All the LEED-NC credits for water efficiency are valid for laboratory facilities. The AGL also adds a pre-requisite and a credit specifically addressing process water use, since this is significant in laboratories.

- Ensure that no domestic water is used ”once-through” for any laboratory equipment, since this is often a major cause for excess water use. (This is a prerequisite). At EPA’s Ann Arbor laboratory, the elimination of once through cooling reduced water use by 50%.
- Document and reduce process water use and process wastewater generation by 20% (1 point) or 30% (2 points).

Energy and atmosphere: Focus on laboratory systems

Given the significance of energy use in laboratory buildings, this section has some of the most important changes relative to LEED-NC.

- Optimize ventilation rates considering user needs, health/safety protection and energy consumption. (This is a prerequisite). Ventilation is a major component in the energy use of laboratories. There is a wide range of, and debate over required ventilation rates for different types of laboratories. While LEED cannot prescribe a particular rate, the intent of this prerequisite is to ensure that owners do not use excessively conservative rates without due analysis and consideration of alternatives. Labs21 experience has shown that often projects start out with assuming a high minimum (e.g.12 ACH), but that if this is carefully questioned and investigated by all stakeholders, it can be optimized downward. It is often assumed that more is better, and that is not necessarily the case. In fact, higher air change rates may lead to more turbulent airflow that affects hood performance, compromising safety and energy efficiency. Thus, just going through the process of properly assessing the minimum air change rate can yield optimum results for safety and energy efficiency.
- Increase the efficiency of laboratory HVAC and lighting systems. For energy efficiency, LEED-NC adopts a performance-based approach, using the ASHRAE

[1] See the Labs21 Best Practice Guide on Effluent Dispersion: http://www.labs21century.gov/toolkit/bp_guide.htm

90.1 energy cost budget (ECB) method (ECB) as the benchmark, with points awarded for reductions below the benchmark. ASHRAE 90.1 as applied in LEED-NC currently has several limitations vis-à-vis laboratory HVAC systems and promoting energy efficient strategies for laboratories. To address these limitations, the credit requires the use of the Labs21 Laboratory Modeling Guidelines, which provide additional guidance that modifies and clarifies some of the requirements in ASHRAE 90.1. This ensures that major energy efficiency strategies for laboratories are properly rewarded. (see sidebar)

- Right-size mechanical equipment by improving estimates of heat gain from laboratory equipment. Heat loads from laboratory equipment are often significantly overestimated leading to grossly over-sized mechanical and electrical equipment (see figure 2). This results in wasted first cost, and inefficient operation. Measured data should be used for estimating loads and allowances for future growth should be taken judiciously.[2]

In addition to the above changes, the AGL reduces the percentage requirements for renewable energy and green power. Laboratories are anywhere from 3-8 times as energy intensive as an office building. Thus it is much more difficult and expensive to achieve the same percentage thresholds as commercial buildings. Accordingly, the AGL conservatively reduces the requirements for renewable energy and green power by about half.

Materials and resources: Manage hazardous material flows

The AGL does not add any new credits to LEED-NC in this area, but makes a few modifications:

- Use environmentally preferable finishes, fixed furniture and laboratory furniture. This credit has been significantly changed from the LEED-NC Renewable Materials credit to meet the credit intent with a larger range of materials. Currently very few renewable materials are suitable for use in laboratories. This credit, as redefined, expands the palette of finish and furniture materials available to laboratory designers.

In addition to the above change, the AGL modifies the default materials cost used in calculations for credits pertaining to materials reuse, recycled content, and regional materials. This modification accounts for the fact MEP costs (as % of total costs) in laboratories are much higher than in other commercial buildings.

Indoor Environmental Quality: Design for health and safety

Safety is the first priority for any laboratory environment. The AGL makes several important modifications and additions to the LEED-NC credits in order to ensure that efforts to improve health and safety are appropriately recognized. These include:

- Meet the minimum requirements of relevant sections of ANSI/AIHA Z 9.5. (This is a prerequisite).

[2] See the Labs21 Best Practice Guide on Right-sizing: http://www.labs21century.gov/toolkit/bp_guide.htm

- Commission all fumehoods per the ASHRAE 110 method of testing, as installed. Additionally, comply with the SEFA (Scientific Equipment and Furniture Association) 1.2 “As Installed” recommended practices.
- For biosafety cabinets, meet or exceed the requirements of the National Sanitation Foundation International (NSF) Standard 49
- For exhaust devices that do not have standardized test procedures (e.g. ventilated storage cabinets, snorkels, instrument exhausts), verify performance with smoke test or other appropriate method.
- Optimize indoor airflow based on results of computational fluid dynamics (CFD) or physical modeling.
- Improve indoor chemical and pollution source control through measures such as chemical storage cabinets vented to the outside, raised lips around cup sinks, and other methods of secondary containment to prevent accidental discharge to drains.
- Design all alarm systems in the laboratory to be inherently self-identifying and failsafe. This includes fume hood alarms, ventilation alarm, exterior door/window alarms, etc.

The AGL provides for certain exemptions for the LEED-NC credits pertaining to low-VOC paints and coatings, thermal comfort, lighting and temperature control, and daylighting. Laboratory spaces in which the credit requirements directly conflict with experimental work are exempt from the requirements. For example, certain optical laboratories require complete darkness, and would therefore be exempt from meeting the daylight requirements.

Applying the draft LEED-AGL to your laboratory project

As noted earlier, the LEED-AGL is still in draft form, and at this time, it is unclear when it will be approved for use in LEED certification. In the interim there are at least two ways in which the AGL can be leveraged for your sustainable laboratory design projects:

- The credits may be used to obtain innovation points under LEED-NC. For example, the USGBC has approved fumehood commissioning using ASHRAE 100 as an innovation credit.
- The AGL may be used for internal “self-certification” and to evaluate laboratory projects at various stages of the design process.

Experience with the Labs21 EPC, upon which the AGL is based, indicates that laboratory owners and designers are well-served by using these criteria. The recently completed Molecular Foundry Laboratory (MFL) at Lawrence Berkeley National Laboratory (LBNL) is a case in point. The MFL has applied for certification under LEED-NC and is expected to get a silver rating. The design team also used the Labs21 EPC criteria to further improve the design in areas not addressed by LEED-NC. The EPC right-sizing credit calls for measuring equipment loads in comparable spaces to inform the sizing decisions. LBNL and the design team measured actual loads in three other laboratory buildings at the LBNL campus, and the electrical and mechanical systems were downsized by roughly one-third, resulting in a savings of about $2.5 million. These savings covered the LEED compliance “hard” (construction) costs of just over $400,000,

with money to spare. The $2.1 million in net savings represented over 4% of the total construction costs of the project.

Thus, while the LEED-AGL is still forthcoming, laboratory owners and designers can benefit from applying it to their projects.

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Sidebar

Major Efficiency Strategies for Laboratories

- VAV fume hoods
- High performance low-flow fume hoods
- Energy recovery (latent and sensible) *
- Low-pressure drop design *
- Systems that minimize or eliminate reheat *
- Multi-stack exhaust plenum with staged exhaust fans
- Multiple cooling loops at different temperatures.
- High part-load heating and cooling efficiency
- Occupancy controls for lighting and ventilation
- Minimize areas requiring high ventilation rates

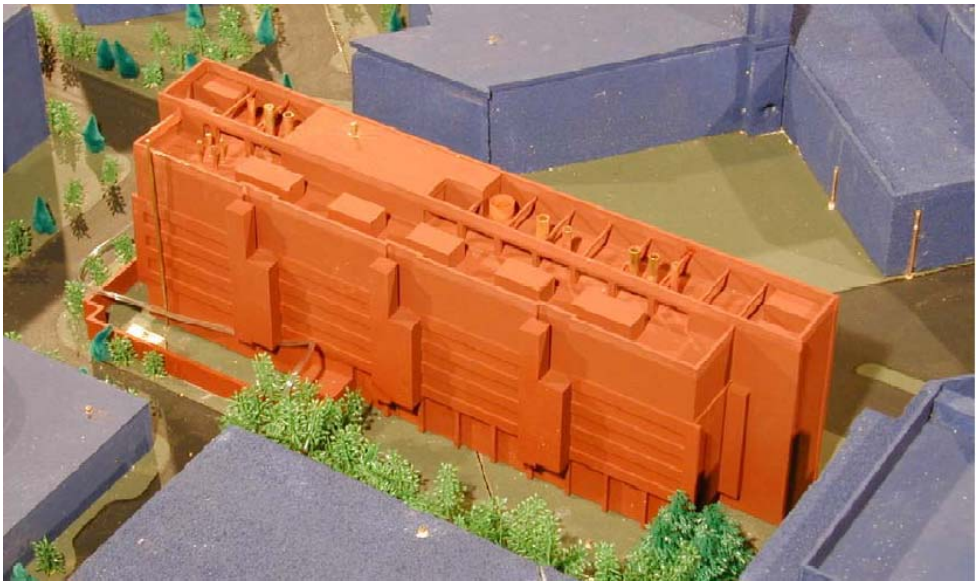

Figure 1. This wind tunnel model for a medical research laboratory in an urban environment showed that stack configuration was inadequate, even with an entrained air stack. Source: Cermak Peterka Petersen

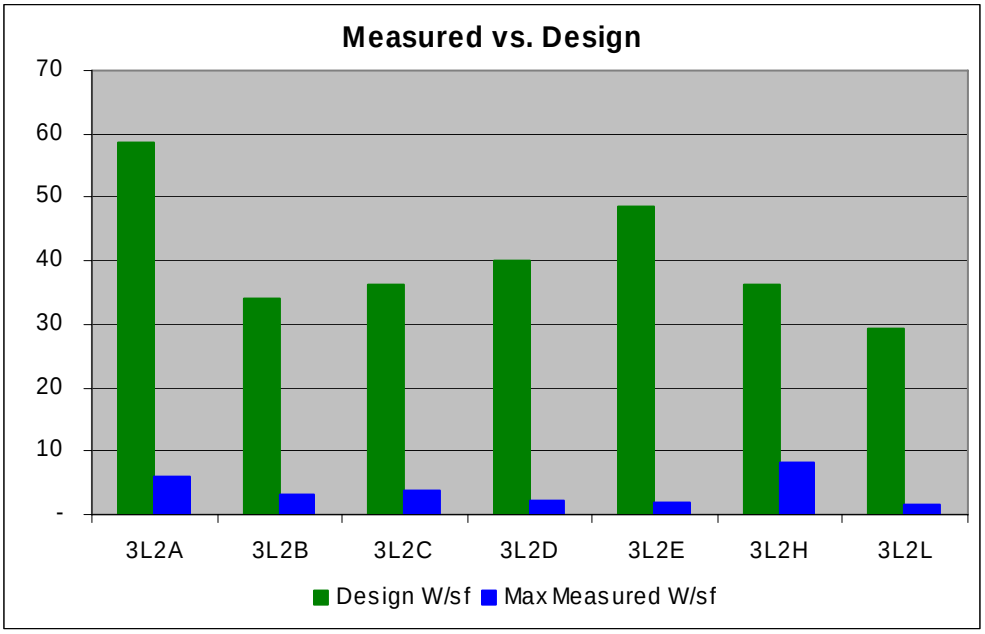

Figure 2. Measured vs. design plug loads in various laboratory spaces at a large university.

Figure 3. The Molecular Foundry at Lawrence Berkeley National Laboratory is one of many projects that have applied Labs21 EPC (precursor to the LEED-AGL) to improve the sustainability of laboratory systems.