

Laboratory Efficiency Strategies and the Smart Labs Program



Session Outcomes

- Recognize the benefits of implementing a Smart Labs Program.
- Identify how to reduce energy consumption and carbon emissions.
- Choose characteristics of a core team for successful project implementation.
- Recognize how to improve efficacy of laboratory ventilation systems.
- Select options that indicate an understanding of the tools that can be utilized in the design and construction process.



Laboratory Efficiency Strategies and the Smart Labs Program

Rachel Romero

National Renewable Energy Laboratory

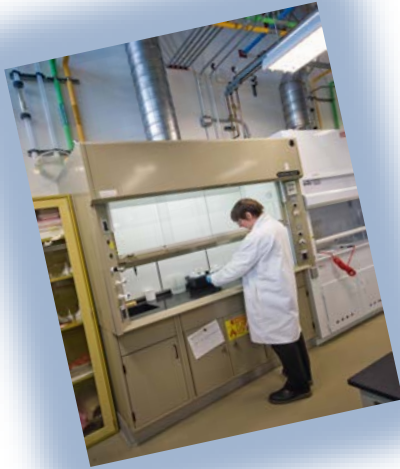




Rachel Romero, PE

Senior Engineer

Why Labs?



Laboratories typically use **3 - 4**
(up to 10) times more energy
than an average office building.



20% - 40%

Cost-saving opportunities in
labs



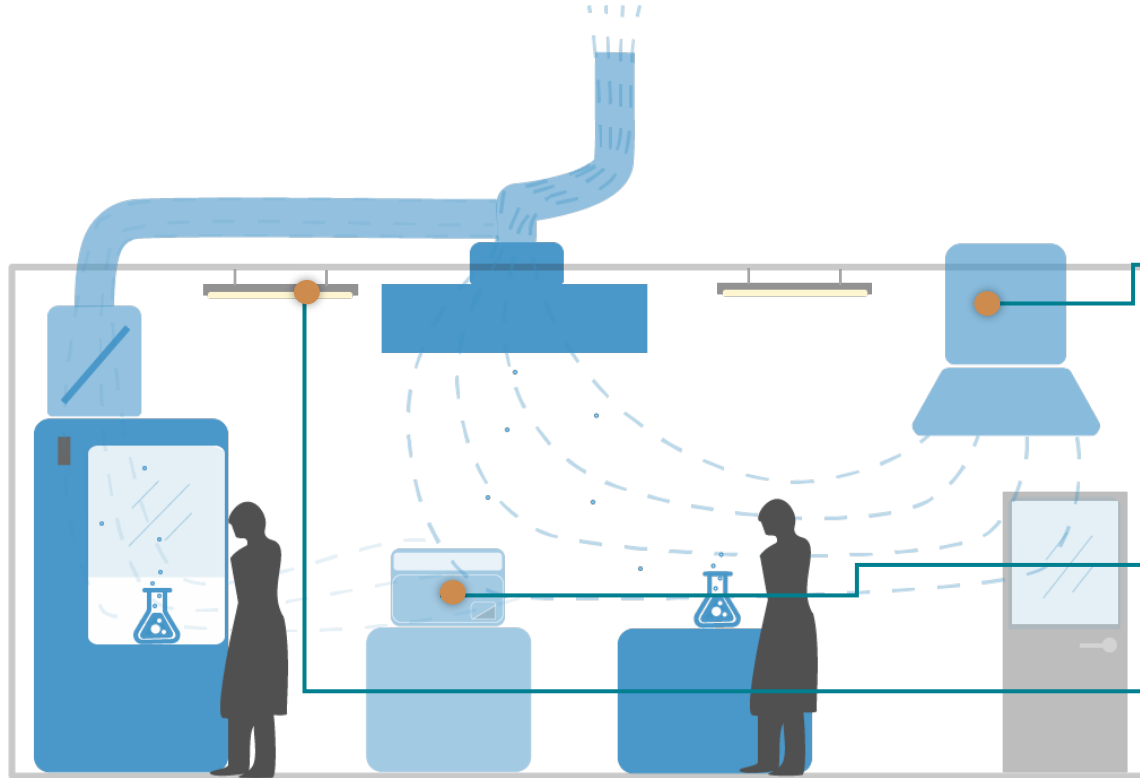
\$1-2 Billion

Potential energy savings across
US labs



Energy Use in Laboratories

Top 5 Energy Users



1 **Ventilation**

2 Cooling

3 Heating

4 Plug Loads

5 Lighting

Big Picture Impact

There are over **150,000 U.S. labs** where **500,000 people** collectively depend on laboratory systems to **keep them safe**.

Even high-performance airflow systems **can lose up to 50% of their control ability** within five years.

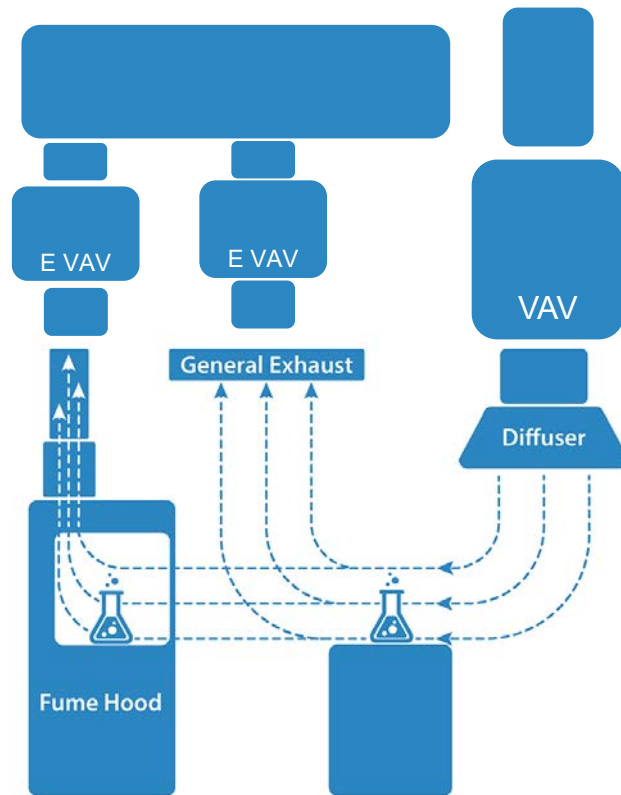
Yet...



ACH



Improved Safety



Big Picture Impact

ANSI Z9.5: Laboratory Ventilation...

- Discusses how air flow rate is just one factor that **safeguards** workers from harmful airborne contaminants
- Recommends a **ventilation risk assessment** to determine minimum airflow rates

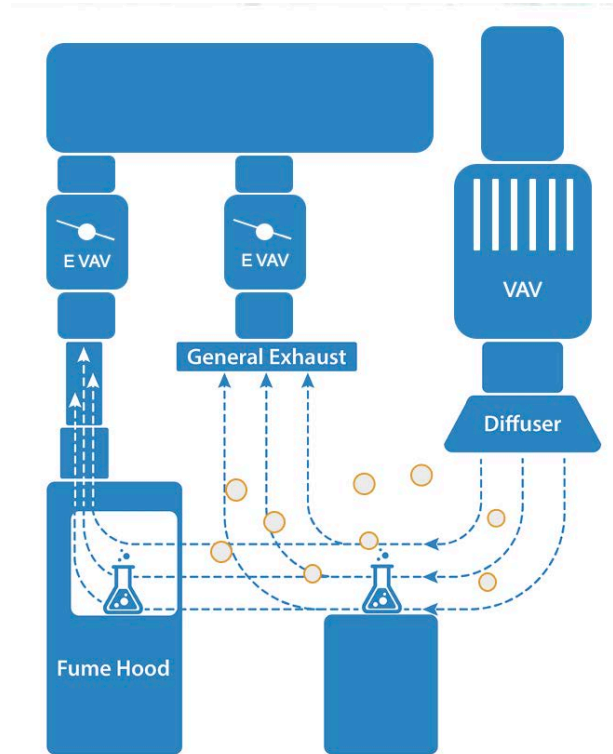
Pattern of airflow



ACH



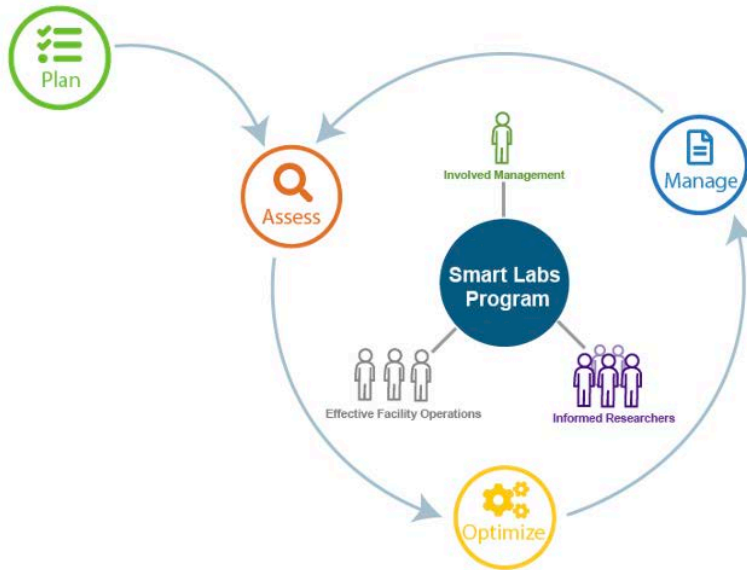
Improved Safety



A Smart Labs program enables **world class science** through the design and operation of **safe and efficient** high-performance labs.

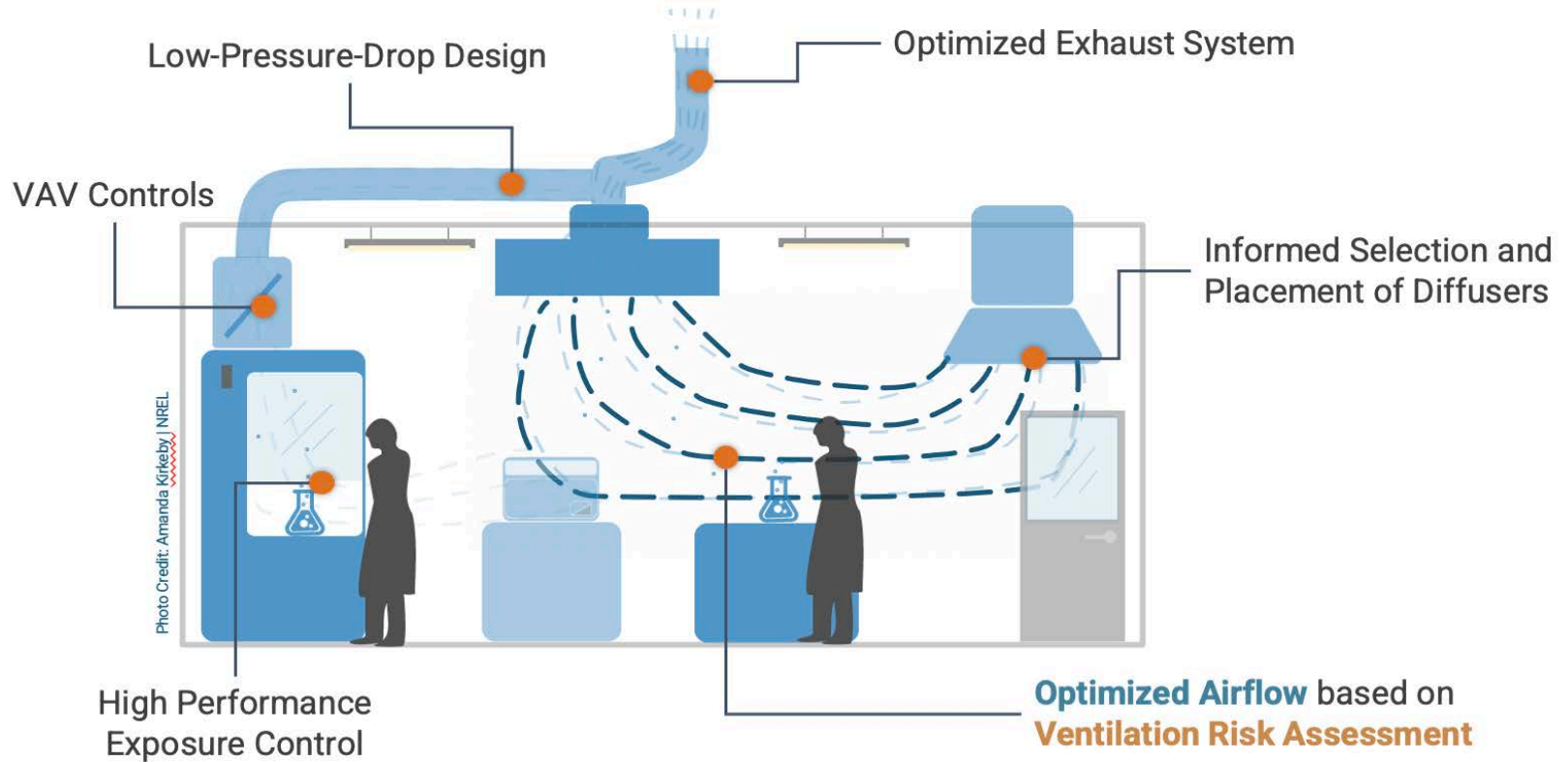


The Future is...Smart Labs!



- Optimize Safety
- Improve Energy Efficiency
- Reduce Costs
- Maintain High Performance Labs

High Ventilation Effectiveness




Laboratory Ventilation Risk Assessment

Method to provide ventilation designers and laboratory safety personnel with a **systematic, effective process to assess risk.**

- Assessment Categories

- Types of hazards and procedure
- Generation characteristics of hazard
- Quantity of materials used or generated
- Frequency and duration of hazard generation
- Containment by exposure control devices

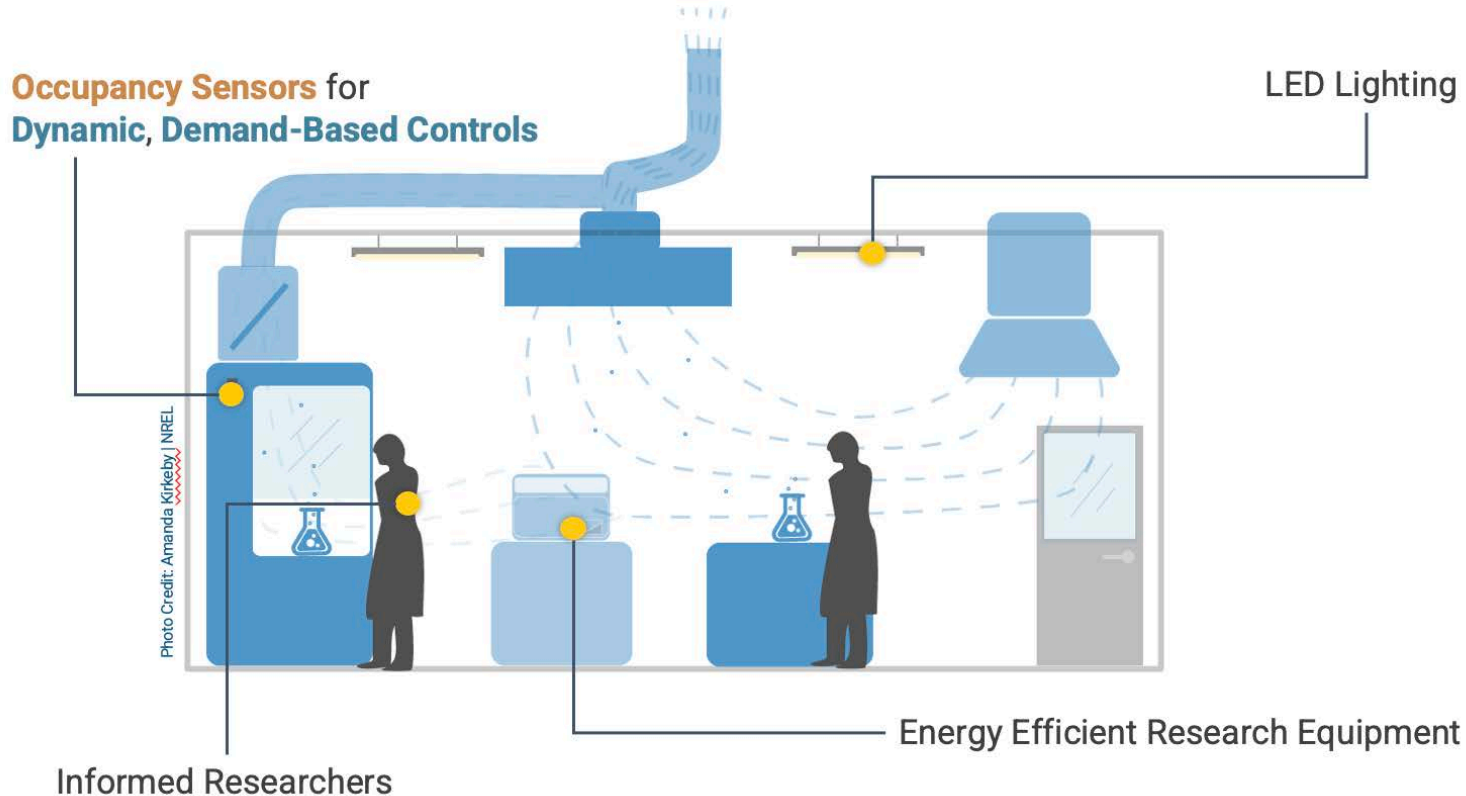


Risk Level	Description
0	Negligible
1	Low
2	Moderate
3	High
4	Extreme

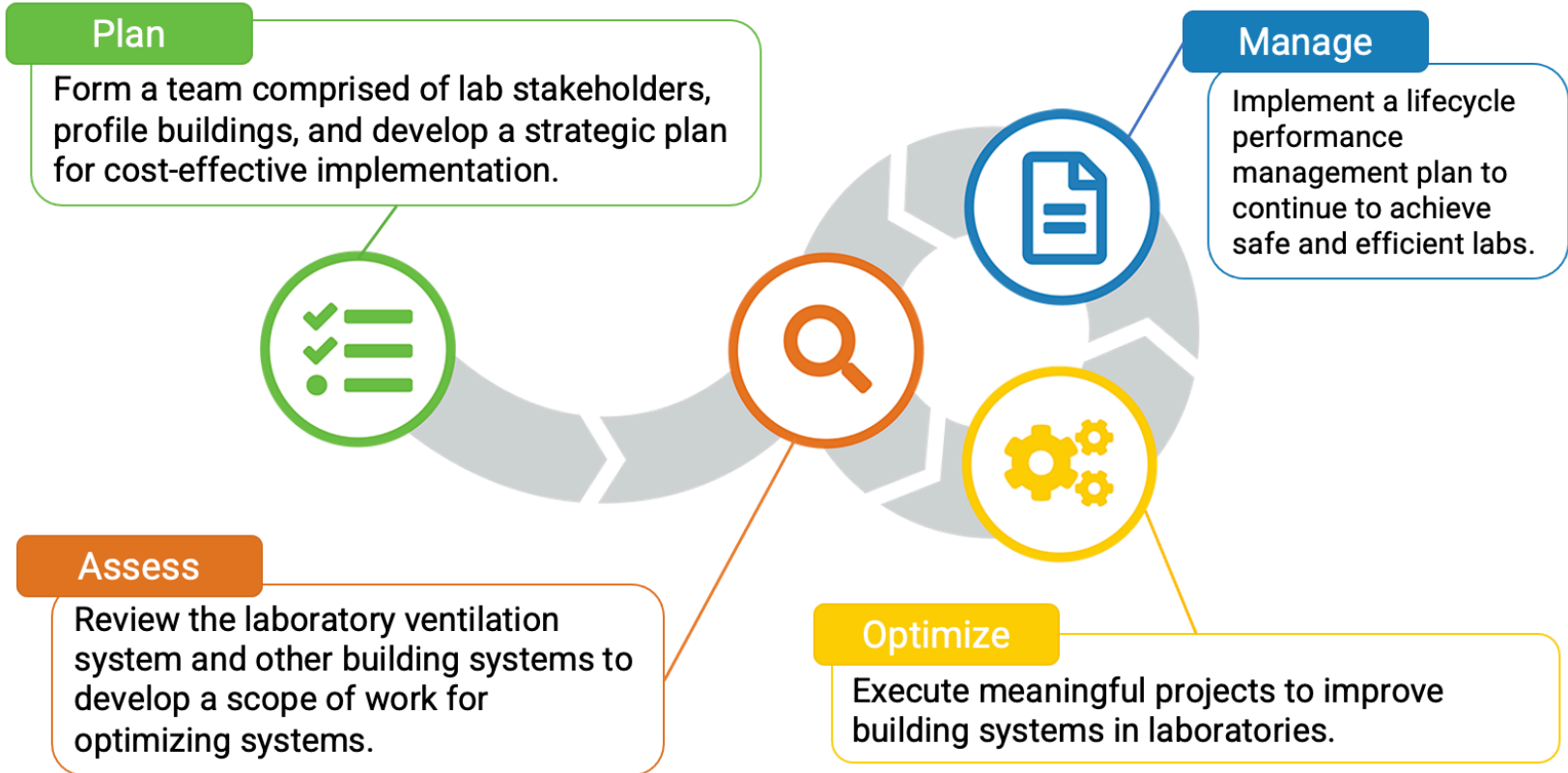


ASHRAE-
Recommended
Minimum Room
Flows

Reducing Lighting and Plug Loads



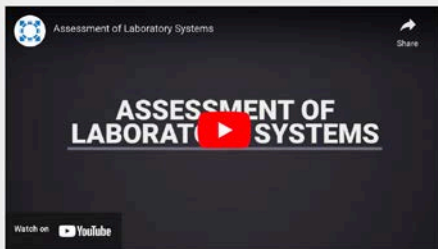
The Smart Labs Process



Visit the Smart Labs Toolkit

Assess

Once the team has a roadmap for the Smart Labs program, the next step is to thoroughly assess the first building on the roadmap. Comparing the baseline performance metrics to design specifications and safety requirements will enable the Smart Labs team to identify appropriate measures and opportunities to optimize laboratory system performance. The goal of the Assess phase is to identify areas in which the lab facility can be improved. Once an assessment process is established, it will be incorporated into the Smart Labs management plan in the Manage Phase and continue to inform areas of improvement in the facilities.



General Guide for Laboratory Building System

ON THIS PAGE

- Review General Guide for Laboratory Building System Assessments
- Conduct a Laboratory Ventilation Risk Assessment
- Complete Laboratory Ventilation Risk Assessment Deliverables
- Execute an Energy Assessment
- Perform a Water Assessment
- Perform a Resilience Assessment
- Deliverable: Scope of Work for Lab Upgrades

SLT User Guide

Range of Risk (Spectrum)				
0	1	2	3	4
Negligible	Low	Moderate	High	Special

Figure 6: Spectrum of risk divided into five categories. Each RCB defines a range of risk scores.

The Risk Score will fall within one of the RCB segments in the distribution of risk for assignment to the RCB. The range of scores for each RCB can be adjusted based on the tolerance for risk. Figure 7 shows the distribution recommended for a moderate tolerance for risk with RCB 4 used to capture extensive risk activities or activities requiring special attention rather than prescriptive specifications.

Distribution of Risk				
Tolerance for Risk	0	1	2	3
High	0	1	2	3
Moderate	0	1	2	3
Low	0	1	2	3

Figure 7: Distribution of risk by the tolerance for risk. A high tolerance for risk enables higher risk scores to be assigned to a lower risk control band. A low tolerance for risk allows for scores to be assigned to a higher risk control band.

Risk Control Bands				
Risk	0	1	2	3
High	< 9	10 - 15	16 - 24	25 - 49
Moderate	< 9	10 - 15	16 - 24	25 - 49
Low	< 9	10 - 15	16 - 24	25 - 49

Figure 8: Range of scores for each RCB with a moderate tolerance for risk.

Risk Control Bands				
Risk	0	1	2	3
High	< 24	25 - 35	36 - 52	53 - 108
Moderate	< 24	25 - 35	36 - 52	53 - 108
Low	< 24	25 - 35	36 - 52	53 - 108

Figure 9: Range of scores for each RCB with a low tolerance for risk.

- Partner Case Studies
- Step-by-step Guidance
- User Friendly Tools & Calculators
- Helpful Resources & Templates
- Best Practices Guides

SMART
LABS
TOOLKIT

INTRODUCTION

PLAN

ASSESS

OPTIMIZE

MANAGE

NEW

CONSTRUCTION

WORKING

Smart Labs Toolkit

The Smart Labs Toolkit describes a systematic process that helps laboratory owners and operators design, build, and operate efficient, and sustainable laboratories. This Toolkit was developed by several contributors and is based on the [Better Buildings Smart Labs Accelerator](#).



Click on each dot in the graphic to learn about Smart Lab components that increase safety, reduce hazards, and increase energy efficiency.

What is a Smart Lab?

Smart Labs enable safe and efficient world class science to occur in laboratories through high-performance methods. A Smart Labs program employs a combination of physical, administrative, and management techniques to assess, optimize, and manage high performance laboratories. A smart lab program designs and operates

HVAC Resource Map

HVAC Resource Map

HVAC design, operations, and maintenance best practices



Home Commercial HVAC **Lab HVAC** Contributors Contact Us

LAB SPACE

DISTRIBUTION

LAB EXHAUST DEVICES

CENTRAL PLANT

HVAC Resource Map for Laboratories

What is this resource?

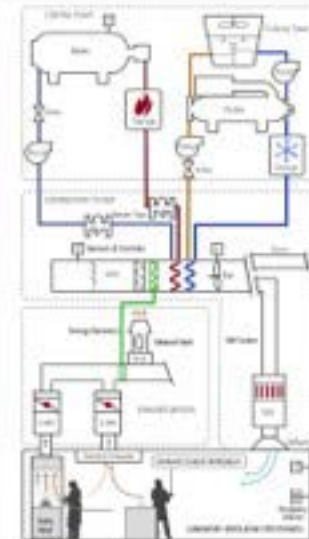
The HVAC Resource Map for Laboratories is an intuitive graphical interface that provides quick access to a broad array of quality information on design, operations and maintenance best practices, and energy and water efficiency measures in single-pass HVAC systems that are 100% outside air and do not have return air.

The resources cover the central plant, distribution systems, and zone systems. The primary audiences are facility managers, operations staff, and design engineers who want to improve central plant and distribution efficiency.

Explore HVAC Resources

Use the navigation on the left or the interactive diagram on the right to dive into resources on different HVAC components.

The interactive diagram will not be available on Internet Explorer. Please

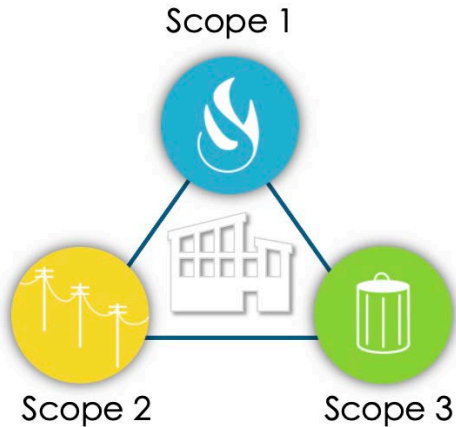




Decarbonization in Labs

Preparing for the Future

Decarbonizing Labs



- **Energy Efficiency**
 - Reduces a building's energy loads, decreasing dependence on fossil fuels
- **Renewable Generation**
 - Produces energy from clean energy sources where the supply cannot be depleted or can be reliably restored
- **Electrification**
 - Converts technologies that rely on fossil fuels to using electricity
- **Demand Flexibility and Grid Interaction**
 - Shifts a building's energy loads to non-peak demand, reducing strain on the grid

Decarbonizing Checklist

- **Get the ventilation right!**
 - Conduct recurring LVRAs
 - Modify setpoints and operating specs to optimize HVAC systems
- **Consider energy recovery**
 - Exhaust energy recovery
 - Heat recovery chillers
 - Other sources of waste heat
 - Data Centers
 - Sewer pipelines
- **Install heat pump, air-source or ground source**



Argonne National Laboratory Incorporates a Smart Labs Program



ANL enhanced existing campus-wide sustainability efforts with new resources and a network of laboratory partners

2017

ANL launched a pilot of its retro commissioning program

2018

ANL joined the SLA, a DOE program committed to the adoption of best practices

2019

Foundation set by ANL's existing sustainability infrastructure for its Smart Labs program

Learn more about ANL's Smart Lab Program Case Study on the [toolkit](#)

The University of Chicago's Smart Labs Program

The University of Chicago's Ellen and Melvin Gordon Center for Integrative Science (GCIS)

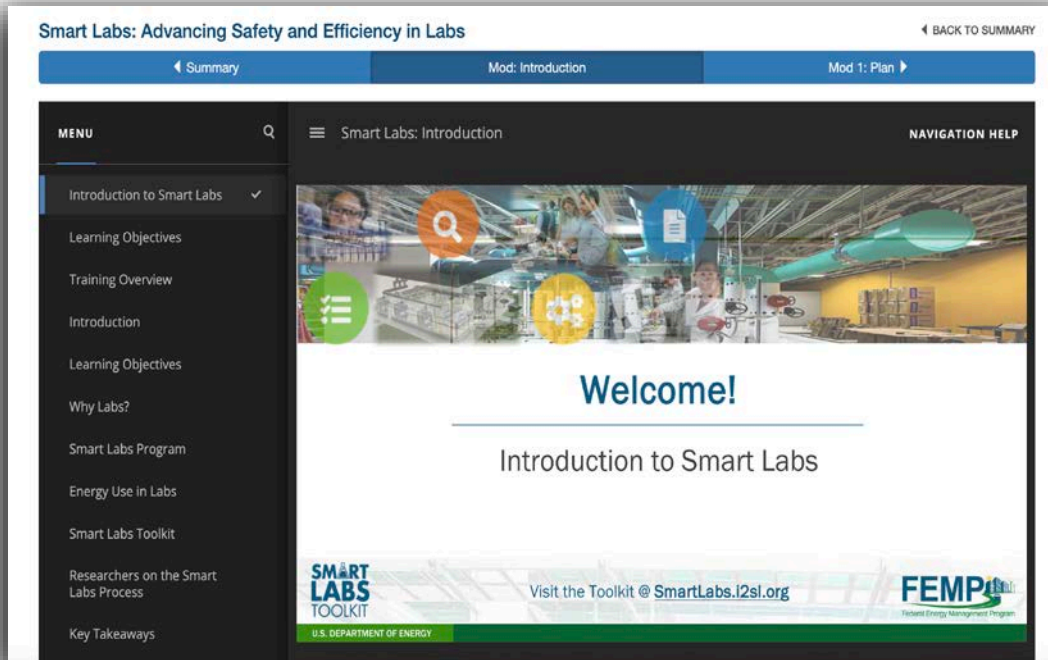


GCIS is also the largest energy consumer on campus, accounting for over 15% of usage

- ✓ Laboratory safety benefited through improved fume hood
- ✓ Occupant comfort improved through optimizing equipment and sensors
- ✓ Reduced equipment loads increased available capacity improving system performance
- ✓ Energy savings reduced total building energy use intensity by over 13%

See more on University of Chicago's Smart Labs Program [here](#)

Smart Labs Training

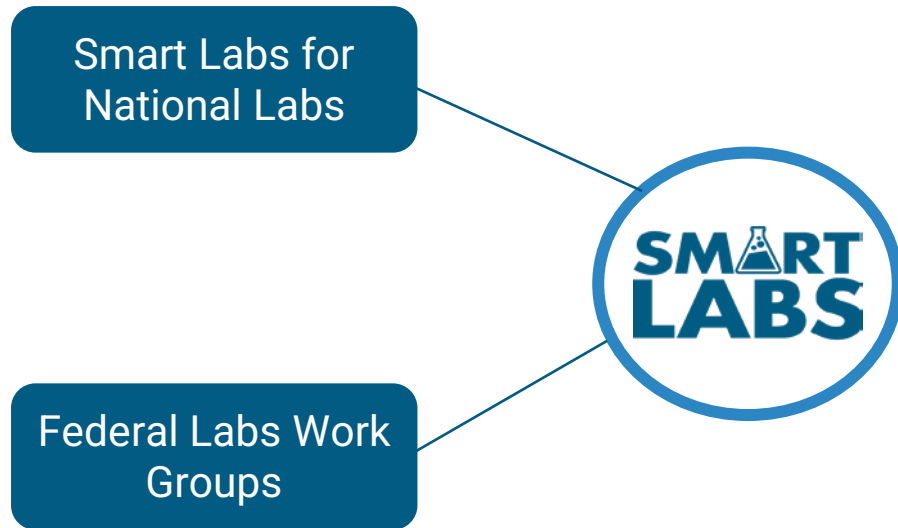


The Smart Labs Training Provides:

The framework necessary to assemble a collaborative team

Identify and implement efficiency improvements

Join Us!



Various groups to share **best practices** and **strategies**



Use the QR Code to join the Smart Labs
Partner List

Act Today!

1. Take the Smart Labs training and read the Smart Labs Toolkit
2. Find your EHS/Industrial Hygienist
3. Develop your Smart Labs Roadmap with your team

“People willing to buck the status quo and question all the assumptions which have been touted as best practices for not just years, but decades.”

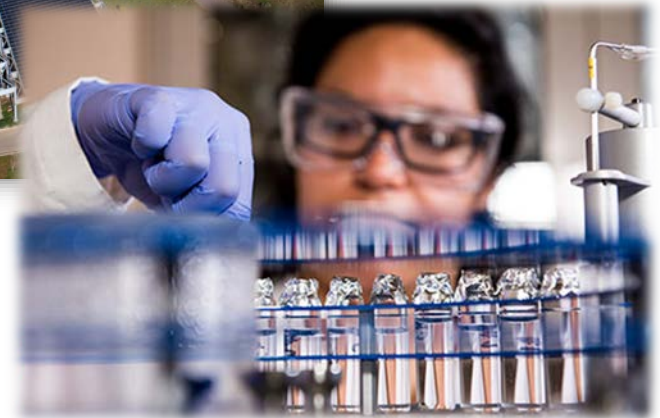
– Wendell Brase, *Vice Chancellor, University of California, Irvine*

Questions?

Rachel Romero

National Renewable Energy Laboratory

Rachel.Romero@nrel.gov





This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Federal Energy Management Program Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

NREL/PR-5500-89115