

**NC STATE
UNIVERSITY**



Sustainable Labs

Sustainable Laboratory Program Guidelines Document

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1. Introduction

Laboratories are amongst the largest consumers of resources on NC State University's campus. With an impact that affects both cost savings and environmental initiatives, labs have a significant financial and environmental impact. Diverting efforts towards increasing the reliability, efficiency, and sustainability of laboratory facilities will help decrease emissions and additional spending generated by integral research.

1.1 Purpose

Sustainable laboratories are lab environments that are cognizant of the behavioral and infrastructural impact a university research space can induce on its environmental footprint. Such laboratories aim to improve the efficiency of the steps taken to achieve meaningful results in a less impactful manner. NC State's Sustainable Laboratory Program attains this effect through four main pillars of implementation; energy consumption, waste reduction, water conservation, and safety enhancement.

1.2 Scope

The Sustainable Laboratory Program (SLP) is open and applicable to all university-owned laboratories on NC State's campus on a voluntary basis.

1.3 Glossary

- **SLP:** Sustainable Laboratory Program
- **BM&O:** Building Maintenance & Operations
- **CAV:** Constant Air Volume (in regard to chemical fume hoods)
- **EHS:** Environmental Health & Safety
- **Fume Hood Sash:** the glass doorway to access the airflow of a chemical fume hood in a laboratory.
- **Green Laboratory:** the behavioral approach to achieving a Sustainable Laboratory status. This may include efforts by the personnel directly interacting with the laboratory and intentional actions.
- **Pilot Laboratory:** a laboratory participating in the initial launch of the Sustainable Laboratory Program (any lab onboarded and certified in Spring 2024).
- **PPE:** Personal Protective Equipment
- **Smart Laboratory:** the infrastructural approach to achieving a Sustainable Laboratory status. This may include efforts by campus departments to achieve resource efficiency through technological advancements.
- **SOP:** Standard Operating Procedures
- **VAV:** Variable Air Volume (in regard to chemical fume hoods)

2. Objectives

By achieving the four objectives of the Sustainable Laboratory Program, NC State will enhance the quality of its environmental impact, safety culture, resource efficiency, and knowledge capacity within its esteemed research.

2.1 Improvement of environmental footprint resulting from campus laboratory activities.

The most evident objective of the SLP is its focus on reducing the University's environmental impact. The program achieves this through minimizing waste that is generated in a variety of channels and by reducing energy and water consumption. In fiscal year 2023, for example, laboratory and safety materials accounted for 52% of the University's single-use plastic purchases.

2.2 Enhancement of safety procedures and reagents that play an active role in a laboratory environment.

At NC State, a strong safety culture is an imperative element of a successful laboratory. The EHS department has a goal to "go for zero" as it pertains to incident prevention. Utilizing chemical agents that are benign alternatives to hazardous substances is one prominent way to prioritize safety within a sustainable lab. A sustainable lab recognizes its hazards and prioritizes safety compliance to minimize unnecessary waste and incidents.

2.3 Stimulation of resource consumption efficiency to drive cost savings.

Through the minimization of resource consumption, waste, and other operational inefficiencies, the University will generate significant cost savings that would have otherwise been spent to purchase and dispose of such resources. In 2023, it was estimated that NC State spends approximately 45% of its energy budget on laboratory environments. By implementing energy efficient practices and equipment, this number can easily be cut in half. Albeit invisible to laboratory personnel, the generated savings will be significant to the University's budget.

2.4 Creation of on-campus learning opportunities surrounding the sustainable cultivation of impactful research.

The final objective of the SLP is the generation of learning opportunities in methodologies under which research can be simultaneously sustainable, efficient, and high quality. The program encourages laboratories to host training and information sessions on sustainable laboratory practices. Personnel and interested university individuals may benefit from such opportunities

regardless of their role in laboratory spaces. Instructional material should be transferable to sustainable practices and concepts both within and beyond a lab environment.

3. Relevant Requirements

To achieve a Sustainable Lab Certification, a laboratory will need to undergo a series of internal requirements to verify their efforts. The steps necessary include direct communication with the NC State Sustainability Office, completion of the REPORTER Sustainable Labs Certification Course, implementation of the Sustainable Laboratory Checklist, and verification by a member of Sustainability or Energy Management Offices. Each of these steps is outlined below.

3.1 Step 1: Initial consultation with the NC State Sustainability Office

All interested laboratory personnel should contact the NC State Sustainability Office for additional instructions on how to proceed with the certification. We also recommend ensuring all members of the laboratory are willing to participate and are aware of the initiative. The initial consultation will solidify the laboratory's recognition of participation and will begin the certification process. This will consist of a laboratory walk through and a scheduled discussion.

3.2 Step 2: Completion of the Sustainable Labs Certification REPORTER Course

After the initial consultation, the laboratory should designate a point of contact for the certification. This point of contact must take the certification REPORTER course to meet the requirements for certification, however any laboratory personnel is able (and encouraged) to take the course. The certificate of completion for taking the course will be emailed to the participant upon finishing the modules.

3.3 Step 3: Implementation of the Sustainable Laboratory Checklist

The Sustainable Laboratory Checklist is located on the program web page and at the end of the REPORTER course. To achieve certification, a lab must earn at least 80% of the possible points. Each laboratory has the option to count additional practices towards the 80% achievement goal under the "Innovation" section, however they must provide adequate documentation to earn innovation points.

3.4 Step 4: Verification of completion by a member of the Sustainability and/or Energy Management Office.

Once submitted, the completed Sustainable Laboratory Checklist will be reviewed by the University Sustainability Office and Energy Management Office for validation. A final lab walk through will be completed to verify the results and present the laboratory with their certification materials.

4. Roles and Responsibilities

This section identifies the stakeholder groups involved in the project along with their associated responsibilities. The defined responsibilities are strictly limited to the SLP and do not include any regulatory requirements nor typical responsibilities of the identified group and/or individual.

4.1 Sustainable Lab Coordinator

This individual is designated by the Principal Investigator (PI) to be responsible for all efforts associated with the SLP within the designated lab. This individual will learn, adjust, maintain, and enforce the practices embedded within the program within their laboratory environment. All actions taken should be reported to approved by the laboratory PI. All individuals within the lab are responsible for upkeep and continual improvement of all implemented sustainable lab practices. Active support and facilitation from departmental administration is also key to ensuring the success of this role. Primary responsibilities of the Sustainable Lab Coordinator include:

1. Maintain strong communication with the University Sustainability Office and Energy Management Office
2. Ensure all personnel are educated about the program and its intentions
3. Implement standard practice modifications to adhere to the Sustainable Lab Checklist
4. Take the Sustainable Lab Certification REPORTER Course
5. Track progress throughout the designated cycle
6. Ensure all actions are approved by the laboratory PI
7. Provide resources for continual improvement and maintenance of the program for personnel working in the lab.

4.2 Facilities Division

The SLP combines both behavioral and infrastructural commitments to sustainability. Laboratory affiliates are responsible for the behavioral components, however offices within the Facilities Division are responsible for taking steps to implement infrastructural upgrades. The following offices are key stakeholders in the program and are integral to the success of the SLP.

4.2.1 Sustainability

The University Sustainability Office is the primary host of the SLP. All activities are stewarded by this office and are continually improved overtime. The following responsibilities outline the role of this stakeholder in the SLP:

1. Host and provide all content and marketing for the SLP
2. Connect stakeholder groups across the university
3. Engage participating laboratories across NC State's campus
4. Verify and certify laboratories
5. Administer the applications and cycles of participating labs on an annual basis
6. Continually improve the SLP

4.2.2 Energy Management

Energy Management at NC State initiated the process of developing the SLP through a Sustainability Fund grant in 2023. The infrastructural upkeep and quantitative analyses of the program are to be conducted through this office. The responsibilities of Energy Management are detailed below:

1. Provide technical assistance to all participating stakeholders
2. Design and suggest infrastructural improvements to laboratories that meet the objectives of the SLP
3. Analyze building meters to assess impact of resource use reduction
4. Assist with large equipment enhancement and rebate programs

4.2.3 Waste Reduction & Recycling

The Waste Reduction & Recycling (WRR) office at NC State is a key stakeholder in providing laboratories with behavioral opportunities to engage in the SLP. The office had conducted its own programs of laboratory waste reduction prior to the creation of the SLP in 2023. Key responsibilities of the WRR office include:

1. Provide all necessary equipment to divert waste within participating laboratory settings
 - a. Including, but not limited to general recycling bins, pipette tip recycling bins, compost pick-up availability, and styrofoam recycling
2. Strong communication with participating labs regarding waste needs
3. Creation of appropriate waste signage
4. Availability to discuss take-back vendor options and disposal

4.2.4 Building Maintenance & Operations

Building Maintenance & Operation (BM&O) aims to provide comfort and maintenance of campus mechanical building operation systems. Within the SLP, this stakeholder is key to ensuring the safety and efficiency of existing laboratory spaces. This department provides assistance with infrastructural improvements embedded within each pillar of the SLP. Defined responsibilities include the following:

1. Provide all necessary maintenance to laboratory facilities and/or equipment
2. Replace inefficient, outdated university-owned equipment with energy efficient alternatives
3. Routinely inspect building processes and operations
4. Provide assistance as needed to laboratory personnel inquiring about sustainable building modifications

4.3 Environmental Health & Safety (EHS)

The Environmental Health & Safety (EHS) department is responsible for all laboratory regulatory compliance and safety requirements. In participating in the SLP, laboratories are expected to maintain and exceed such requirements as they pertain to resource use efficiency. The EHS

department at NC State is responsible for supporting and advocating for the participation of laboratories in the SLP. Formal responsibilities of this department within the SLP are outlined below:

1. Provide all participating laboratories with necessary compliance inspections and information
2. Monitor a small list of checklist items on annual laboratory inspections for data collection on sustainable practices within laboratories
3. Advocate for the participation of laboratories in the SLP

5. Focal Areas

This section describes the primary pillars of the program, and each focal area involves a variety of stakeholder groups and activities that are critical to the quantitative and qualitative success of the SLP. Each description is broken down into behavioral initiatives and infrastructural improvements.

5.1 Energy Consumption

Energy consumption focuses on the consumption, efficiency, and budget of the university's energy supply within laboratory spaces, as supported by the Energy Management team. The Department of Energy projects that laboratory spaces can occupy up to 70% of a campus' energy footprint. Making a concerted effort within the following action groups can drastically reduce consumption and increase savings.

	Behavioral Initiatives	Infrastructural Improvements
Actions	<ul style="list-style-type: none"> - Turn off overhead lights - Install task lighting - Unplug dormant equipment - Shut fume hood sashes - Shut biosafety cabinets - Install outlet timers - Defrost freezers - Participate in the freezer rebate program - Keep a comprehensive freezer inventory - Perform routine equipment maintenance - Share equipment with neighboring labs 	<ul style="list-style-type: none"> - Install LEDs - Purchase ENERGY STAR equipment - Replace CAV fume hoods with VAV - Replace outdated equipment - Uphold energy efficient building practices
Responsible Parties	Principal Investigators, Laboratory Personnel	Energy Management, Building Operations & Maintenance

5.2 Waste Reduction

Laboratory spaces generate an exorbitant amount of plastic, paper, glass, chemicals, cardboard, styrofoam, and other materials. At NC State, lab and safety equipment account for 52% of all single use plastic purchases each year. The following actions detail methods in which waste can be effectively minimized within on-campus laboratories.

	Behavioral Initiatives	Institutional Improvements
Actions	<ul style="list-style-type: none"> - Consolidate purchases with neighboring labs - Keep a comprehensive inventory of all lab supplies - Purchase materials through sustainable vendors - Utilize vendor take-back programs - Recycle general waste (paper, plastic, glass, aluminum) - Compost organic waste - Recycle pipette tip boxes - Recycle styrofoam - Reuse sterilized materials - Visit NC State Surplus prior to any external purchasing - Adhere to EHS guidelines for hazardous waste disposal - Schedule regular lab clean outs - Minimize printer usage - Substitute plasticware for glassware when available 	<ul style="list-style-type: none"> - Provide recycling bins - Provide compost bins - Provide pipette tip recycling boxes - Provide information on vendor take back programs - Provide guidance on waste diversion practices - Pick up materials from each laboratory - Create a university-wide equipment sharing database
Responsible Parties	Principal Investigators, Laboratory Personnel	Waste Reduction & Recycling, Sustainability Office

5.3 Water Conservation

With the sterilizing, cooling, and calibrating procedures conducted in a standard laboratory, water can easily be wasted in inefficient processes. The SLP aims to revitalize the equipment and procedures that consume water in ways that cost both time and resources. One laboratory faucet alone, for example, can dispense up to 4 gallons per minute. The following actions can have a great impact on the daily water consumption of a laboratory space.

	Behavioral Initiatives	Infrastructural Improvements
Actions	<ul style="list-style-type: none"> - Run autoclaves and dishwashers at full capacity - Install low flow aerators on faucet nozzles - Minimize the use of deionized water - Install valve timers - Implement efficient leak reporting procedures 	<ul style="list-style-type: none"> - Retrofit autoclaves - Use reclaimed/alternative sources of water for cooling processes - Install efficient HVAC equipment
Responsible Parties	Principal Investigators, Laboratory Personnel	Energy Management, Building Operations & Maintenance

5.4 Safety Enhancement

A sustainable lab is a lab that stewards the concept that environmental consciousness encourages safe work environments. This includes green chemistry practices, EHS guidelines, worker accountability, and more. The SLP aims to increase the safety and efficiency of laboratories without compromising effective research capabilities. The actions undertaken to encourage sustainable safety enhancement are detailed below.

	Behavioral Initiatives	Institutional Improvements
Actions	<ul style="list-style-type: none"> - Replacement of hazardous chemicals with benign alternatives - Adhere to principles of green chemistry - Update all labels and signage - Maintain a comprehensive safety plan 	<ul style="list-style-type: none"> - Routine maintenance and equipment inspection - Routine laboratory inspections - Provide adequate training to all laboratory personnel
Responsible Parties	Principal Investigators, Laboratory Personnel	Environmental Health & Safety, Building Operations & Maintenance

6. Program Logistics

6.1 Certification Cycles

To create a streamlined process for certifying labs, new cycles will start at the beginning of each academic term, including summer terms. For example, a lab that completes its Sustainable Labs checklist and achieves certification any time between August-December 2024 will be part of the fall 2024 cohort. The term of certification will play a significant role in the renewal process.

6.2 Certification Renewal

Each calendar year, previously certified labs will need to undergo the renewal process to remain certified. This process will consist of a re-completion of the sustainable labs checklist and subsequent verification. If a new sustainable labs coordinator is appointed, they will need to complete the REPORTER certification course. However, it is not required to retake for personnel that have already completed the training. Should a laboratory choose not to recertify, their recognition will be revoked and all stakeholders will be made aware of the change. If a lab achieves certification in fall 2024 (August-December 2024), it will be required to complete the renewal process any time between August-December 2025.

The most recently listed sustainable labs coordinator will receive an email at the beginning of the appropriate academic term to be made aware that their certification will expire.

6.3 Continual Improvement

In order to ensure the future success of the SLP, the program will need to undergo review periods that encourage continual improvement. This may entail the stringency of the required checklist, planning team attendance at international conferences, routine communication with external organizations, and other educational enhancements.