

# Michigan Green Labs Initiative – Resources and Opportunities

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# Background

- Michigan DEQ – Office of Environmental Assistance
  - Voluntary Environmental Improvement Programs
    - Pollution prevention
    - Sustainability
    - Continuous environmental improvement
- Chris:
  - Michigan Green Chemistry Program
  - Michigan Business Pollution Prevention Partnership
- Green Labs



# Michigan Green Labs Initiative Background

- Sudhakar Reddy and the U of M Sustainable Labs Recognition Program
- U.S. EPA P2 grant opportunity
  - Focus on pollution prevention, toxics reduction, and green chemistry
- Stephen Maldonado, PhD, Professor of Chemistry
- Grand Valley State letter of support



# Michigan Green Labs Initiative Grant

- Received grant late 2012; work has occurred since January 2013
- U of M Undergraduate Research Opportunity Program – Adam Waggoner
- Mission:
  - The Michigan Green Labs Initiative (MGLI) is an effort dedicated to promoting sustainability within academic and institutional laboratories. The MGLI strives to facilitate the implementation of pollution prevention and energy conservation best practices and techniques without compromising the safety or integrity of laboratory research.



# Michigan Green Labs Initiative Grant

- **Goals:**

- Hold workshop and develop materials
- Partner with institutions interested in green lab practices
- Create network and opportunities for partners with laboratory operations
- Provide small amount of competitive funding for partners
- Encourage partners to implement new pollution prevention and green practices
- Report environmental performance results



# MGLI Project so far

- Student research
- Materials development
- Workshop
- Website and Network
- Timeline

# MGLI Student Research

- Adam Waggoner, U of M student
  - Undergraduate Research Opportunity Program
- Summary:
  - Survey of programs, including best practices checklists
  - Lab visits at U of M with Dr. Reddy
  - Summarize trends and practices
  - Catalog resources
  - Analyze programs and practices
  - Assist with development of materials



# MGLI Research – Research Opportunity

- Undergraduate Research Opportunity Program – Initial Research Facilitator



- UM Sustainable Labs Recognition Program – Program Model



**Mplanet blue**  
sustainable laboratory

- Michigan Department of Environmental Quality – Research Sponsor



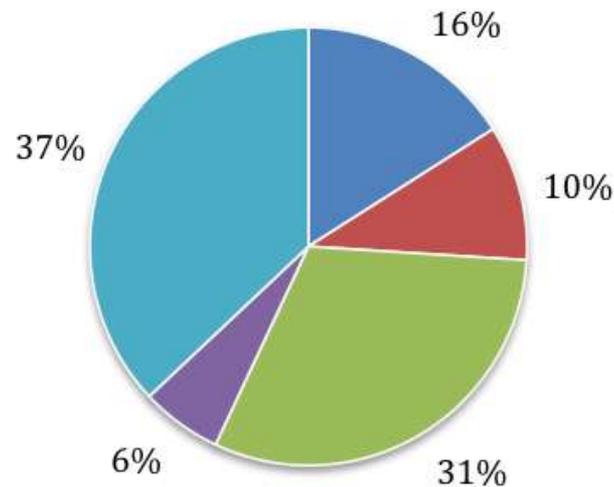
# MGLI Research – Background

- Laboratories have been identified as a major opportunity for environmental improvement on campuses and within institutions.
- Labs are energy intensive, using 5 to 10 times more energy per square foot than an average office building. Fortunately, there are ways to improve efficiency and reduce energy use. The US EPA's Laboratories for the 21st Century (Labs21) program estimates that most labs can reduce energy use by 30 to 50 percent.
- A key step towards identifying savings is to assess how efficiently your lab uses energy. This is the key principle behind the Michigan Green Labs self-assessment process.



# MGLI Research

## Emmission Sources by Building Type (Fiscal Year 2009)



■ Residence Halls ■ Health Care Clinical ■ Office / Classroom ■ Other ■ Penn Labs

[http://www.upenn.edu/sustainability/sites/default/files/Green%20Labs%20@%20Penn\\_0.pdf](http://www.upenn.edu/sustainability/sites/default/files/Green%20Labs%20@%20Penn_0.pdf)

# MGLI Research – Existing Programs and Networks

- Academic Institutions
- Arizona State University
- Duke University
- Emory University
- Harvard University
- Massachusetts Institute of Technology
- Michigan State University
- University of California - Davis
- University of California - San Francisco
- University of California - Santa Barbara
- University of California – Los Angeles
- University of Colorado - Boulder
- University of Illinois - Chicago
- University of Maryland
- University of Michigan - Ann Arbor
- University of Nebraska
- University of New South Wales
- University of Oregon
- University of Pennsylvania
- University of Queensland
- University of Texas
- University of Vermont
- University of Washington
- Yale University
- Government and Private Entities
- U.S. Environmental Protection Agency
  - Pollution Prevention (P2) Program
  - Green Chemistry Program
- International Institute for Sustainable Laboratories
- Beyond Benign
- American Chemical Society
- Pacific Northwest Pollution Prevention Resource Center - Green Labs Alliance
- Argonne National Laboratory
- National Institute of Health - Environmental Management System
- Pacific Gas & Electric Company
- U.S. National Research Council



# MGLI Research – Lab Sustainability Principles

## Pollution Prevention

- Toxic source reduction
- Hazardous product substitution
- Waste neutralization
- Waste disposal
- Contamination avoidance
- Spill prevention

## Energy and Material Conservation

- Utility use minimization
- Micro analytical procedures
- Green purchasing
- Reusable components
- Recyclable systems
- Water use mitigation



# MGLI Research – Lab Sustainability Principles

12 Principles of Green Chemistry (<http://www.epa.gov/sciencematters/june2011/principles.htm>)

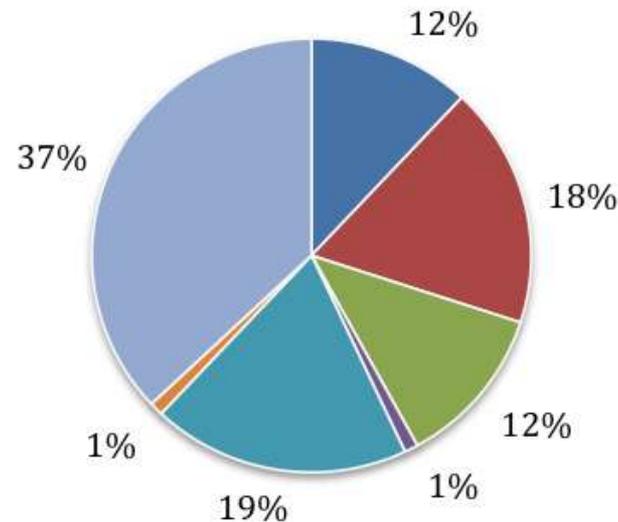
- **Prevention:** It's better to prevent waste than to treat or clean up waste afterwards.
- **Atom Economy:** Design synthetic methods to maximize the incorporation of all materials used in the process into the final product.
- **Less Hazardous Chemical Syntheses:** Design synthetic methods to use and generate substances that minimize toxicity to human health and the environment.
- **Designing Safer Chemicals:** Design chemical products to affect their desired function while minimizing their toxicity.
- **Safer Solvents and Auxiliaries:** Minimize the use of auxiliary substances wherever possible and make them innocuous when used.
- **Design for Energy Efficiency:** Minimize the energy requirements of chemical processes and conduct synthetic methods at ambient temperature and pressure if possible.
- **Use of Renewable Feedstocks:** Use renewable raw material or feedstock whenever practicable.
- **Reduce Derivatives:** Minimize or avoid unnecessary derivatization if possible, which requires additional reagents and generate waste.
- **Catalysis:** Catalytic reagents are superior to stoichiometric reagents.
- **Design for Degradation:** Design chemical products so they break down into innocuous products that do not persist in the environment.
- **Real-time Analysis for Pollution Prevention:** Develop analytical methodologies needed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
- **Inherently Safer Chemistry for Accident Prevention:** Choose substances and the form of a substance used in a chemical process to minimize the potential for chemical accidents, including releases, explosions, and fires.

12 Principles of Green Engineering (<http://www.acs.org/content/acs/en/greenchemistry/about/principles/12-principles-of-green-engineering.html>)



# MGLI Research

## Emmission Sources by Use (Fiscal Year 2009)



■ Heating ■ Fans ■ Lighting ■ Pumps ■ Cooling ■ Domestic Hot Water ■ Equipment

[http://www.upenn.edu/sustainability/sites/default/files/Green%20Labs%20@%20Penn\\_0.pdf](http://www.upenn.edu/sustainability/sites/default/files/Green%20Labs%20@%20Penn_0.pdf)

# MGLI Research

## Fume Hoods

- *Average cost of operation: \$9100/year*
- *Average cost after sustainability retrofit: \$5600/year*
  - [http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/biotech/fs\\_FumeHood.pdf](http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/biotech/fs_FumeHood.pdf)
- *UCLA EH&S began its Laboratory Energy Efficiency Program (LEEP) to encourage campus energy savings through behavioral change. As its first initiative, LEEP sponsored a competition to encourage reduced fume hood sash heights in research laboratories. The first fume hood competition took place in MSB during Fall 2008 and included about 230 fume hoods. Overall, the competition saw a 40% sash height decrease from 13.4" to 8" (as shown by competition behavior and the long-term followup). This reduction of 5.4 inches means a reduction of over 1,400,000 lbs of CO2 emissions [and \$149,730] each year.*
  - [http://ehs.ucla.edu/Pub/Fall08\\_FumeHoodResults.pdf](http://ehs.ucla.edu/Pub/Fall08_FumeHoodResults.pdf)

## Freezing Equipment

- *One ultra-low temperature freezer uses the equivalent energy of a large household, and an ultra-low temperature freezer set to minus 60 degrees Celsius may use half the electricity of one set at minus 86 degrees Celsius. At minus 70 degrees Celsius, there are examples of microbial cultures, proteins, yeast strains and cell lysates, among other sample types, being stored for years. DNA can be stored safely at minus 20 degrees Celsius, in standard freezers, for an energy savings of nearly 75 percent.*
  - [http://sustainability.ucdavis.edu/action/conservation\\_energy/store\\_smart.html](http://sustainability.ucdavis.edu/action/conservation_energy/store_smart.html)
- Opportunities for savings and efficiency exist with numerous other types of equipment.

# MGLI Research – Self-Assessment Method

The purpose of a laboratory self-assessment is to:

- Identify laboratory components applicable for environmental improvement.
- Introduce best known practices that maximize efficient use of energy and resources.
- Facilitate the implementation of recommended sustainability-focused techniques.
- Provide a mode of recognition for successful optimization of laboratory operations.

Post-Certification Benefits For Laboratory

- Reduced pollution and a cleaner environment
- Improved safety for laboratory personnel
- Reduction in operational expenses
- Increased grant application competitiveness
- Community recognition



# MGLI Research – Certification Process

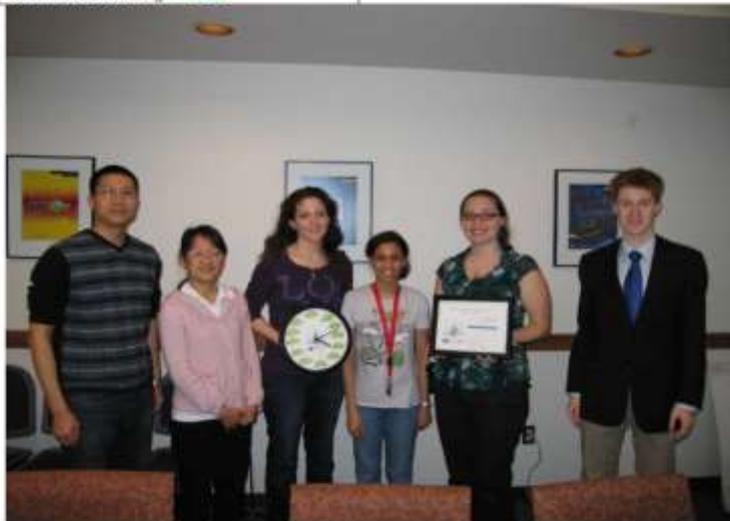
To facilitate the assessment, evaluation, and certification of your laboratory, please follow the following steps to ensure your lab is properly evaluated and eligible for recognition.

1. Contact your institution sustainability office to download the laboratory self-assessment package.
2. Complete the laboratory audit checklist and other appropriate fields as they apply to your facility.
3. Review your application with laboratory personnel to ensure the provided information is correct.
4. Return this application to your institution's sustainability office or green labs coordinator.
5. Await communication from a green labs representative to schedule a follow-up evaluation.
6. Select and implement operational enhancements and environmental goals.
7. Report results and adopted practices to your green labs representative for final review.
8. Upon successful optimization and results, receive a certification.



# MGLI Research – Case Example

Laboratory of Cellular and Molecular Systems		
Room: 249	Laboratory of Cellular & Molecular Systems, EWRE, College of Engineering	
# of Students: 7	PI: Prof. Allen Liu	Lab ID#: 539
<p>Research in our lab involves working at the interface of biology and engineering, focusing on cellular dynamics, mechanics, cell migration, clathrin-mediated endocytosis, biological signal processing at the cell membrane, and synthetic biology. We employ techniques from a range of disciplines such as molecular biology, cell biology, microfluidics, biochemistry, bioengineering, mechanical engineering, and signal processing. Our research involves the need for mammalian cell culture, bacterial culture, as well as use of viral vectors. We have a variety of equipment ranging from centrifuges to syringe pumps, heat blocks, incubators, an oven, in addition to microscopes and cameras.</p>		
Sustainable Lab Rating: <b>GOLD</b>	Date Received: 03-06-2013	



Standing L to R: Prof. Allen Liu (PI), Xinyu Tan, Dr. Victoria Murray, Johanna Heureaux, Elisabeth Steel (Lab Manager), Adam Waggoner (intern)

*"Professor Liu and the members of his Laboratory of Cellular and Molecular Systems have embraced and implemented sustainable research practices with a continued focus on safety and hazardous waste reduction. Important behavioral modifications include recycling packaging materials, replacing the use of ethidium bromide with the safer alternative, Gel-Red, as well as conserving energy by turning off small equipment and computers."* Elisabeth Steel, Laboratory Manager

University of Michigan,  
Laboratory of Cellular and Molecular  
Systems

*"Professor Liu and the members of his Laboratory of Cellular and Molecular Systems have embraced and implemented sustainable research practices with a continued focus on safety and hazardous waste reduction. Important behavioral modifications include recycling packaging materials, replacing the use of ethidium bromide with the safer alternative, Gel-Red, as well as conserving energy by turning off small equipment and computers."*

- Elisabeth Steel, Laboratory Manager

# MGLI Project Today

- Workshop
- Interested individuals and organizations:
  - Connect, network, sign on
  - Provide feedback and contribute to materials
  - Take back and find ways to implement

# MGLI Materials Version 1.0

- MGLI Laboratory Coordinator Materials
  - Ideas and suggestions:
  - How to start with examples
  - Green Team and buy-in
  - Measurement and tracking
  - Recognition/certification
  - U of M case study



# MGLI Materials Version 1.0

- MGLI Lab Assessment Packet
  - Self-Assessment Process

## C. Self-Assessment Form

### Questionnaire and Checklist

*For checklist items below, review current practices, then answer "YES", "NO", or "N/A" if they are being implemented. Refer to the reference document for further information on best practices. When you have completed the checklist, you can review your answers and set goals to turn your "NO" answers into "YES".*

#### ENERGY CONSERVATION



1. Equipment and Operations		YES	NO	N/A
<b>Essential Items</b>				
1.1	Are computers and monitors set to automatically enter sleep mode after a period of inactivity? Are computers and monitors shut down when not in active use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2	Are electrical and mechanical units maintained and powered off when not in use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3	Is heating equipment properly maintained and turned off when not in use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4	Are fume hoods closed and set to the minimum ventilation rate when unattended?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Advanced Items</b>				
1.5	Are freezers, refrigerators, and common access storage in a centralized location?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



# MGLI Materials Version 1.0

- MGLI Laboratory Assessment Materials
  - Inventory and resources documents
  - Suggestions to incorporate at institution
  - Recognition and certification

# MGLI Materials Version 1.0

- MGLI Performance Measurement and Tracking Materials
  - After self-assessment
  - Can you answer “Yes” to as many relevant questions as possible?
  - Focus on additional items
  - Are practices working?
  - Environmental goals and results

# MGLI Materials Feedback

- Please provide feedback on materials and project:
- Functionality
- Usability
- Gaps
- Opportunities
- Any other feedback

# MGLI Website and Network

- MI Green Chemistry Clearinghouse page
  - <http://migreenchemistry.org/education/green-labs/>



## Michigan Green Labs Initiative



The **Michigan Green Labs Initiative (MGLI)** is a project of the Michigan Department of Environmental Quality in partnership with the University of Michigan and supported by a U.S. EPA grant.

MGLI seeks to deliver resources and partner with institutions in Michigan to implement green laboratory practices. The University of Michigan Office of Campus Sustainability is partnering to provide resources and expertise after implementing their own sustainable labs program.

We have developed materials that will serve as the basis of the program by compiling best practices, methods, and resources for implementation at your institution. The MGLI materials can be downloaded on the sidebar of this page.

We would also like to begin building a network of green lab professional partners in Michigan. The forum below will serve as a vehicle to connect others thinking about greening their labs. We hope you will sign up and join the discussion.

Ultimately, we hope your institution will become a partner and start a pilot green labs project or program. See the information in the Green Labs Coordinator Packet to find out how to sign up and get started.

### Opportunities for Michigan Green Labs partner institutions:

- Join as partner for your organization, department, or individual labs.

## Events

### Michigan Green Labs Initiative Workshop: *Transferring Green Labs Best Practices*

Wednesday, July 31, 2013; University of Michigan, Ann Arbor; 9.00AM to 2.00PM

For more information and to register:

 Workshop Flyer

## Resources

The following program materials will be available soon:

- Michigan Green Labs Initiative Green Labs Coordinator Packet
- Michigan Green Lab Initiative Lab Assessment Packet



# MGLI Website and Network

- MI Green Chemistry Clearinghouse page
  - <http://migreenchemistry.org/education/green-labs/>
- Network and forum
- Updates and opportunities
- List of partners
- Download materials

## Forum



Coming soon...

The **Michigan Green Labs Initiative Forum** is intended to serve as a meeting place for green labs practitioners implementing MGLI materials.

You can use the forum to:

- Inquire about best practices with materials, equipment, or any other subject related to greening up your lab operations.
- Discuss material issues such as reuse and exchange on or between sites.
- Learn from others implementing sustainable lab techniques.
- Promote practices and programs.
- Post other questions or opportunities related to the topic.

# MGLI Project Looking Ahead

- Next Steps:
  - Sign-on partners interested in greening lab operations
  - Partners pilot in labs
  - Partners and MGLI team communicate
    - Comment on materials
    - Participate in network
    - Communicate with MGLI team
  - By September 2014 – partners report results



# MGLI Partner Sign-on

- Voluntary Commitment:
  - Implement program on campus
    - Anything from piloting in one lab to fully institutionalizing
  - Report results
- MGLI Partner Opportunities
  - Listed on MI GC Clearinghouse site
  - Future RFP – small amount of funding for student or staff time

# MGLI Partner Opportunities

- Informational and marketing materials feedback
  - Example items:
    - Shut the sash magnets (fume hoods)
    - Shut off stickers (lights, water, equipment)
    - Recycling information poster
    - Green chemistry principles list (poster, cards, etc.)
    - Others?

# Next Steps after Workshop

- Follow up:
  - Workshop survey
  - Create mailing list
  - Join network
  - Comment on materials
  - Second workshop next year?
    - Summit, tour, etc.
  - Sign on as a partner!

# Thank You!

Questions?

Chris Affeldt

517-241-9505

[affeldtc@michigan.gov](mailto:affeldtc@michigan.gov)

[www.migreenchemistry.org/education/green-labs](http://www.migreenchemistry.org/education/green-labs)

DEQ Environmental Assistance Center

1-800-662-9278

